2.0 ALTERNATIVES INCLUDING APPLICANT'S PREFERRED ALTERNATIVE

The Council on Environmental Quality's (CEQ's) regulations require federal agencies to "rigorously explore and objectively evaluate all reasonable alternatives and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated" (40 Code of Federal Regulations [CFR] Part 1502.14).

Alternatives screening is also pertinent to Clean Water Act (CWA) 40 CFR Part 230 Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (hereafter identified as 404(b)(1) guidelines), which require the analysis of practicable alternatives to the proposed discharge. The 404(b)(1) guidelines define a practicable alternative as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 CFR Part 230.10[a][2]).

Implementation Procedures for the Regulatory Program (33 CFR Part 325, Appendix B; referred to hereafter as USACE implementation procedures), the alternatives analysis should be thorough enough to use for both the NEPA review and 404(b)(1) guidelines analysis.

In addition to evaluating the Applicant's proposed project[1] under NEPA, USACE will be evaluating the Applicant's permit application pursuant to Section 10 of the Rivers and Harbors Act of 1899 (RHA) and Section 404 of the CWA. The Record of Decision (ROD) will rely on information provided by the Applicant and contained in the Environmental Impact Statement (EIS) and include a Section 404(b)(1) analysis (40 CFR Part 230) and public interest review (33 CFR Part 320).

Chapter 2 summarizes the alternatives development process, identifying a reasonable range of alternatives; summarizes alternatives eliminated from further consideration; and describes the alternatives carried forward for detailed analysis in the EIS.

2.1 ALTERNATIVES DEVELOPMENT PROCESS

2.1.1 Public Input on Alternatives

As part of scoping, the public was encouraged to provide specific suggestions for alternatives that should be considered in preparing the EIS. The following guidelines for providing input on alternatives were communicated in scoping materials:

1. Any suggestions should fulfill the overall project purpose in consideration of the applicant's objectives with a focus on reducing potential adverse environmental impacts.
2. Alternatives may be suggested that address specific components for developing the mine (e.g., mining methods, water treatment, tailings management), the port site, the transportation corridor and modes (e.g., rail), and the natural gas pipeline.
3. Changes in location of project components (e.g., road, port site, mine components) may be suggested.
4. Potential mitigation measures and conditions of development that may reduce environmental impacts may be suggested.

[1] USACE is required to evaluate the Applicant's project, as proposed in the Department of Army permit application. Future expansion of the mine has been determined reasonably foreseeable by USACE, and an expansion scenario developed and analyzed as a cumulative effect.

5. Be as specific as possible and provide the reason for making your suggestions (e.g., construction of a rail connection may eliminate truck traffic and reduce dust levels).

Specific suggestions for alternatives that were provided by the public, stakeholders, and agencies during scoping have been fully considered in the alternatives development process.

2.1.2 Screening for Full Range of Action Alternatives

Appendix B details the action alternatives development process for the Pebble Project EIS. A summary of the screening criteria applied to develop the range of reasonable of action alternatives is provided below.

- Purpose and Need: Options not meeting USACE's overall project purpose were eliminated from further consideration as part of an action alternative.
- Reasonable and Practicable: Options not meeting the NEPA regulatory intent of reasonable alternatives, which includes those that are practical or feasible from the technical and economic standpoint and using common sense, were eliminated from further consideration as part of an action alternative.

  Options not meeting the 404(b)(1) guidelines definition of practicable in terms of cost, existing technology, and logistics in light of the overall project purpose were also eliminated from further consideration as part of an action alternative.
- Environmental Impacts: Options that would not have less environmental damage than the relative component(s) of the Applicant's proposal were eliminated from further consideration as part of an action alternative. Note that at this screening stage, most assessments of environmental impacts were qualitative.

The criteria screening steps were followed sequentially. If an option clearly did not meet a screening criterion, it was eliminated from further consideration, and did not proceed to the subsequent screening tests.

2.1.3 Updates Based on Comments on Draft EIS

During the public comment period on the Draft EIS (DEIS), alternatives-related comments included, but not limited to:

- Support for the Alternative 2 mine access road versus the Alternative 1 mine access road.
- Assertions that some alternatives were not practicable and should not be analyzed in the EIS because portions crossed lands owned by entities who have declared their lands not available to Pebble Limited Partnership (PLP).
- Suggestions for new alternatives.

The Final EIS (FEIS) addresses these comments as follows:

- A new alternative (Alternative 1a) composed of components from Alternative 1 and Alternative 2 from the DEIS was developed based on public comments. The transportation corridor consists of the mine access road from Alternative 2 (from the mine site to a ferry terminal at Eagle Bay), a ferry crossing from Eagle Bay to the Kokhanok west ferry terminal, and the Alternative 1 port access road (from Kokhanok to Amakdedori port). This alternative also evaluates a different natural gas pipeline alignment across Iliamna Lake.

- USACE has determined that even though some alternatives may not be available to the Applicant at this time, the alternatives remain reasonable under NEPA guidelines and are retained in the FEIS.
- New alternatives that were suggested were screened and documented in Appendix B.

2.2 ALTERNATIVES CARRIED FORWARD FOR DETAILED ANALYSIS

Options that met screening criteria were packaged into action alternatives (i.e., a functioning project including power, a port, transportation, and mine facilities), listed below. Variations to components of the project that do not comprise a complete alternative are analyzed as variants under action alternatives. Although a variant may be analyzed under a specific action alternative, the USACE's determination of the least environmentally damaging practicable alternative (LEDPA) in its final permit decision may include a combination of components from the various alternatives and variants analyzed in the EIS. Additionally, even though an alternative may be carried forward for detailed analysis in the EIS, it may be determined not practicable during USACE 404(b)(1) analysis.

2.2.1 Optimization/Avoidance

The USACE regulatory process is iterative; therefore, the USACE works with applicants to identify additional avoidance and minimization measures that are often incorporated into the proposed project. These changes to the applicant's proposed project frequently result in updated project descriptions. Primary updates to the proposed project since PLP's initial application was submitted to USACE in December 2017 (PLP 2017) are listed below. Details regarding the impact being mitigated by the project enhancement is provided in Chapter 5, Mitigation.

1. The milling rate increased to 180,000 tons per day (tpd) from 160,000 tpd. The long-term ore stockpile was removed, and mining would take place over the full 20 years, rather than 14 years with 6 years of stockpile reclaim. The peak annual mining rate reduced as a result.
2. The pyritic tailing storage facility (TSF) was sited closer to the pit, in the location of the previous low-grade ore storage.
3. The main water management pond was made larger and moved to a new location, and the open pit water management pond was relocated.
4. The tailings storage management plan changed from a single facility with separate cells for storage of bulk and pyritic tailings to two separate facilities in different drainages: one for storage of bulk tailings, and one for storage of pyritic tailings and potentially acid generating (PAG) waste rock.
5. The natural gas pipeline has been modified as follows:
    A. The point of origin moved south to a location near Anchor Point, removing about 9 miles of pipeline on the Kenai Peninsula.
    B. The pipeline diameter increased from 10 inches to 12 inches.
    C. The pipeline route across Cook Inlet has been refined (note: this applies to Alternative 1a and Alternative 1).
    D. The Amakdedori port compressor station has been removed (note: this applies to Alternative 1a and Alternative 1).
6. The Amakdedori port has been modified as follows (note: these apply to Alternative 1a and Alternative 1):

   A. Amakdedori port operations include a lightering barge system to transport concentrate containers to bulk carriers anchored offshore; eliminating the need to dredge a deepwater channel that would enable bulk carriers to access the port facility directly (PLP 2018-RFI 032a).
   B. The anchor design concept for lightering points no longer considers drilling into the seafloor to install the anchors.
   C. The port causeway and dock construction methodology changed from an earthen fill with sheet pilings to a concrete-supported caisson[2] design.
   D. The port runway location was moved slightly.
   E. The terrace elevation was increased to allow for tsunami runup (PLP 2019-RFI 112a).
7. The Sid Larson Creek crossing was relocated (note: this applies to Alternative 1a and Alternative 1).
8. A southern Newhalen River crossing was identified (PLP 2019-RFI 154) (note: this applies to Alternative 1a, Alternative 2, and Alternative 3).
9. The Diamond Point port and related facilities were modified as follows (note: these apply to Alternative 3):
   A. The dock facility, dredged channel, and turning basin were moved approximately 0.75 mile north in Iliamna Bay, the onshore facility was moved approximately 2.5 miles north, and the gas pipeline and fiber-optic cable right-of-way (ROW) location was updated to reflect the change in port location.
   B. The port causeway and dock construction methodology changed from an earthen fill with sheet pilings to a concrete-supported caisson design.
   C. The alternate lightering location west of Augustine Island was eliminated.
   D. Added an approximately 0.5-mile access road from the transportation corridor to the Pedro Bay airport.
10. The locations and sizes of support infrastructure were optimized.

2.2.2 Overview of Alternatives Carried Forward for Detailed Analysis

Alternative 1a—This alternative, identified based on comments on the DEIS and continued project optimizations, is composed of components from Alternative 1 and Alternative 2 analyzed in the DEIS. It consists of PLP's proposed mine site (center-line construction for the bulk TSF main embankment); a transportation corridor with a mine access road to a ferry terminal at Eagle Bay, with a south crossing of Newhalen River; a ferry crossing of Iliamna Lake to a south ferry terminal west of Kokhanok; continuation of the transportation corridor with a port access road to the western side of Cook Inlet; a port at Amakdedori with a caisson dock design; and a natural gas pipeline from the Kenai Peninsula to the mine site with five main segments: 1) Cook Inlet crossing to the Amakdedori port; 2) along the port access road to Iliamna Lake; 3) across Iliamna Lake to Newhalen; 4) overland to connect with the mine access road east of the Newhalen River crossing; and 5) along the mine access road to the mine site. No variants are analyzed under Alternative 1a.

Alternative 1—The base case for Alternative 1 is PLP's original proposed Pebble Project, described in detail in the DEIS, with minor project optimizations to avoid and minimize environmental impacts. Alternative 1 includes PLP's proposed mine site (centerline construction for the bulk TSF main embankment) ; a transportation corridor with a mine access road in the

[2] Caissons are pre-cast concrete open-top rectangular prisms with a flat bottom that would be lowered onto the seabed and then filled with quarried material to act as supports for the causeway and jetty.

Upper Talarik Creek (UTC) watershed to a north ferry terminal; a ferry crossing of Iliamna Lake to a south ferry terminal west of Kokhanok; continuation of the transportation corridor with a port access road to the western side of Cook Inlet; a port at Amakdedori with an earthen fill causeway and sheet pile jetty design; and a natural gas pipeline from the Kenai Peninsula to the mine site with four main segments: 1) Cook Inlet crossing to the Amakdedori port; 2) along the port access road to Iliamna Lake; 3) across Iliamna Lake to the north ferry terminal; and 4) along the mine access road to the mine site. Three variants have been analyzed that would modify minor project features.

Alternative 2—This alternative, termed the North Road and Ferry Alternative with Downstream Dams, is an alternative that would reduce the overall length of access roads and use different methods for construction of the bulk TSF. It consists of the same mining methods and facilities as Alternative 1a, but uses downstream construction methods for the bulk TSF; a transportation corridor with a mine access road to a ferry terminal at Eagle Bay, with a southern crossing of Newhalen River; a ferry crossing of Iliamna Lake to a south ferry terminal near Pile Bay; continuation of the transportation corridor with a port access road to the western side of Cook Inlet; a port at Diamond Point with an earthen fill causeway and sheet pile jetty design; and a natural gas pipeline from the Kenai Peninsula to the mine site with three main segments: 1) Cook Inlet crossing coming ashore at Ursus Cove; 2) northward to Diamond Point port; and 3) overland to the mine site, following along the port and mine access roads with a pipeline-only segment between. Alternative 2 has two of the same variants identified for Alternative 1, as well as a variant for a north crossing of the Newhalen River.

Alternative 3—This alternative, termed the North Road Only Alternative, has been identified by PLP as their preferred alternative (referred to herein as the Applicant's Preferred Alternative). This alternative is being considered, along with one additional variant, because it would provide an alternative transportation corridor and natural gas pipeline route, and would eliminate the need for ferry transportation across Iliamna Lake. Alternative 3 includes the proposed mine site at Pebble; a transportation corridor with a north access road from the mine site to the western side of Cook Inlet, with a southern crossing of Newhalen River; a port north of Diamond Point with a caisson-supported dock design; and a natural gas pipeline that follows the same general route from the Kenai Peninsula to the mine site as Alternative 2.

Table 2-1 describes the variants being considered for each action alternative. Figure 2-1 illustrates the primary differences between the action alternatives. For each of the variants, the alternative that the variant is being evaluated under is considered the base case. Descriptions of the variants focus on how the project components of the base case would change with incorporation of the variant.

In addition to the above action alternatives, as required by CEQ regulations (40 CFR Part 1502[e]), this EIS analyzed the No Action Alternative.

CEQ's NEPA regulations (40 CFR Part 1502.14) specify that agencies shall identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement; and identify such alternative in the final statement unless another law prohibits the expression of such a preference. According to USACE's NEPA implementation procedures, USACE cannot identify an agency-preferred alternative in the EIS, because USACE is neither a proponent nor opponent of an individual project proposed for permitting.

Table 2-1: Summary of Variants Analyzed for Each Action Alternative

Variant Description/ Project Component	Alternative 1a	Alternative 1	Alternative 2—North Road and Ferry with Downstream Dams	Alternative 3—North Road Only
Summer-Only Ferry Operations Variant Pebble Limited Partnership (PLP) has proposed to use an ice-breaking ferry on Iliamna Lake to allow year-round transportation of concentrate, freight, and diesel fuel. An option to restrict ferry operations to the open water season was suggested during scoping due to concerns with use of an ice-breaking ferry. This option is evaluated as a variant to Alternatives 1 and 2.				
Mine Site	No variants are analyzed for this alternative.	Instead of daily transportation to the proposed Amakdedori port, concentrate would be stored in a container-based system that would be stockpiled at the mine site during the period when the water is not open. The containers would be stored in a laydown area at the mine site. The sewage tank pad at the mine site would be relocated to accommodate the container storage area.	Instead of daily transportation to the proposed Diamond Point port, concentrate would be stored in a container-based system that would be stockpiled at the mine site during the period when the water is not open. The containers would be stored in a laydown area at the mine site. The sewage tank pad at the mine site would be relocated to accommodate the container storage area.	This variant is not evaluated for Alternative 3 because there is no ferry with this alternative.
Transportation Corridor		With ferry operations limited to the open water season only, there would be increased truck traffic along the transportation corridor during the operating months to handle the movement of the full year of concentrate production, fuel, and consumables.	With ferry operations limited to the open water season only, there would be increased truck traffic along the transportation corridor during the operating months to handle the movement of the full year of concentrate production, fuel, and consumables. Concentrate containers would be stored at a laydown area along the Williamsport-Pile Bay Road because there is insufficient space available at the Diamond Point port. This container storage laydown area would enable shipping at the port to continue during the period the ferry is not operating.	
Port		Concentrate containers would need to be stockpiled at Amakdedori port to enable shipping to continue during the period the ferry is not operating. This would require increased storage capacity at the port.	This variant would not change this component (same as Alternative 2 base case).	

Table 2-1: Summary of Variants Analyzed for Each Action Alternative

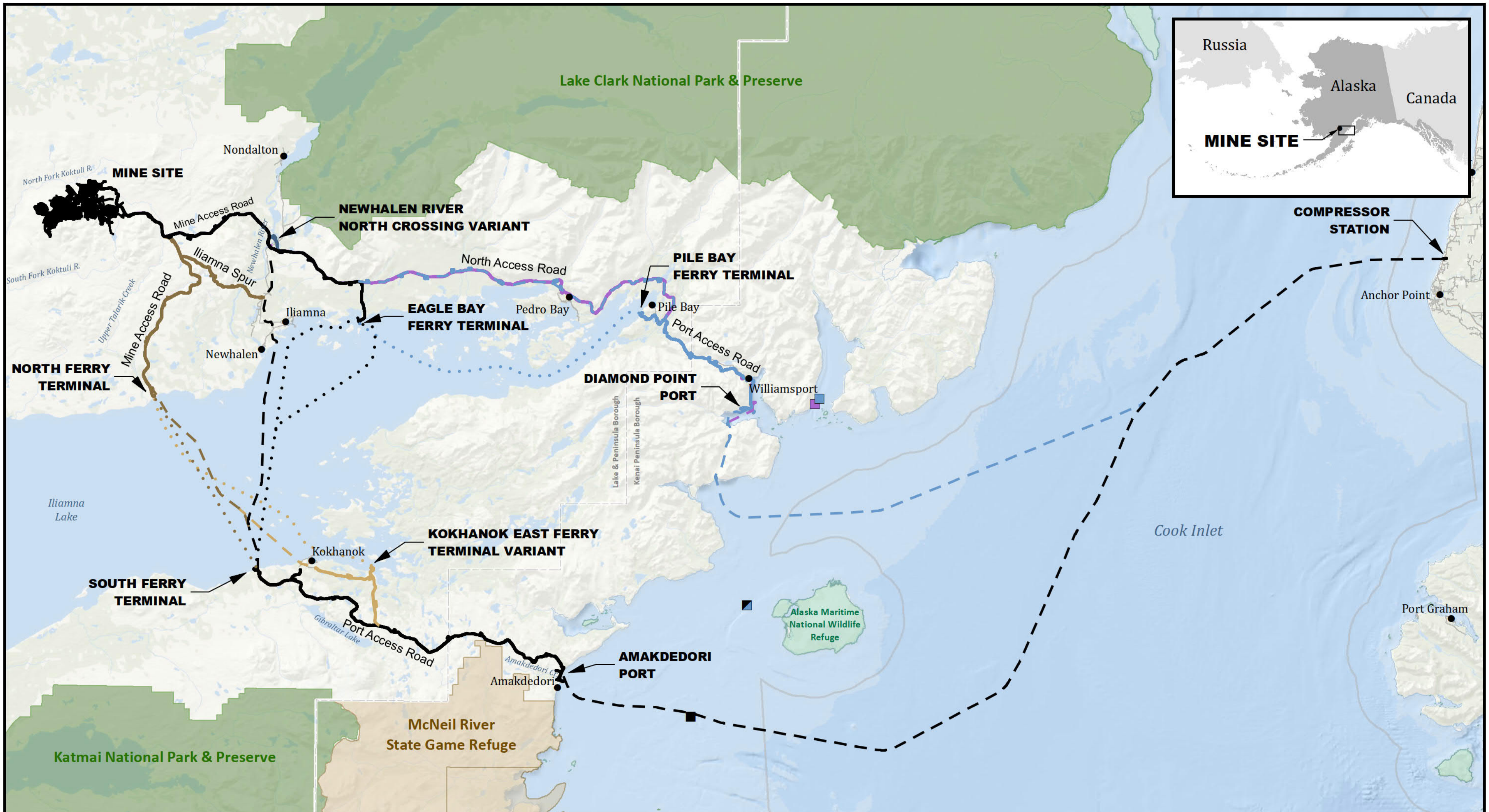
Variant Description/ Project Component	Alternative 1a	Alternative 1	Alternative 2—North Road and Ferry with Downstream Dams	Alternative 3—North Road Only
Natural Gas Pipeline		This variant would not change this component (same as Alternative 1 base case).	This variant would not change this component (same as Alternative 2 base case).	
Kokhanok East Ferry Terminal Variant PLP proposes to construct the south ferry terminal on Iliamna Lake about 5 miles west of Kokhanok as the base case. Evaluation of alternative ferry terminal locations was suggested during scoping. This option considers an alternative south shore ferry terminal location east of Kokhanok (Kokhanok east ferry terminal site) and is evaluated as a variant to Alternative 1.				
Mine Site	No variants are analyzed for this alternative.	This variant would not change this component (same as Alternative 1 base case).	This variant is not evaluated for Alternative 2 because the access roads and ferry terminals are on the north of Iliamna Lake (not near Kokhanok).	This variant is not evaluated for Alternative 3 because there is no ferry with this alternative.
Transportation Corridor		The Kokhanok east ferry terminal site would result in changes to port access road route, Kokhanok east spur road (from port access road to community of Kokhanok), and ferry route.		
Port		This variant would not change this component (same as Alternative 1 base case).		
Natural Gas Pipeline		With this variant, the natural gas pipeline alignment would follow the Kokhanok east spur road, and then follow an existing road alignment to the point where it departs the shoreline to tie into the proposed route from the Kokhanok west ferry terminal site.		
Newhalen River North Crossing Variant This variant considers a north crossing location of the Newhalen River as an alternative to the south crossing location that is evaluated as the base case in Alternative 1a, Alternative 2, and Alternative 3.				
Mine Site	No variants are analyzed for this alternative.	This variant is not evaluated for Alternative 1 because it does not involve a crossing of Newhalen River.	This variant would not change this component (same as Alternative 2 base case).	This variant is not evaluated for Alternative 3 because it has the same transportation component as Alternative 2 at the Newhalen River crossing.
Transportation Corridor			North crossing location of the Newhalen River.	
Port			This variant would not change this component (same as Alternative 2 base case).	

Table 2-1: Summary of Variants Analyzed for Each Action Alternative

Variant Description/ Project Component	Alternative 1a	Alternative 1	Alternative 2—North Road and Ferry with Downstream Dams	Alternative 3—North Road Only
Natural Gas Pipeline			This variant would not change this component (same as Alternative 2 base case).	
Pile-Supported Dock Variant The base case for Alternative 1 and Alternative 2 is to construct a sheet pile dock structure filled with granular (gravel) material. This option considers a pile-supported dock design at the port site to minimize in-water impacts and is evaluated as a variant to Alternative 1 and Alternative 2.				
Mine Site	No variants are analyzed for this alternative.	This variant would not change this component (same as Alternative 1 base case).	This variant would not change this component (same as Alternative 2 base case).	This variant is not evaluated for Alternative 3.
Transportation Corridor		This variant would not change this component (same as Alternative 1 base case).	This variant would not change this component (same as Alternative 2 base case).	
Port		Pile-supported dock design at Amakdedori port.	Pile-supported dock design at Diamond Point port.	
Natural Gas Pipeline		This variant would not change this component (same as Alternative 1 base case).	This variant would not change this component (same as Alternative 2 base case).	
Concentrate Pipeline Variant PLP proposes to transport all concentrate produced at the mine in containers using trucks. Evaluation of an option for an ore concentrate pipeline was suggested during scoping due to concerns with ferrying ore concentrate across Iliamna Lake. This variant, evaluated under Alternative 3, considers the concept of delivering copper and gold concentrate from mine site to port using a single approximately 6.25-inch-diameter steel pipeline. Under this variant, molybdenum concentrate (approximately 2.5 percent of the concentrate) would continue to be separated at the mine site and trucked to the port. This variant also includes an option to construct an additional 8-inch return water pipeline to pump the concentrate filtrate back to the mine site for reuse.				
Mine Site	No variants are analyzed for this alternative.	This variant is not evaluated for Alternative 1 because the concentrate pipeline would need to be co-located with a road to allow inspections and response actions in the event of a pipeline leak/rupture (not compatible with a ferry crossing).	This variant is not evaluated for Alternative 2 because the concentrate pipeline would need to be co-located with a road to allow inspections and response actions in the event of a pipeline leak/ rupture (not compatible with a ferry crossing).	With this variant, copper-gold concentrate slurry would be transported from the mine site to the port by pipeline, where it would be filtered; requiring an electric pump station to be sited at the mine site.

Table 2-1: Summary of Variants Analyzed for Each Action Alternative

Variant Description/ Project Component	Alternative 1a	Alternative 1	Alternative 2—North Road and Ferry with Downstream Dams	Alternative 3—North Road Only
Transportation Corridor				The concentrate pipeline (and the optional return water pipeline) would be co-located in a single trench with the gas pipeline at the toe of the north road corridor embankment. An intermediate booster station would be sited along the road alignment.
Port				This variant would require a water treatment plant at the port site to treat and discharge the slurry water. The option to return the water to the mine site would require a pumping station at the port.
Natural Gas Pipeline				This variant would not change this component (same as Alternative 3 base case).



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless specified otherwise.

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Miles

Action Alternatives

- Lightering Locations
- Ferry Routes
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 1 Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 2 Newhalen River North Crossing Variant
- Alternative 3

Other Features

- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ACTION ALTERNATIVES COMPARISON

FIGURE 2-1

2.2.3 No Action Alternative

The No Action Alternative is intended to be used as a baseline to facilitate the comparison of impacts between the action alternatives analyzed in detail in the EIS. Baseline conditions for all resources are described in the affected environment sections of Chapter 3, Affected Environment. Impacts from the Applicant's Preferred Alternative (beneficial or adverse) would not occur under the No Action Alternative.

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the preferred alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the state's authorization process, as well as any activity that would not require federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other individuals or companies.

Current state-authorized activities associated with mineral exploration and reclamation and scientific studies would be expected to continue at levels similar to recent post-exploration activity. The state requires reclaiming sites at the conclusion of their state-authorized exploration program. If reclamation approval is not granted immediately after the cessation of activities, the state may require continued authorization for ongoing monitoring and reclamation work as it deems necessary.

The No Action Alternative would not meet the overall purpose of the project under the 404(b)(1) guidelines; however, NEPA requires evaluation of the No Action Alternative. Moreover, the No Action Alternative could be selected if USACE determines during its Public Interest Review (33 CFR Part 320.4[A]) that it is in the best interest of the public, based on an evaluation of the probable impacts of the proposed activity and its intended use on the public interest. USACE's 404(b)(1) evaluation and Public Interest Review will be completed after the FEIS.

2.2.4 Alternative 1a

PLP's Project Description (PLP 2019d) and the Pebble Project Department of the Army Application for Permit POA-2017-271 (PLP 2019h), both updated in December 2019; various responses to Requests for Information (RFIs) as cited herein; and Geographic Information System (GIS) data provided by PLP form the basis for the description of Alternative 1a.

Appendix K2 provides the proposed construction schedule and a summary of the permanent and temporary construction footprints for each project component (mine site, transportation corridor, port, and natural gas pipeline). Proposed mitigation measures, project elements, and environmental protections, including best management practices (BMPs), identified to avoid and minimize impacts, are described in Chapter 5, Mitigation. A technical glossary of mining-related and scientific terms applied throughout project documents can be accessed online at https://pebbleprojecteis.com/overview/glossary.

PLP proposes to develop the Pebble copper-gold-molybdenum porphyry deposit (Pebble deposit) as an open pit mine, with associated infrastructure. The project is in a sparsely populated region of southwest Alaska near Iliamna Lake, in the Lake and Peninsula and Kenai Peninsula boroughs (LPB and KPB). The Pebble deposit is approximately 200 miles southwest of Anchorage, and 60 miles west of Cook Inlet. The closest communities are Iliamna, Newhalen, and Nondalton, each approximately 17 miles from the Pebble deposit (Figure 2-2).

REGIONAL MAP

PEBBLE PROJECT EIS

FIGURE 2-2

The project is composed of four primary components: the mine site at the Pebble deposit location, the Amakdedori port on the western shore of Cook Inlet, a transportation corridor connecting these two sites, and a natural gas pipeline corridor connecting to existing infrastructure on the Kenai Peninsula. Figure 2-3 shows the general project layout of Alternative 1a.

The project would progress through four distinct phases: construction, operations (also referred to as the production phase), closure, and post-closure. However, the four phases would be integrated under the concept of designing, constructing, and operating with closure and post-closure in mind. Appendix K2 presents a summary and schedule of the four project phases.

Construction would last for approximately 4 years, during which the facilities would be built, and pre-production mining would occur. Commissioning to transition the facilities into full operational status would commence near the end of the construction phase and continue into the operations phase (approximately 4 to 6 months). The operations phase would last for 20 years. This phase would consist of mining in the open pit, processing of the mineralized material, expansion of the tailings facilities, and water management.

Closure would commence once mining and processing are complete. However, there would be a “pre-closure” closure of one of the material sites (quarries) that would be developed as part of the initial construction, but would need to be closed during the early operations before it would become inundated with tailings. This pre-closure design would need to be integrated with tailings drainage system design.

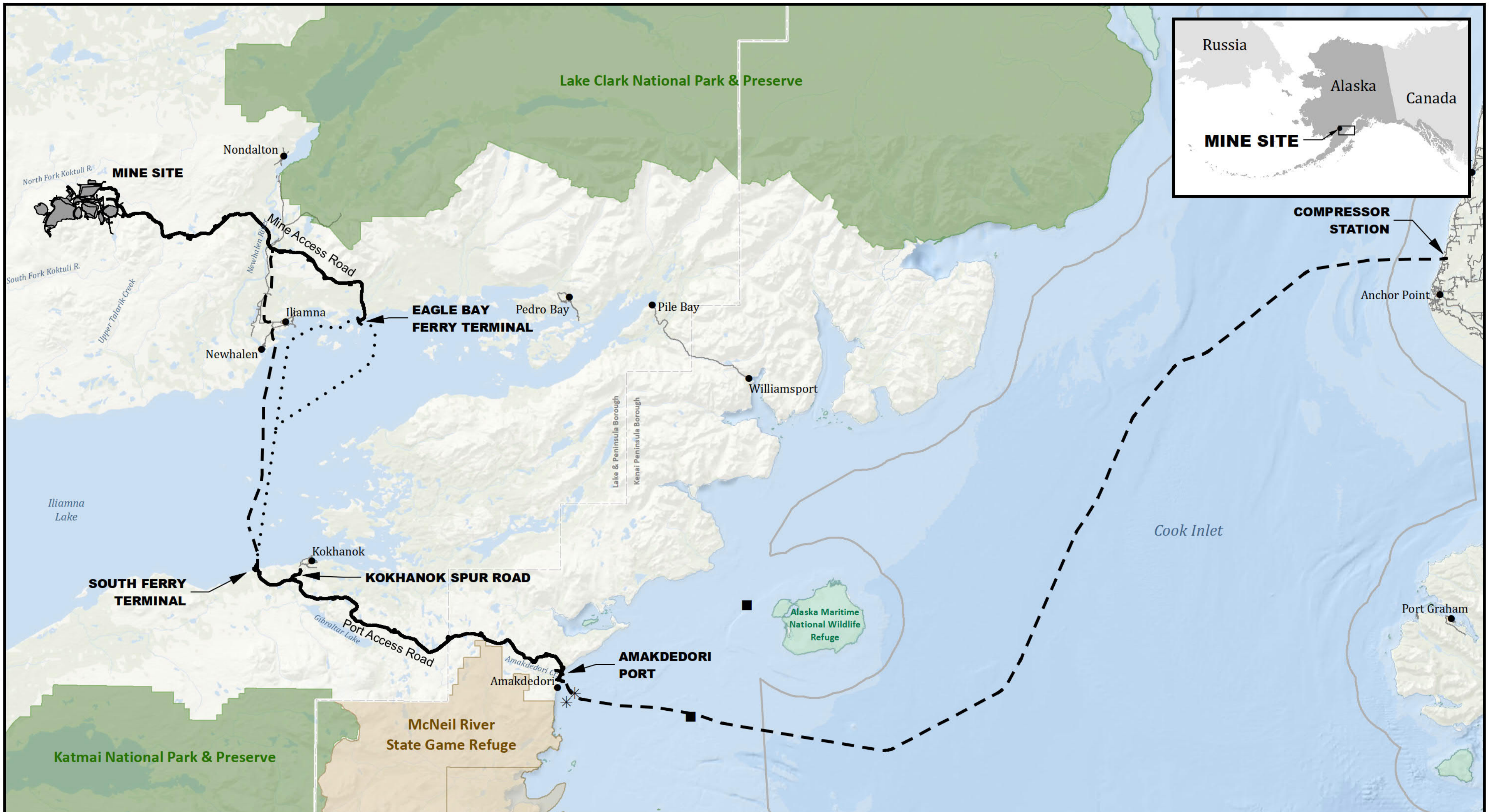
During closure, the production-related facilities would be removed, the material removed from the pyritic TSF, and other facilities reclaimed. Water management would continue through the closure phase. The post-closure phase is the period of time after the closure phase when water quality would be closely monitored, and changes and adjustments to the treatment process would be made, as needed. The long-term post-closure phase is expected to last for centuries.

The workforce during construction is expected to peak at 2,000 personnel. During operations, the project would have an operating schedule of two 12-hour shifts per day, 365 days per year, and employ an average annual of approximately 850 personnel.

Key project details are listed below and summarized in the following sections. Additional project details can be found in Appendix K2 and in PLP’s Project Description (PLP 2019d).

- A total of 1.4 billion tons of material mined over the life of the project.
- Final open pit dimensions of 6,800 feet in length, 5,600 feet in width, and 1,950 feet in depth.
- Mining rate up to 73 million tons per year (tpy), average rate of 70 million tpy.
- Milling rate[3] up to 66 million tpy.
- Average annual copper-gold concentrate production (dry concentrate) of 613,000 tons.
- Average annual molybdenum concentrate production (dry concentrate) of 15,000 tons.
- Final bulk TSF capacity of 1,140 million tons.
- Temporary storage of 155 million tons of pyritic tails in the pyritic TSF.
- Temporary storage of up to 93 million tons of PAG and/or metal leaching (ML) waste rock in the pyritic TSF until closure.
- Construction materials for mine site development would be primarily sourced from three quarries.

[3] Milling rate represents the rate at which ore is processed at the mine.



Sources: PLP 2019-RFI153; ADNR

US Army Corps of Engineers

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Miles

Alternative 1a
- Lightering Location
- Lighted Navigation Buoys
- Ferry Route
- Natural Gas Pipelines
- Transportation Corridor
- Mine Site

Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1A - GENERAL PROJECT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-3

- Power plant generating capacity of 270 megawatts (MW).
- A transportation corridor from the mine site to a year-round port site on Cook Inlet near the mouth of Amakdedori Creek consisting of:
  - A 35-mile private[4] two-lane unpaved road from the mine site to a ferry terminal at Eagle Bay on the northern shore of Iliamna Lake (referred to herein as the mine site access road) with a connection to the existing Iliamna/Newhalen road system.
  - A 28-mile lake crossing using an ice-breaking ferry to a ferry terminal on the southern shore of Iliamna Lake.
  - A 37-mile private two-lane unpaved road from the south ferry terminal to Amakdedori port (referred to herein as the port access road).
- An unpaved spur road, approximately 1 mile long, connecting the transportation corridor to the community of Kokhanok.
- A port facility and jetty with docking for lightering[5] and supply barges.
  - Annual vessel traffic of up to 27 concentrate vessels and 33 supply barges.
  - Lightering of concentrate between Amakdedori port and offshore lightering locations for loading onto bulk carriers.
- A 192-mile gas pipeline from the Kenai Peninsula across Cook Inlet to the project site with a compressor station on the Kenai Peninsula.

2.2.4.1 Mine Site

The mine site (approximately 8,390 acres) would include the open pit, bulk TSF, pyritic TSF, overburden stockpiles, material sites (quarries), water management ponds (WMPs), seepage collection ponds (SCPs), sediment ponds, milling and processing facilities, and supporting infrastructure such as the 270-MW power plant, water treatment plants (WTPs), camp facilities, and storage facilities. Figure 2-4 shows the proposed layout of the mine site. The site is undeveloped, and not served by transportation or utility infrastructure. Figure 2-5 presents a digital simulation of the mine site at the end of the operations phase (Year 20) with the maximum footprint for facilities. Simulations presented in Chapter 2 were provided by PLP, and created using a digital process based on actual terrain scans, three-dimensional mapping, and modeling and rendering software to present alterations to the landscape from proposed facilities (PLP 2018-RFI 034d and PLP 2019-RFI 034e).

A proposed mine site safety boundary has been identified by PLP as the minimum area needed to safely conduct mine construction, operations, and reclamation (PLP 2018-RFI 058). The boundary, shown on Figure 2-4, would be demarcated by signage at regular intervals and at logical locations such as the mine access road and waterways. The boundary would be reduced during the post-closure phase of the project.

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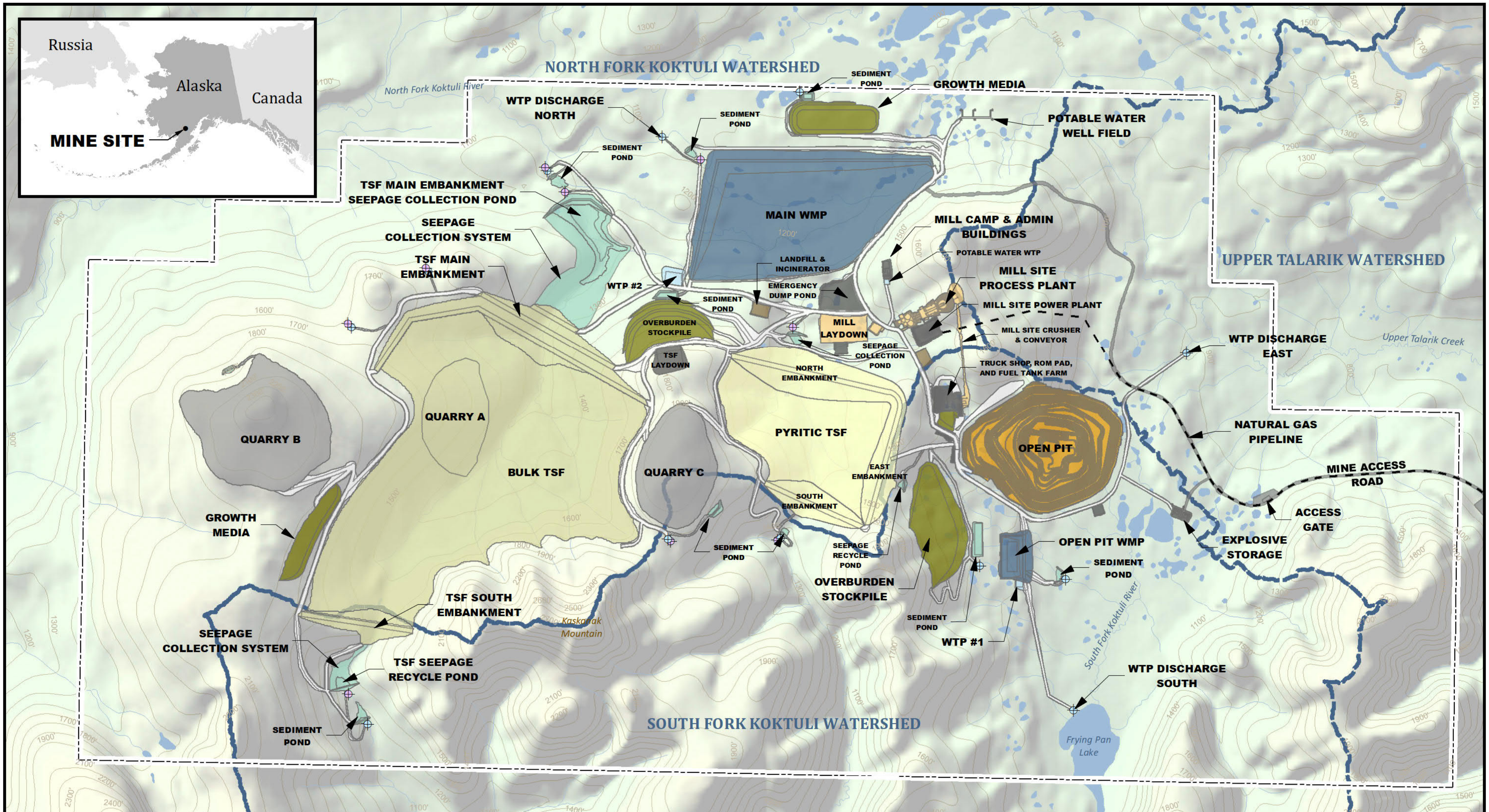
[4] Private road means that access would be controlled. Controlled use could include scheduled conveys for the transport of private vehicles and supplies, qualification and limited use authorization of third-party vehicles and drivers using the access infrastructure, or other similar arrangements.
[5] Lightering is the process of transferring cargo between vessels of different sizes. The proposed project would use shallow draft barges to transfer the concentrate product from the port to bulk carriers moored in deep water.



Sources: PLP 2019-RFI153; USGS; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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0.5 0 0.5 1
Miles

Alternative 1a
- GW Quality Monitoring and Pump Back
- Water Quality Monitoring Point
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site Safety Boundary

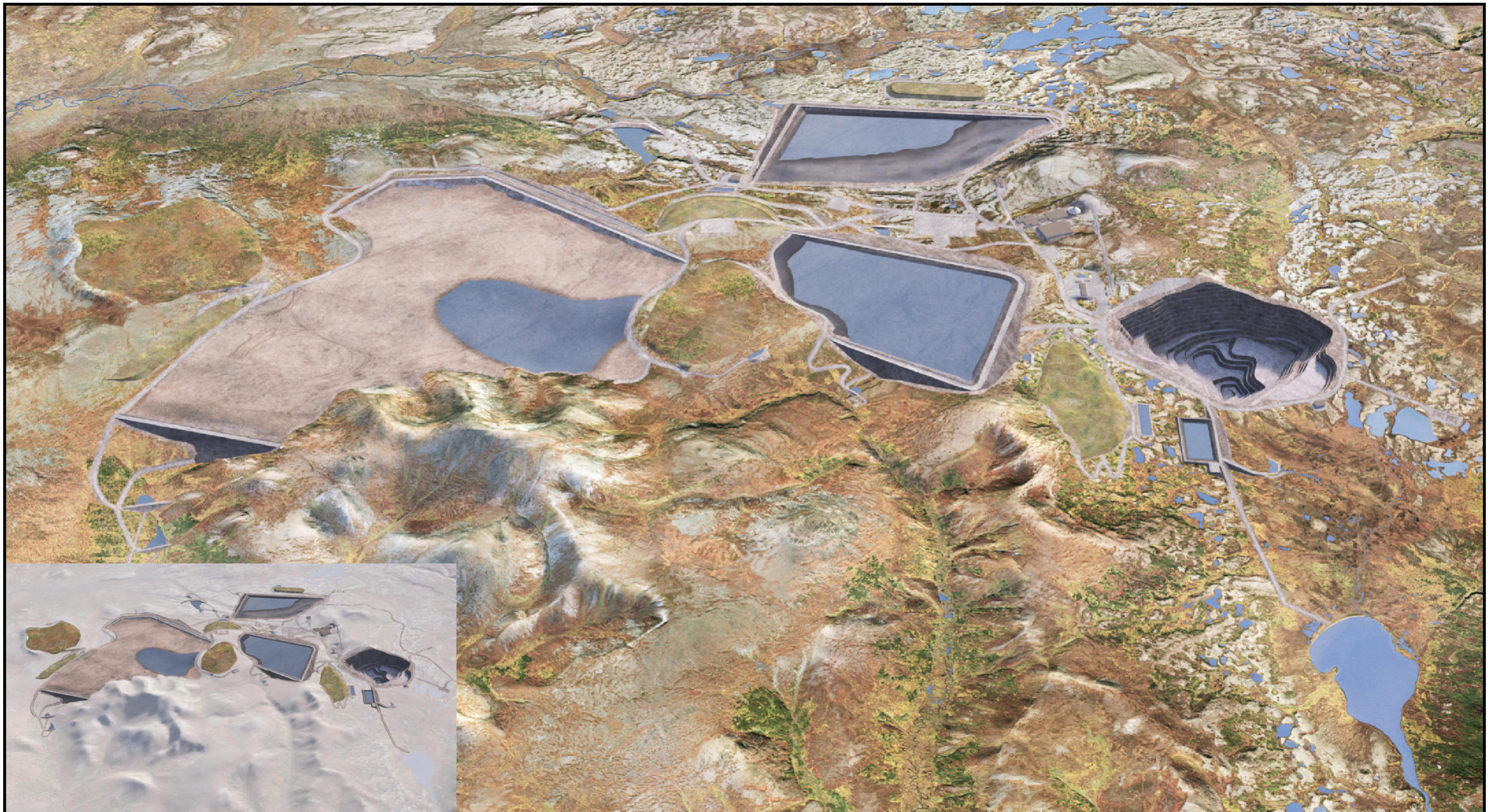
Mine Site Infrastructure
- Bulk Tailing Storage Facility
- Mine Site Infrastructure
- Mineral Processing Facilities
- Onsite Access Roads
- Open Pit
- Pyritic Tailings Storage Facility
- Quarries
- Sediment/Seepage Collection Systems
- Stockpiles
- Waste Management Facilities
- Water Management Ponds
- Water Treatment Plants

Other Features
- River/Stream
- Lake/Pond
- Watershed
- 100' Contour (Existing)

ALTERNATIVE 1A - MINE SITE LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-4



Sources: PLP 2019-RFI034e
Note: The displayed features are the permanent footprint unless otherwise specified.

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DIGITAL SIMULATION OF MINE SITE

Mining Methods and Phasing

The open pit mine would be a conventional drill, blast, truck, and shovel operation with an average mining rate of 70 million tpy, and an overall stripping ratio of 0.12 ton of waste per ton of mineralized material.

Mining would commence during the construction phase (mine pre-production) and extend 20 years during the operations phase. Appendix K2 summarizes the types and volumes of material proposed to be mined.

Mine pre-production would commence with dewatering of the open pit before the start of pre-production mining. This water would be primarily collected from perimeter wells, and discharged to the environment if it meets water quality criteria; otherwise, it would be treated in a water treatment plant prior to discharge. The purpose of the pre-production mining is to prepare the open pit for production. Approximately 33 million tons of material, primarily overburden and waste rock with a small amount of accompanying mineralized material, would be mined during this period.

Mine production during the operations phase encompasses the period during which economic-grade mineralized material would be fed to the mill. Mineralized material would be fed through the process plant at a rate of 180,000 tpd. The open pit would be mined in a sequence of increasingly larger and deeper stages. Figure 2-6 shows the open pit design. Approximately 1.4 billion tons of material are planned to be mined during the operations phase. The final footprint of the open pit at the end of the operations phase would be 609 acres.

Blasting

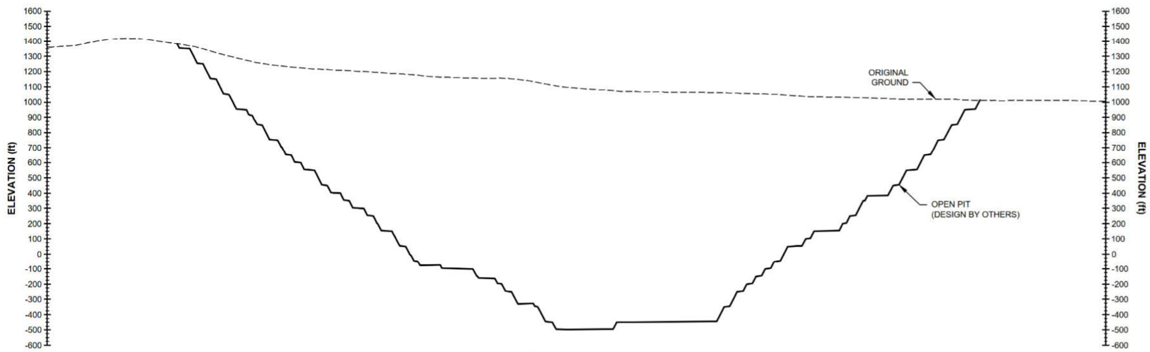
Most of the material to be removed from the open pit consists of intact rock, which must be blasted to enable it to be excavated. Most open pit blasting would be conducted using emulsion blasting agents manufactured on site. Pre-packed emulsion blasting agents or a mobile bulk emulsion manufacturing plant may be used for initial mining operations during pre-production. After the explosives plant is completed, emulsion-based ammonium nitrate and fuel oil (ANFO) explosives with a density of 68.7 pounds per cubic foot (pcf) would be used as the primary blasting agent.

Blasting events during mining pre-production would occur approximately once per day. The frequency would increase during the operations phase, with events occurring as often as twice per day.

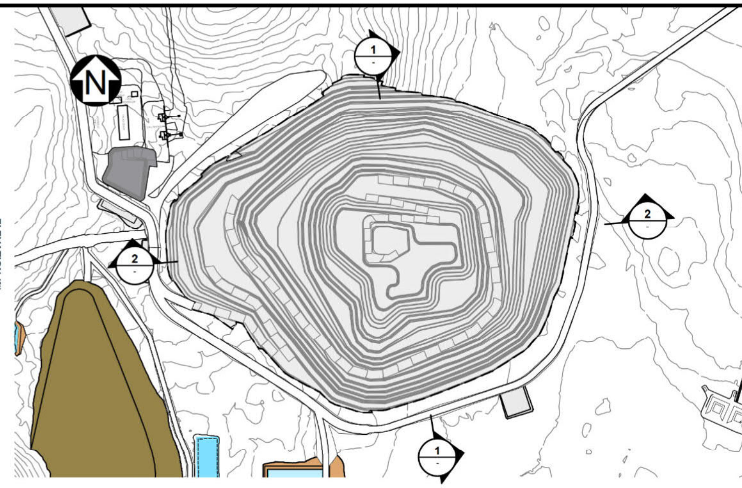
Waste Rock and Overburden Storage

Waste rock is mined material with a mineral content below an economically recoverable level that is removed from the open pit and stored on site. PAG and ML waste rock[6] would be stored in the pyritic TSF until mine closure, when it would be back-hauled into the open pit. During operations, PLP would assume that all waste rock requires management in the pyritic TSF unless test work (blast hole, drill core, and pit face sampling) and geologic mapping demonstrate that the rock is non-potentially acid generating (NPAG) and/or non-metal leaching (non-ML), and could safely be segregated from the PAG/ML waste rock for use in project construction activities (PLP 2020a). Site-specific studies have shown that the older mineralized (Cretaceous age) rock and younger (Tertiary age) non-mineralized rock have very different geochemical signatures and acid

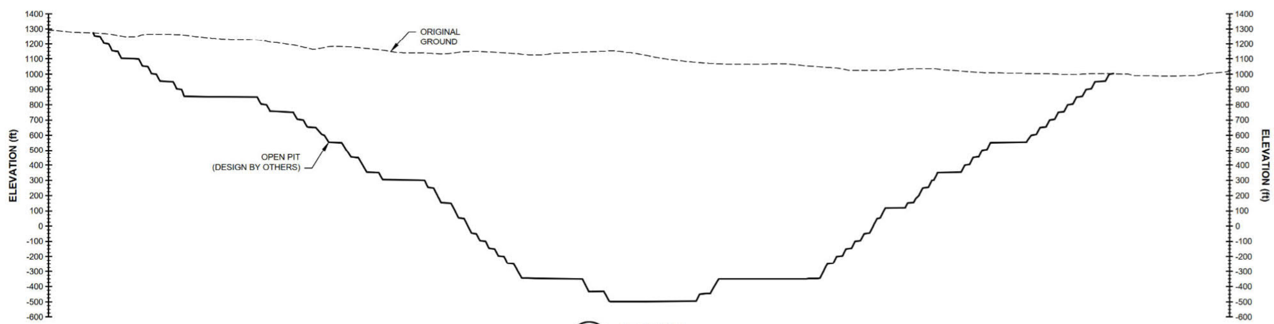
[6] All PAG would be metal leaching. There could also be NPAG waste rock that would leach metal. Metal leaching rock is defined for this document as any rock where runoff or seepage water could exceed water quality standards for metal levels (PLP 2020a).



1 M-002 **SECTION** SCALE B



OPEN PIT
PLAN
SCALE A



2 M-002 **SECTION** SCALE B

NOTES:

1. COORDINATE GRID IS UTM NAD 83, ALASKA STATE PLANES ZONE 5.
2. CONTOUR INTERVAL IS 25 FEET.
3. DIMENSIONS AND ELEVATIONS ARE IN FEET, UNLESS NOTED OTHERWISE.
4. OPEN PIT SURFACE PROVIDED BY TETRA TECH JUNE 2019.

Sources: PLP 2019h

Note: The displayed features are the permanent footprint unless otherwise specified.

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ALTERNATIVE 1A - OPEN PIT DESIGN

generation potential, and that PAG waste rock has a site-specific neutralization potential (NP)/ acid-generating potential (AP) ratio equal to or greater than 1.4. Regardless of rock age and NP/AP ratio, however, the project proposes to manage all waste rock that has ML potential by submergence to limit sulfide oxidation and leaching (PLP 2018a; PLP 2019-RFI 021f, RFI 110). The State of Alaska will require the final determination of site-specific NP/AP ratio and/or other geologic criteria and test work used for separation of rock material to be determined in coordination with the State during the permitting process. Demonstrated NPAG and non-ML waste rock could be used for embankment or other construction uses at the site.

Non-mineralized waste and overburden would be stockpiled (as described below) or used in construction. Mineralized waste would be stockpiled in the open pit footprint and relocated to the pyritic TSF once complete; or if grades are sufficient, sent for milling once the mill is complete.

Overburden is the collective name of the soil (boulders, cobbles, gravel, sand, silt, and clay) and other consolidated materials that overlie the bedrock. At the Pebble deposit, the overburden depth ranges from 0 to 140 feet. Overburden removal would commence during mining pre-production and would recur periodically during the operations phase. The overburden would be segregated and stockpiled in dedicated locations southwest of the open pit and north of the TSF embankments (Figure 2-4). Overburden materials deemed suitable would be used for construction. Fine- and coarse-grained soils suitable for plant growth would be stockpiled for later use as growth medium during reclamation. Growth medium stockpiles would be stored at designated locations around the mine site (Figure 2-4) and stabilized to minimize erosion potential. As needed, berms built of NPAG/Non-ML rock would surround the stockpiles to contain the material and increase stability. The berms would be shaped and seeded to promote stability and prevent erosion and sediment-laden runoff through operations.

Mine Site Material Sources (Quarries)

Construction materials for mine site development are proposed to be primarily sourced from three quarries[7] (Quarry A [243 acres], Quarry B [556 acres], and Quarry C [303 acres]) in and adjacent to the bulk TSF, as shown on Figure 2-4. Construction materials for the various embankments would be sourced from these quarries, with additional NPAG/Non-ML materials sourced from the open pit, as available. Quarry A is in the footprint of the bulk TSF and would be active during construction and operations until the tailings level in the bulk TSF inundates the quarry. Ongoing construction materials would be sourced from Quarry B, Quarry C, and open pit stripping (as required) throughout operations.

The estimated volumes of material that would be blasted and excavated from the quarries are as follows (PLP 2018-RFI 015b):

- 1.7 billion cubic feet (ft^3) from Quarry A
- 3.2 billion ft^3 from Quarry B
- 1.4 billion ft^3 from Quarry C.

Preliminary testing of quarried material was completed in 2018, and confirmed suitability of the material. The quarry rock was found to be dominantly non-mineralized granodiorite that is geochemically suitable as construction fill due to its low acid rock drainage (ARD) and ML potential (SRK 2018d). As the material is quarried, its suitability would be confirmed by visual inspection, bench mapping, and blast-hole testing.

Quarry A would need to be closed soon after mine operations start and before it becomes inundated with bulk tailings. The closure plan would need to include topographic linkage to the bulk TSF underdrain system. This might require some backfilling of the quarry to help implement

[7] A quarry is an open material site where stone and other materials are extracted for use as construction material.

the flow-through design of the main embankment by enhancing seepage drainage and making sure that the quarry bottom does not trap water.

Surface runoff from the quarries is assumed to be non-contact water that can be collected and treated in sediment ponds before being released to the environment. Runoff from Quarry A during the early TSF operations would be collected and managed in the water pond (supernatant pond) that would form in the lowest part of the bulk TSF as the tailings solid particles settle. Quarry B and Quarry C runoff would be collected and treated in sediment ponds before being released. The Quarry B runoff would discharge to the North Fork Koktuli (NFK) drainage. Quarry C runoff would drain to a pond that would discharge to a pyritic TSF diversion channel, which would discharge to the NFK drainage.

Mineral Processing

Mineral processing facilities such as the mill site process plant, crusher and conveyor, and container yard would be located at the mine site near the open pit (Figure 2-4). Blasted mineralized material from the open pit would be fed to a crushing plant, and then conveyed to a coarse ore stockpile, which in turn would feed a grinding plant in the process plant. At various points throughout the mill, water and reagents would be added to the process (see Appendix K2 for a list of mine site supplies, including reagents). In the grinding plant, mineralized materials would be reduced to the consistency of very fine sand. The next step in the process would be froth flotation, in which the copper and molybdenum minerals are separated from the remaining material to produce concentrates. Multiple flotation steps would be used to produce the copper-gold and molybdenum concentrates. The concentrates would then be filtered for shipment for off-site refining.

Gravity concentrators would be placed at various locations throughout the grinding and flotation circuits in the process plant, with the intent of recovering a portion of the free gold and silver in the plant feed. The concentrates from these facilities would consist primarily of higher-density particles with accompanying gold and silver.

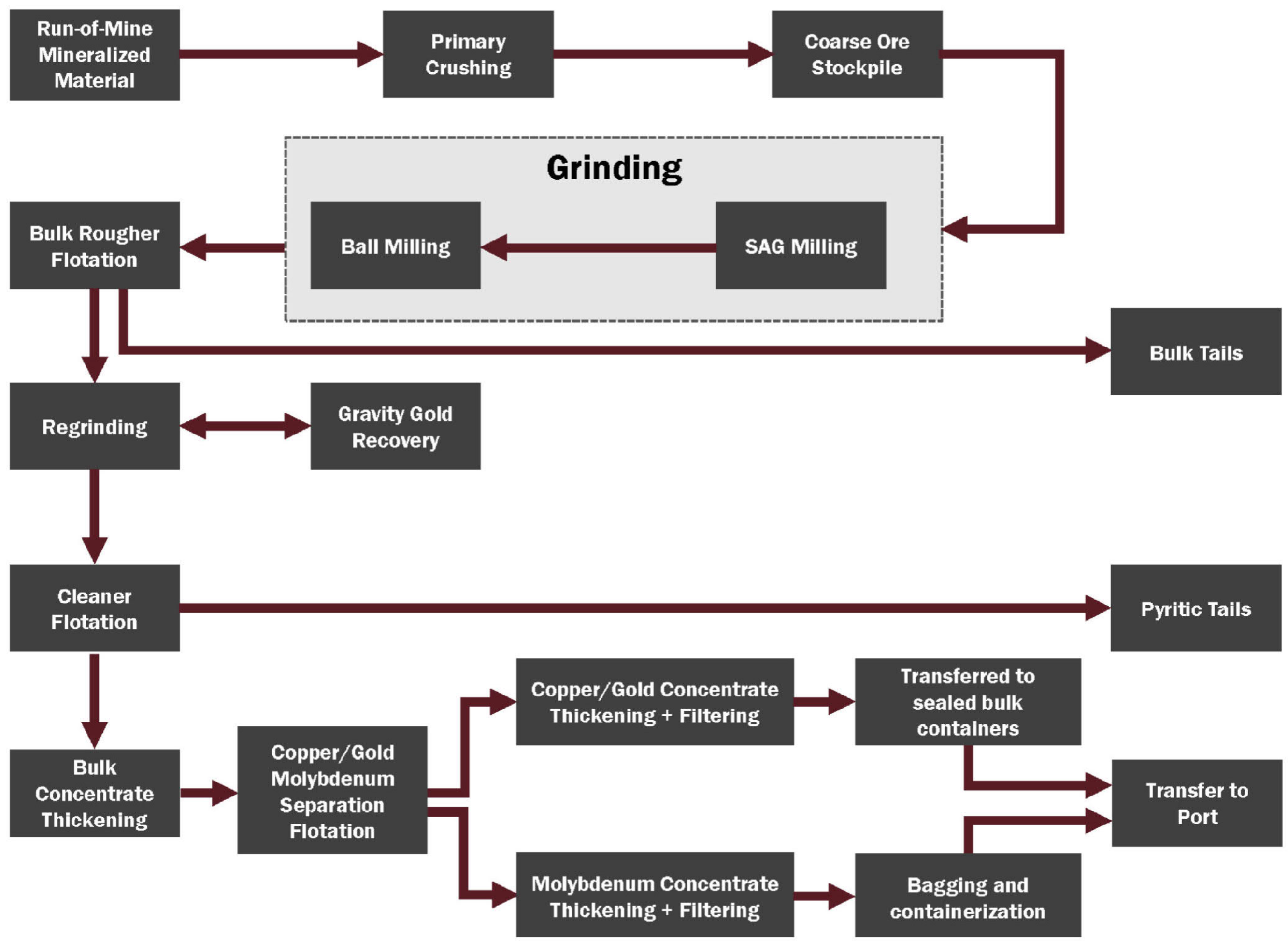
Processing mineralized material to recover concentrates would result in two types of tailings: bulk tailings and pyritic tailings (Figure 2-7 shows the process flow diagram).

The copper-gold concentrate would be loaded into covered bulk shipping containers, and the molybdenum concentrate would be packaged in bulk bags and loaded into shipping containers for off-site transport. Other economically valuable minerals (e.g., palladium and rhenium) would be present in the concentrates and may be recovered at the refineries. The gravity concentrate would be packaged in bulk bags, trucked to the Iliamna Airport, and shipped by air.

Tailing Storage Facilities and Main Water Management Pond

Separate TSFs for the bulk tailings (approximately 2,797 acres) and pyritic tailings (approximately 1,000 acres) would be in the NFK and South Fork Koktuli (SFK) watersheds (Figure 2-4). The main WMP (approximately 1,002 acres) would be in the NFK. Both TSFs and the main WMP would have associated SCP facilities.

The Dam Safety and Construction Unit of Alaska Department of Natural Resources (ADNR), is responsible for the “supervision” of the safety of dams in Alaska and the administration of the Alaska Dam Safety Program (ADSP) (ADNR 2020). The TSF, SCPs, and WMP embankments would be jurisdictional dam structures regulated by the ADNR, Dam Safety and Construction Unit. The TSFs and main WMP embankments dimensions would be designed to the standards of Class 1 hazard potential dam (the highest classification). All embankments would be subject to State of Alaska regulations per Chapter 17 in Title 46 of the Alaska Statutes (AS 46.17) and Article 3 Dam Safety of Chapter 93 in Title 11 of the Alaska Administrative Code (11 AAC 93). Permitting for large mine projects in Alaska is further discussed in Chapter 5, Mitigation, and Appendix E, Laws, Permits, Approvals, and Consultation Required.



Sources: PLP 2019d

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PEBBLE PROJECT EIS

PROCESS FLOW DIAGRAM

FIGURE 2-7

The total TSF capacity would be sufficient to store the 20-year mine life tailings volume. Approximately 88 percent of the tailings would be bulk tailings, and approximately 12 percent would be pyritic tailings.[8]

According to PLP, the final TSF designs would incorporate the following:

- Permanent, secure, and total confinement of bulk tailings solids in an engineered disposal facility.
- Secure and total confinement of pyritic tailings and PAG waste rock in a fully lined, engineered facility, with these materials relocated to the open pit at closure.
- Control, collection, and recovery of tailings water from the tailings impoundments for recycling to the process plant operations as process water, or treatment prior to discharge to the environment.
- Providing SCPs below the impoundment structures to prevent adverse downstream water quality impacts.
- The inclusion of sufficient freeboard in the bulk TSF that the entire volume of the Inflow Design Flood (IDF) would not flood the entire tailings beach, maintaining the beach between the maximum operating pond and the bulk TSF embankments.
- Limiting the volume of stored water in the bulk TSF and keeping the operating pond away from the dam face.
- Maintaining the pyritic tails and PAG waste in a sub-aqueous state to prevent or minimize oxidation.
- The consideration of long-term closure management at all stages of the TSF design process.
- The inclusion of monitoring instrumentation for all aspects of the facility during operations and after closure.
- Flattened slopes to increase the static factor of safety.

All embankments would be constructed using suitable NPAG and non-ML rockfill or earthfill materials (see discussion of Mine Site Material Sources above). Embankment raises would be completed on an annual or bi-annual basis.

Liner systems with geomembranes as their barrier component would be installed in the proposed lined facilities for seepage prevention purposes (discussed below). Liner materials would be selected during the preliminary and detailed designs, and would be installed following manufacturer specifications and quality control and assurance guidelines (PLP 2018-RFI 019c). The foundations of the lined facilities would require basin stripping, clearing, and grubbing of organic and unsuitable materials to allow for the placement of the liner system on competent subgrade (PLP 2019-RFI 109e).

Bulk TSF

The bulk TSF would have two embankments: the main, and south. The bulk TSF downstream embankment slopes would be constructed and maintained at approximately 2.6 horizontal:1 vertical (H:V) including buttresses established at the downstream toe of the main embankment. The bulk TSF embankments would be raised progressively during the mine life. The final embankment crest

[8] Bulk tailings are primarily composed of non-acid-generating finely ground rock material that remains after economic minerals, and most pyritic materials have been extracted through mineral processing at the mine site. Pyritic tailings are composed of potentially acid-generating finely ground rock material containing the naturally occurring mineral pyrite that remains after economic minerals have been extracted through mineral processing at the mine site.

elevation would be approximately 1,730 feet above sea level for bulk TSF. Embankment heights, as measured from lowest downstream slope elevation, would be 545 feet (main) and 300 feet (south) (PLP 2019-RFI 008g). Figure 2-8 shows the bulk TSF embankment cross sections.

The bulk tailings cell would have a small pond of water (supernatant pond), located away from the embankments. This would be achieved by depositing the tailings from spigot points along the embankment crests. The spigots would discharge the tailings alongside the upstream slopes of the embankments. This would create a tailings deposit by forcing the tailings and water to flow away from the embankments in a way that would create a tailings surface (beach). The beach would extend from the embankments and slope down away from the embankments to the supernatant pond.

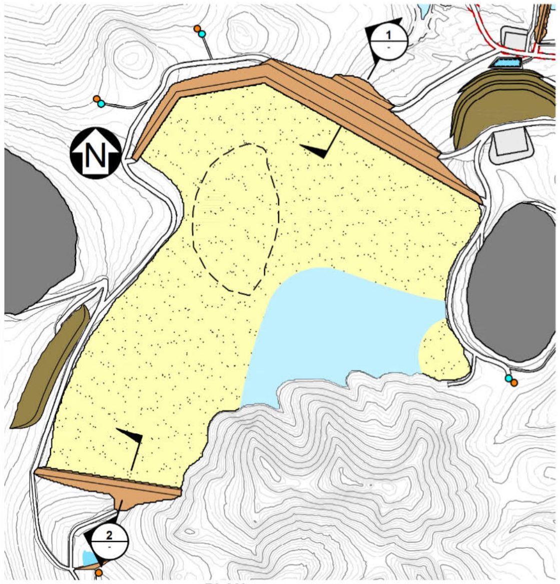
Bulk TSF Main Embankment – The main embankment of the bulk TSF would be built with earthfill and rockfill material. The embankment would not be lined. It would function as a permeable flow-through structure to continually enhance the seepage of water out of the tailings mass so that the tailings mass can drain, consolidate, and increase in strength over time. This feature would force the water level down deeper in the embankment and in the tailings close to the embankment, and thereby decrease the water content of the embankment fill and of the tailings near the embankment. This would increase the stability of the embankment and the TSF.

The bulk TSF main embankment would be constructed using the centerline construction method with local borrow materials, including appropriate open pit materials and rock from the three quarries. The embankment foundation would be prepared by removing overburden materials to competent bedrock prior to placing structural fill materials. Construction would begin with a cofferdam to capture upstream runoff during starter embankment construction. The starter embankment would be constructed to a height of approximately 265 feet, and provide capacity to store tailings for the first 24 months of operation. The bulk TSF embankments would be raised progressively during the mine life.

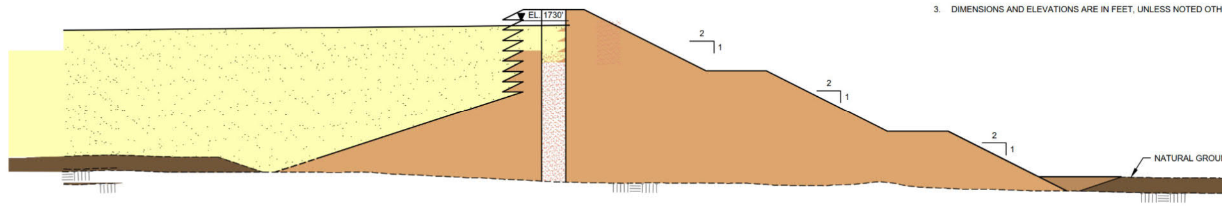
The bulk TSF main embankment would include engineered filter zones, a crushed or processed aggregate main underdrain along the topographic low profile of the creek bed, and under the highest part of the embankment, and finger underdrains as needed to the main drain. The Quarry A closure design would need to be integrated into the underdrain system design. The filter zone would allow seepage water to flow through the embankment, but would prevent tailings particles and fine-grained embankment fill particles from being carried out with the seepage water. The underdrains would enhance the flow-through design concept by providing a preferable seepage path from the tailings mass to the SCP downstream of the embankment toe. Additional underdrains running parallel to the embankment would allow for drainage of seepage collected along the embankment and discharge to the SCP. The SCP and its feeder drains would be designed to capture the TSF seepage that would flow through, under, or around the main embankment (Figure 2-8).

Locations, alignments, configurations, sizes, capacities, and other details of the underdrains would be developed following more detailed site-specific geotechnical and geological investigations and observations made during the preliminary and detailed designs, as administered through the ADSP permitting process.

The flow-through structure, engineered filter zones, downstream buttresses, underdrains, and tailings beach placement, and pumping of surplus TSF pond water to the main WMP during operations would serve to minimize seepage pressure and maintain permeability and stability of the embankment (Section 4.15, Geohazards and Seismic Conditions). All bulk TSF contact water that seeps through the embankment would be hydraulically contained at a low point in the valley where it would be collected in the bulk TSF main SCP, which would be designed with a lined embankment, a grout cut-off keyed into bedrock, and downstream pumpback and monitoring wells to intercept affected water and prevent it from flowing off site, and return it to the main WMP (Section 4.18, Water and Sediment Quality).



PLAN
BULK TAILINGS STORAGE FACILITY
SCALE A



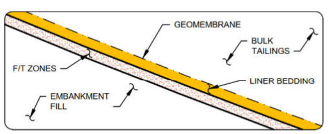
SECTION 1 (M-002)
BULK TSF MAIN EMBANKMENT
SCALE B

LEGEND:

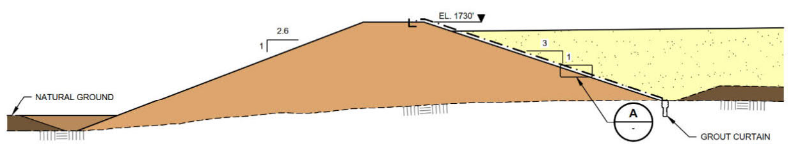
- BULK TAILINGS
- EMBANKMENT FILL
- FILTER / TRANSITION ZONES
- LINER BEDDING
- OVERBURDEN
- SUPERNATANT WATER POND
- TOE FILL
- GEOMEMBRANE
- BEDROCK
- WATER QUALITY MONITORING POINT
- GROUNDWATER QUALITY MONITORING AND POTENTIAL PUMP BACK AREA

NOTES:

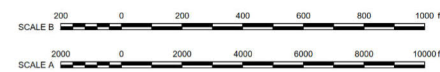
1. COORDINATE GRID IS UTM NAD83, ALASKA STATE PLANES; ZONE 5.
2. CONTOUR INTERVAL IS 25 FEET.
3. DIMENSIONS AND ELEVATIONS ARE IN FEET, UNLESS NOTED OTHERWISE.



DETAIL A
LINER
NTS



SECTION 2 (M-002)
BULK TSF SOUTH EMBANKMENT
SCALE B



Sources: PLP 2019h

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ALTERNATIVE 1A - BULK TAILINGS STORAGE FACILITY EMBANKMENT CROSS SECTIONS

Bulk TSF South Embankment—The Bulk TSF south embankment would be an earthfill/rockfill structure. The upstream slope of the south embankment would be covered with a liner system to minimize water seepage through the south embankment. This would force the seepage out of the TSF to flow in a northerly direction, and ultimately flow through and under the main embankment and its underdrains, instead of through and under the south embankment. This direction of seepage flow would be consistent with the objective of managing the TSF with the main embankment being operated as a flow-through facility, and all of the main embankment underdrains discharging to the SCP below the main embankment. However, there would still be an SCP below the south embankment to capture any seepage that might flow out of the TSF through, under, or around the south embankment.

The bulk TSF south embankment would be constructed using the downstream construction method to facilitate lining of the upstream face, which would be constructed with a 3H:1V slope.[9] The downstream slope would be at 2.6H:1V. Overburden materials would be removed to competent bedrock below the embankment. The earthfill/rockfill embankment would include engineered filter zones and a grout curtain tied to the liner to reduce seepage below the embankment (Figure 2-8).

Pyritic TSF

The pyritic TSF would be a fully lined facility with an underdrain system below the liner. It would have three embankments: north, south, and east. As with the bulk TSF south embankment, a liner system would be placed on the upstream slopes, and would be connected to the liner system that would cover the entire pyritic TSF basin. The pyritic TSF embankments would be constructed using the downstream method of construction, with overall downstream slopes of 2.6H:1V and upstream slopes of 3H:1V. The final crest elevation would be 1,620 feet above sea level. The north embankment height would be 335 feet, the south embankment height would be 215 feet, and the east embankment height would be 225 feet. Figure 2-9 shows the pyritic TSF embankment cross sections.

The embankments would be constructed using select borrow materials and would include a liner bedding layer, overlain by a geomembrane and a cover layer, on the upstream slope and over the entire internal basin. Underdrains would be included below the liner system of the pyritic TSF and the main WMP to control groundwater and limit uplift of the liner prior to the facility filling, and to promote drainage beneath the liner systems. The aggregate underdrains would be oversized to account for higher-than-expected seepage flows or potential cementation of the materials during the life of the facility. The underdrains are expected to be constructed in a herringbone pattern to collect and convey seepage to collection points downstream of the embankments. Longitudinal drains would be installed at the upstream toe of the embankments, which would connect with the basin underdrains and direct flows to the downstream SCPs (Knight Piésold 2019c).

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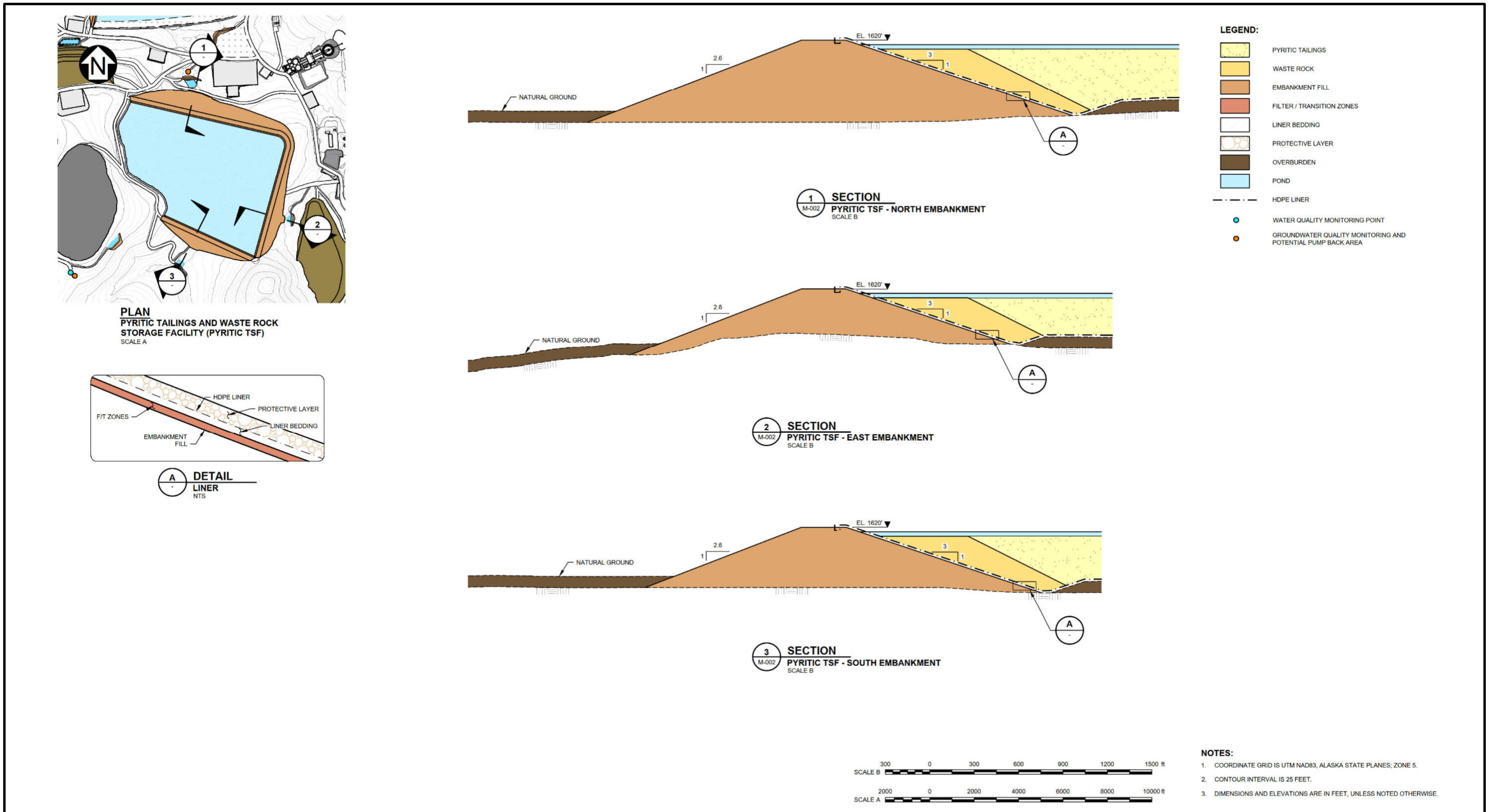
[9] Downstream and centerline construction are methods of dam (embankment) construction in which a rockfill dam is raised. With the downstream construction, the dam is raised completely in the downstream direction using the placement of fill on top of the crest and downstream slope of the previous raise. Therefore, the upstream slope would remain as a uniform slope. With the centerline construction method, the rockfill embankment is raised with the objective of continually raising the crest vertically upwards. This requires the concurrent placement of fill on top of the tailings beach, the remaining upstream slope, the crest, and the downstream slope of the previous raise during the raise process. This results in a zig-zag–shaped upstream face with the upstream part of the raise founded on the part of the tailings beach closest to the embankment.



Sources: PLP 2019h

US Army Corps of Engineers

ALTERNATIVE 1A - PYRITIC TAILINGS STORAGE FACILITY EMBANKMENT CROSS SECTIONS

The pyritic TSF would also contain PAG waste from non-ore material, as well as the pyritic mine tailings; and would have a full water cover during operations. The PAG waste would be placed on the geomembrane cover layer around the perimeter of the TSF before the tailings would be placed. The entire pyritic TSF, including both the tailings and waste rock, would be continually inundated with water to prevent these materials from oxidizing and generating ARD.

Placement of the waste rock on the geomembrane would be accomplished in a similar way as used in placing ore onto heap leach pads, which are widely used in the mining industry and in placing protective rock over geomembranes worldwide in landfills and TSFs. Placement specifics and criteria would be in the installation specifications, Construction Quality Assurance and Construction Quality Control manual, and Operations and Maintenance (O&M) manual developed through the ADSP permitting process.

An interim plan would be that when the geomembrane has been placed and welded, it would be covered with a layer of crushed material, specified to ensure the particles would not penetrate the geomembrane. The layer would be of adequate thickness so that equipment used would not damage the geomembrane. Another layer could then be placed over the first layer if further protection from run-of-mine waste rock is needed.

Water Management Ponds

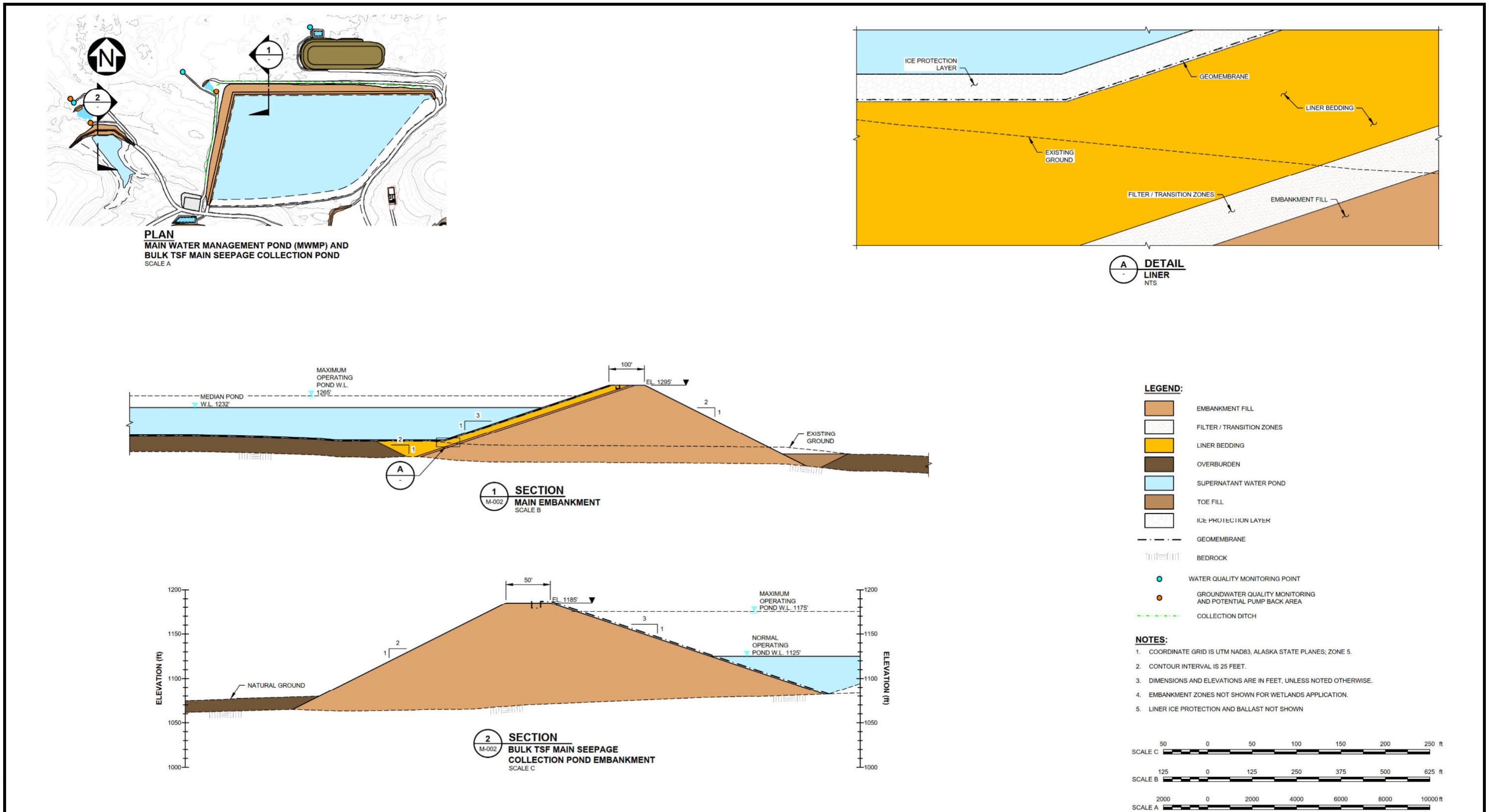
WMPs at the mine site (1,066 acres) include the open pit WMP, bulk TSF main SCP, pyritic TSF SCP, seepage collection and recycle ponds, sediment ponds, main WMP, and main WMP SCP (Knight Piésold 2018a).

The main WMP is the primary water retention facility at the mine site used to store surplus water for milling, or for managing surplus water from other impoundment and seepage structures (Figure 2-10). It would be a fully lined facility and the enclosing embankment would be constructed using quarried earthfill and rockfill materials founded on competent bedrock (PLP 2018-RFI 101). The embankment would be approximately 190 feet high, with an overall downstream slope of approximately 2H:1V, and an upstream slope of 3H:1V to facilitate placement of the liner system. It would be constructed to its final height during the initial construction period. The basin and upstream embankment face would include a layer of materials above the geomembrane to provide ice protection during freezing conditions. Herringbone underdrains would be included below the liner system, as described above for the pyritic TSF.

Tailings Deposition

Each tailings type would be delivered to its respective TSF embankments and parts of the TSF perimeters using two pump stations: one in the process plant; and one booster station positioned approximately mid-way along the pipeline route. The bulk tailings would be discharged via spigots spaced at regular intervals along the main embankment, west perimeter, and south embankment interior perimeter of the bulk tailings cell to promote beach development, which would allow the supernatant pond to be maintained well away from the main and south embankments.

PAG waste rock would be placed in a ring around the interior of the pyritic TSF's three embankments. The top level of the PAG waste rock ring would be a bench below the crests of the TSF embankments. The bench would be raised at intervals of time as more PAG waste rock would be placed as the open pit would be advanced in depth and area. Pyritic tailings from the cleaner scavenger flotation circuit would be discharged into the pyritic TSF at sub-aqueous discharge points along the embankments. The surface level of the tailings would be maintained below the level of the PAG waste rock bench so that the tailings would be buffered from the embankments by the PAG waste rock. The pyritic tailings would be kept submerged to prevent or minimize oxidation and potential acid generation.



Sources: PLP 2019h

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ALTERNATIVE 1A - WATER MANAGEMENT STRUCTURES SECTIONS

PEBBLE PROJECT EIS

FIGURE 2-10

PLP's monitoring summary report (PLP 2019-RFI 135) provides a conceptual-level overview of the management and monitoring plans (MMPs) expected for the project. As outlined in the monitoring summary report, the ongoing permitting process plays an important role in determining MMP criteria and requirements. Multiple plans that address TSF activities would be included in the project's final Plan of Operations, including:

- Tailings Management Plan (TMP) describing procedures and practices associated with the characterization, management, and deposition of process plan tailings in the bulk and pyritic TSFs.
- O&M manual describing day-to-day operations and inspections of TSF facilities, including embankment stability and seepage collection systems.
- Emergency Action Plan (EAP) prepared for all site embankments. The EAP would include maximum pond operating levels for the TSFs, and a response plan to be implemented if the water levels exceed the defined maximum operating levels (PLP 2019-RFI 008h).
- Reclamation and Closure Plan (RCP) describing specific TSF-related measures and activities during all closure phases.

Tailings facility monitoring and reporting is summarized in PLP's monitoring summary report (PLP 2019-RFI 135). Specific monitoring requirements and procedures would be specified in the O&M manual, which would be prepared concurrent with the detailed design documents to obtain embankment starter dam and raise construction permits from ADNR. The O&M manual would be revised after each starter dam and raise construction concurrent with the construction completion report, as well as after every periodic inspection of the embankments, to obtain TSF operations permits from ADNR. Also, the O&M manual would be revised following any event, trend, observation, etc., that triggers a need for monitoring plan changes. The State of Alaska has provided additional information on their regulatory process for permitting large mine projects in responses to RFI 064 (ADEC 2018-RFI 064), RFI 064a (ADEC 2018-RFI 064a), and RFI 131 (SOA 2019-RFI 131). These RFIs are included in Appendix E, Attachment 1.

Freeboard Allowance

All stages of embankment design would 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 would be reviewed as part of each dam lift and dam safety review, and would be adjusted as required to reflect actual mine water management conditions.

Surface Water

The hydrologic input to the TSF design consists of two primary factors: operating conditions based on the 76-year climate record, and the IDF. The IDF for the TSF, pyritic TSF, and the main WMP is the IDF, which in turn is calculated using the 24-hour Probable Maximum Precipitation (PMP) event, plus the snow water equivalent from a 1 in 100 year snowpack. Available storage, or freeboard, would be maintained in the storage facilities to account for the IDF. Maximum operating conditions would not encroach on the freeboard allowance.

Pumps at the bulk tailings cell supernatant pond would control the water level by transferring excess water to either the seepage control pond or the main WMP.

The pyritic TSF would be a fully lined water retention facility. The primary means of controlling the water level in the pyritic TSF would be by pumping from this cell to the main WMP or the mill.

The main WMP would be a fully lined water retention facility used to store surplus water for milling, or for managing surplus water from other impoundment and seepage structures. The primary means of controlling the water level in the main WMP is by pumping to the mill, or treating surplus water and discharging to the environment. The design of the main WMP would also incorporate an emergency spillway.

Seepage

The main embankment of the bulk TSF would be designed to promote seepage to the SCP, thereby minimizing the volume of water contained in the impoundment and enhancing consolidation of the tailings solids.

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

The seepage management system would 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 collection ponds would ultimately be transferred to the main WMP to be used in mining operations, or treated for discharge.

Mine Site Infrastructure

Due to the remote location and absence of existing infrastructure, the project would require construction of basic infrastructure, as well as the support facilities typically associated with mining operations. These facilities would require reasonable access from the Pebble deposit and would be situated foremost for stability and safety. Supporting infrastructure and facilities that would be constructed in the mine site footprint include:

- Mill Site Power Plant: a plant (22 acres) with power generation capacity of 270 MW fired by natural gas, and associated distribution infrastructure. Emergency backup power for the mine site would 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.
- Shops: a truck shop complex housing a light-vehicle maintenance garage, heavy-duty shop, truck wash building, tire shop, and fabrication and welding shop. An oil/water separation system would be designed for water collected from the wash facility and floor drains of the truck shop complex.
- On-site access roads: several access roads in the mine site area, including a road from an access gate to the mine site, and secondary roads linking with the various facilities around the mine. Traffic associated with in-pit activity would be segregated from access road traffic to avoid cross-contamination of vehicles with mud and dust from the pit.
- Permanent personnel camp: a permanent camp used initially during construction to accommodate 1,700 workers, and later refurbished for 850 permanent single-occupancy rooms for the operations phase.

- Potable water supply: a series of groundwater wells north of the mine site to supply potable water and distributed through a pump and piping network.
- Communications: fiber-optic cable connecting to existing fiber-optic infrastructure in the region, or a dedicated fiber-optic cable laid in conjunction with the gas pipeline.
- Laboratories: Two laboratories, the metallurgical laboratory and assay laboratory, which would operate at the mine site during the operations phase. Each laboratory would be equipped with fume hoods and drains connected to a central receiving tank.
- Fire and emergency response: Freshwater supply tanks for fire suppression distributed via an insulated pipeline system, a fire truck and ambulance, and equipment to respond to oil spills. Crews would be appropriately trained for emergency response.

Waste management facilities are discussed in a separate section below.

Temporary Facilities and Initial Site Access

Laydown areas and access roads for construction would be placed in the future footprint of the open pit to minimize impacts. A temporary construction camp (in addition to the permanent personnel camp previously described) would be constructed near the mill lay-down area at the mine to provide accommodations for initial construction (Figure 2-4). Construction crews would use the temporary construction camp and permanent camp when it is complete. As construction is completed and crew sizes reduce, they would transition to the temporary camp only. This would enable the permanent accommodations complex to be refurbished to single-room occupancy for the mine operations staff. All temporary construction facilities would be removed after construction; and the sites would be reclaimed, unless being used for or located in the footprint of permanent facilities. The permitted temporary construction footprint would be clearly marked, using flagging or other methods, to minimize construction impacts (PLP 2019-RFI 071b).

Material Management and Supply

Fuel, lubricants, tires, and blasting agents would be the primary materials used in mining. Reagents[10] would be used in low concentrations throughout the mineral processing plant and are primarily consumed in the process. Appendix K2 includes average annual quantities of fuel, mining, milling, and miscellaneous consumables, as well as common mining supplies, processing reagents, and materials. General supplies would typically be stored in, or adjacent to, the areas where they would be used.

The main mine site fuel storage area adjacent to the open pit would contain fuel tanks in a dual-lined and bermed area. Sump and truck pump-out facilities would be installed to handle spills. There would also be pump systems for delivering fuel to the rest of the mine site. Dispensing lines would have automatic shutoff devices, and spill response supplies would be stored and maintained on site wherever fuel would be dispensed (PLP 2019-RFI 126). Fuel would be dispensed to a pump house in a fuel storage area for fueling light vehicles, and to the fuel tanks in the truck shop complex, which are used for fueling mining equipment. These tanks would also be in lined and bermed secondary containment. Fuel would also be dispensed to tanker trucks, which would in turn transfer the fuel to some of the mining equipment in the open pit.

Lubricants would be packaged in drums and/or totes and stored on site in secondary containment.

[10] Reagents are substances used to promote or suppress chemical reactions to chemically and physically separate metallic elements from ore during the mining process.

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. As a safety precaution, the plant would be situated approximately 0.75 mile southeast of the final open pit rim. Ammonium nitrate prill (a small, usually sphere-shaped pellet of aggregate material) would be stored and prepared for use at this location. Electrical delay detonators and primers would be stored in the same general area, but in a separate magazine apart from each other and separate from the prill. Mine safety and health administration regulations as set forth in 30 CFR Part 56 contain requirements for facilities and blasting operations.

Reagents would arrive at the mine site by truck in 20-ton containers, depending on the reagent. They would be stored in a secure bulk reagent storage area and segregated according to compatible characteristics. The reagent storage area would be sufficient to maintain a 2-month supply at the mine site. Reagents would be used in very low concentrations throughout the mineral processing plant and are mostly consumed in the process; low residual reagent quantities remain in the tailings stream and would be disposed in the TSF, where they would be diluted and decompose. The metallurgical and assay laboratories would also use small amounts of reagents. PLP has committed that any hazardous reagents imported for testing would be transported, handled, stored, reported, and disposed of in accordance with manufacturers' instructions, and consistent with industry best practices. Secondary containment and heated storage would be provided for process and other reagents, as appropriate. Secondary containment is further discussed in Section 4.27, Spill Risk. Precautionary operational measures employed to reduce spill risk and respond to spill events for each project component are described in PLP 2019-RFI 126, and incorporated as part of the Applicant's proposed mitigation (see Chapter 5, Mitigation, Table 5-2).

Water Management

A mine site water management plan is essential to understanding fresh water and mine process water requirements in relation to: 1) natural runoff timing and open pit dewatering requirements; 2) designing water management and treatment systems; and 3) minimizing the potential for an uncontrolled discharge of untreated contact or tailings water. PLP has developed mine site management plans for operations (Knight Piésold 2018a) and closure (Knight Piésold 2018d). Additional detail would be developed and included in updates to these plans as the project proceeds through the state permitting process.

The main objective would be to manage water that flows through the project area, while providing an adequate water supply for operations. PLP proposes to capture all runoff water contacting the facilities at the mine site and water pumped from the open pit to protect downstream water quality; either by reusing this water in the milling process, or treating the water to the permitted discharge limits before releasing it.

About 2 years before process plant startup, the open pit area would begin to be dewatered through groundwater withdrawal from approximately 30 groundwater wells installed around the open pit perimeter. Dewatering would continue throughout operations as the open pit is deepened until collection of flow is more efficient from in-pit ditches, in-pit wells, and/or perimeter wells (PLP 2019-RFI 109e). During closure, water level in the open pit would be managed via pumping of groundwater wells. Extracted water would be pumped into the open pit WMP (Knight Piésold 2018e).

Water Balance

The Pebble comprehensive water modeling system is composed of three models: watershed model; groundwater model; and mine site water balance model. They collectively provide the means of quantifying the numerous water flows in the streams, in the ground, and in the pipes, ponds, and mine structures associated with the mine development. The watershed model focuses on water flows throughout the NFK, SFK, and UTC drainages. The groundwater model focuses on the detailed simulation and understanding of groundwater flows in those drainages and serves to inform the watershed model, and vice-versa. The mine site water balance model is an operational model and focuses on mine site water inflows and uses. Additional information about the mine site water balance model is provided in Knight Piésold 2019f.

Complementing the mine site water balance model 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. These models are further described in Appendix N (PLP 2020d).

Pre-production Water Management Plan

The water management and sediment control plan during mining pre-production would focus on minimizing contact water[11] volumes. Runoff and associated sediment control measures would be managed with BMPs and adaptive control strategies. Where water cannot be diverted, it would be collected, treated, and discharged. PLP's water management plan is further described in Appendix N (PLP 2020d).

Pre-production Water Treatment

Minimal water storage would 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 would be treated and released. Modular construction WTPs would be operational at the mine site prior to the start of earthworks and would remain operational until the open pit and operations WTPs are commissioned. It is anticipated that the treatment would need to address pH and elevated levels of dissolved metals. Treatment would use a high-density sludge (HDS) process with additional polishing steps if necessary. Treated water from the construction WTP would be discharged to the NFK drainage. Water from the following sources and activities would be expected to require treatment prior to release:

- Pre-production open pit dewatering (dewatering of the overburden aquifer near the open pit may require treatment).
- Water, primarily from precipitation, accumulating in the open pit during pre-production mining.
- Runoff from TSF embankment construction.
- Runoff from excavation for site infrastructure such as the process plant, personnel camps, power plant, or storage areas would be routed to settling ponds prior to release.
- Dewatering of foundations for construction of embankments of the bulk TSF, main WMP, and pyritic TSF (PLP 2019-RFI 109e).

Operations Phase Water Management Plan

The water management and sediment control plan during the operations phase would focus on minimizing contact water. Runoff and associated sediment control measures would be managed with BMPs and adaptive control strategies. Where surface water cannot be diverted, it would be

[11] Contact water is surface water or groundwater that has contacted mining infrastructure. This includes "mine drainage" defined in 40 CFR Part 440.132(h) as any water drained, pumped, or siphoned from a mine, as well as stormwater runoff and seepage from mining infrastructure. Examples of contact water include seepage from waste rock piles, seepage from stockpiles (except ore), and water from horizontal drains that accumulates in the pit.

collected either for use in the mining process, or treated to meet permit requirements and discharged to the environment. PLP's water management plan is further described in Appendix N (PLP 2020d).

Water collection, management, and transfer would be accomplished through a system of TSF underdrains, water management channels, ponds, and pump, and pipeline and outfall configurations. These systems would be designed to handle the large flows that occur during spring thaw, late summer/fall rains, and fall-to-spring rain on snow events. Additional pumps and spare parts for pump systems would be kept on site to maintain continuous and effective water management.

Leak detection systems that report to a central control system would be employed, as would 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.

Operations Phase Water Treatment

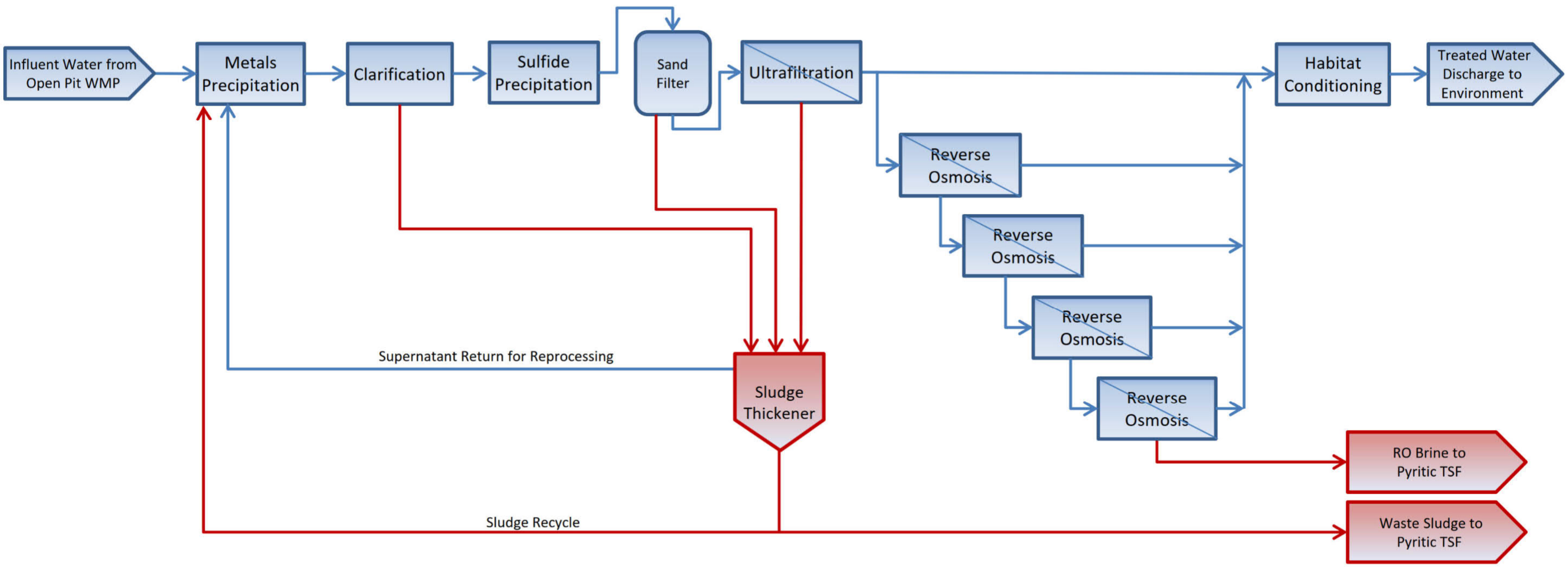
Water collected around the mine area would require treatment prior to discharge to the environment. Treatment methods would include a mixture of settling for sediment removal, chemical additions to precipitate dissolved elements, and filtration to meet final discharge criteria.

The mine area would have two WTPs during operations: WTP #1 (used during operations to treat surplus water from the open pit WMP), and the WTP #2 (used during operations to treat surplus water from the main WMP) (HDR 2019g). Both would be constructed with multiple independent treatment trains. WTP #1 would have two treatment trains to meet the influent flow of 14 cubic feet per second (cfs) (HDR 2019g). WTP #2 would have six treatment trains to meet the influent flow of 46 cfs (HDR 2019g). Both WTPs would have an extra train installed to allow for maintenance rotation. The WTPs would be designed with adequate flexibility in the processes to address the contingency of influent water with lower quality than predicted. Figure 2-11 and Figure 2-12 show simplified schematics of the treatment processes for WTP #1 and WTP #2, respectively. The treatment process for each WTP is further described in Appendix K4.18. WTP discharge locations are shown on Figure 2-4.

Closure/Post-Closure Phase Water Management Plan

Closure and post-closure water management would address both the physical closure of the site and associated reclamation activities, as well as the long-term post-closure period and associated maintenance and monitoring activities. The closure plan would be developed to meet or exceed the requirements of 11 Alaska Administrative Code (AAC) 97. The objectives of the plan would be to:

- Provide for long-term public safety at the mine site.
- Address post-closure land use and development objectives established in consultation with landowners and residents.
- Stabilize and protect surficial soil materials from water and wind erosion.
- Stabilize steep slopes to provide rounded landforms and suitable seedbeds.
- Establish a productive vegetative community that addresses post-mining land use and visual resources.
- Manage water to reduce contact with the disturbed areas and effectively manage and treat pit lake water (i.e., the water that would accumulate in the open pit as a lake at closure).
- Minimize post-closure impacts to downstream flows and habitat.



Sources: PLP 2020-RFI 166

Notes
1) Arrows show water flow through treatment process.
2) Diagonal line indicates membrane process step, with segregation of outflow.
3) Blue cells indicate treated water stream; red cells indicate reject/waste stream.
4) Habitat Conditioning means adjustment of parmeters such as temperature and dissolved oxygen if required.

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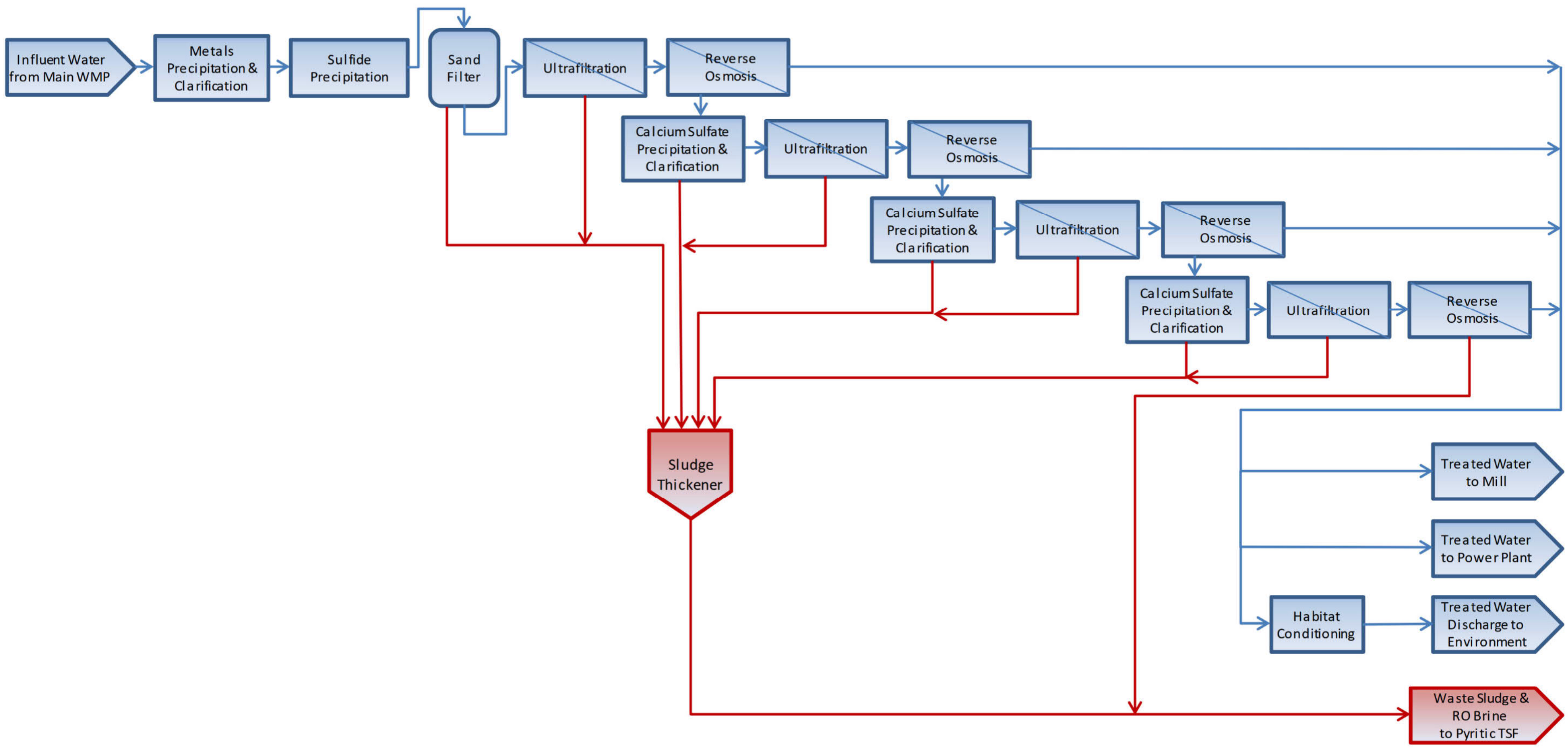
WATER TREATMENT PLANT #1 PROCESS SCHEMATIC



Sources: PLP 2019d

Notes
1) Arrows show water flow through treatment process.
2) Diagonal line indicates membrane process step, with segregation of outflow.
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WATER TREATMENT PLANT #2 PROCESS SCHEMATIC - OPERATIONS PHASE

FIGURE 2-12

Monitoring of the mine site would continue through the physical closure and on into the post-closure period. This would include monitoring the reestablishment of vegetation in reclaimed areas, stability of any remaining embankments, and site-wide ground and surface water quality.

In the event of temporary closure, the open pit, mill, TSFs, and other production-related facilities would be placed in care and maintenance. Water treatment and stormwater management activities would continue through the temporary closure. Care and maintenance staff would continue monitoring and reporting activities. In the event of full premature closure, the basic steps would be the same as those outlined for the ultimate closure, as detailed in the Closure Water Management Plan. Modifications might be required to address the process requirements for the long-term water treatment from the open pit. The pit lake would be maintained below the control level, but stratification would be dependent on the pit depth. Management of the surface runoff from the bulk TSF would be dependent on the elevation of the tailings surface. However, these should not significantly impact the long-term closure plan.

The ADSP provides draft guidance for developing temporary closure plans (ADNR 2017a). All design, construction, and operations activities would need to be integrated with the closure requirements.

Additional details on the water management plan during the closure phase and post-closure are provided in the Reclamation and Closure section below. Monitoring is further discussed in Chapter 5, Mitigation.

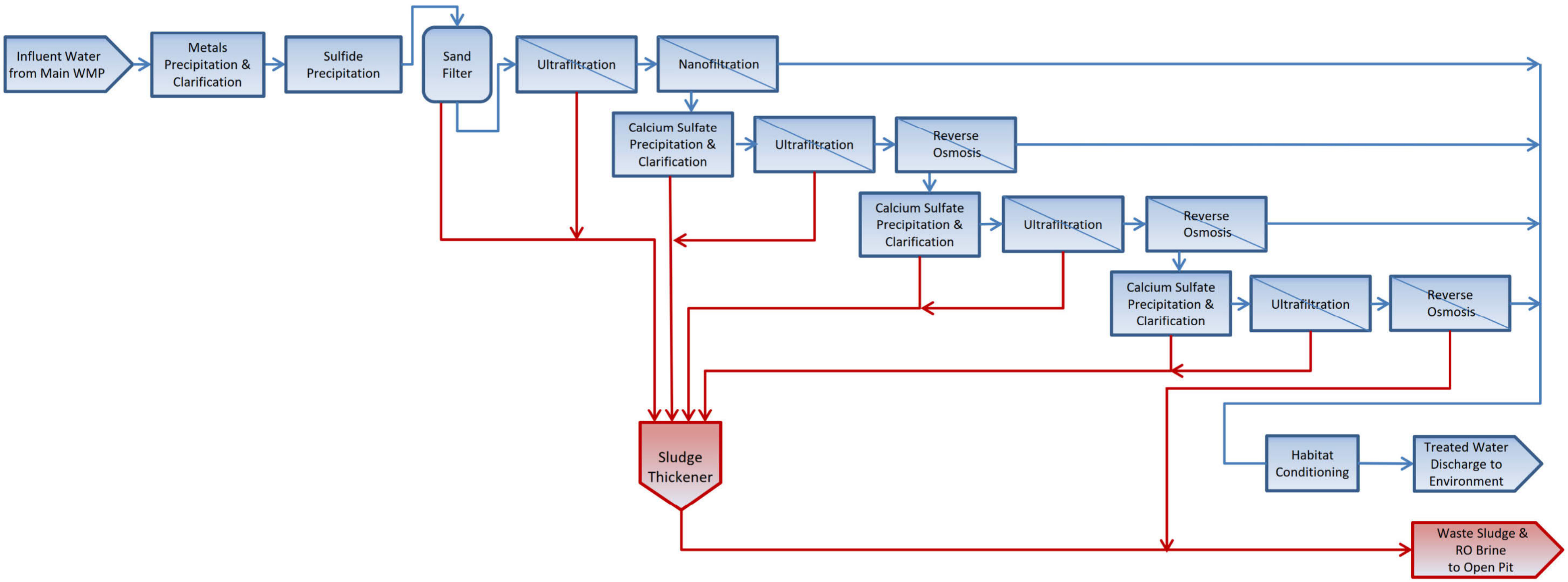
Closure/Post-Closure Water Treatment

WTP #2 would be repurposed for closure phase 1 to treat surplus water from the main WMP. WTP #2 would continue to treat the predicted maximum inflow of 46 cfs with six treatment trains, and a seventh train to allow for maintenance rotation (HDR 2019g).

WTP #3 would be newly constructed for closure phase 1 to treat water from the open pit, and would be south of the open pit adjacent to the site of operations phase WTP #1. Once WTP #3 is operational at the beginning of closure phase 1, WTP #1 would be decommissioned. Predicted maximum inflow to WTP #3 during closure phase 1 is 25 cfs, with three treatment trains and a fourth train to allow for maintenance rotation (HDR 2019g).

Water quality would be closely monitored, and changes and adjustments to the treatment process would be made as needed. Conceptual WTPs would be designed with adequate flexibility in the processes to address the contingency of influent water with lower water quality than predicted.

During closure phase 2 (approximately 5 years), WTP #3 would be maintained in standby, status but not operated, to allow the water level in the pit to rise. In closure phase 3 and post-closure, WTP #3 would treat two influent streams separately: surplus water from the bulk TSF main SCP and surplus water from the open pit. The WTPs would be constructed with instrumentation to monitor parameters of the influent and effluent water, and the effluent would be sampled and analyzed at regular intervals. The WTP operators would evaluate these data, and adjustments would be made to ensure that water discharge criteria stipulated in state permits are being met. Specific details on compliance monitoring and a detailed monitoring plan would be developed during the state permitting process. The State of Alaska oversees reclamation and closure, including provisions for periodic replacement of water treatment facilities, and ongoing operating and monitoring costs over the long-term, post-closure period. Figure 2-13 through Figure 2-16 show simplified schematics of the treatment process during the closure and post closure phases.



Sources: PLP 2020-RFI 166

Notes
1) Arrows show water flow through treatment process.
2) Diagonal line indicates membrane process step, with segregation of outflow.
3) Blue cells indicate treated water stream; red cells indicate reject/waste stream.
4) Habitat Conditioning means adjustment of parmeters such as temperature and dissolved oxygen if required.

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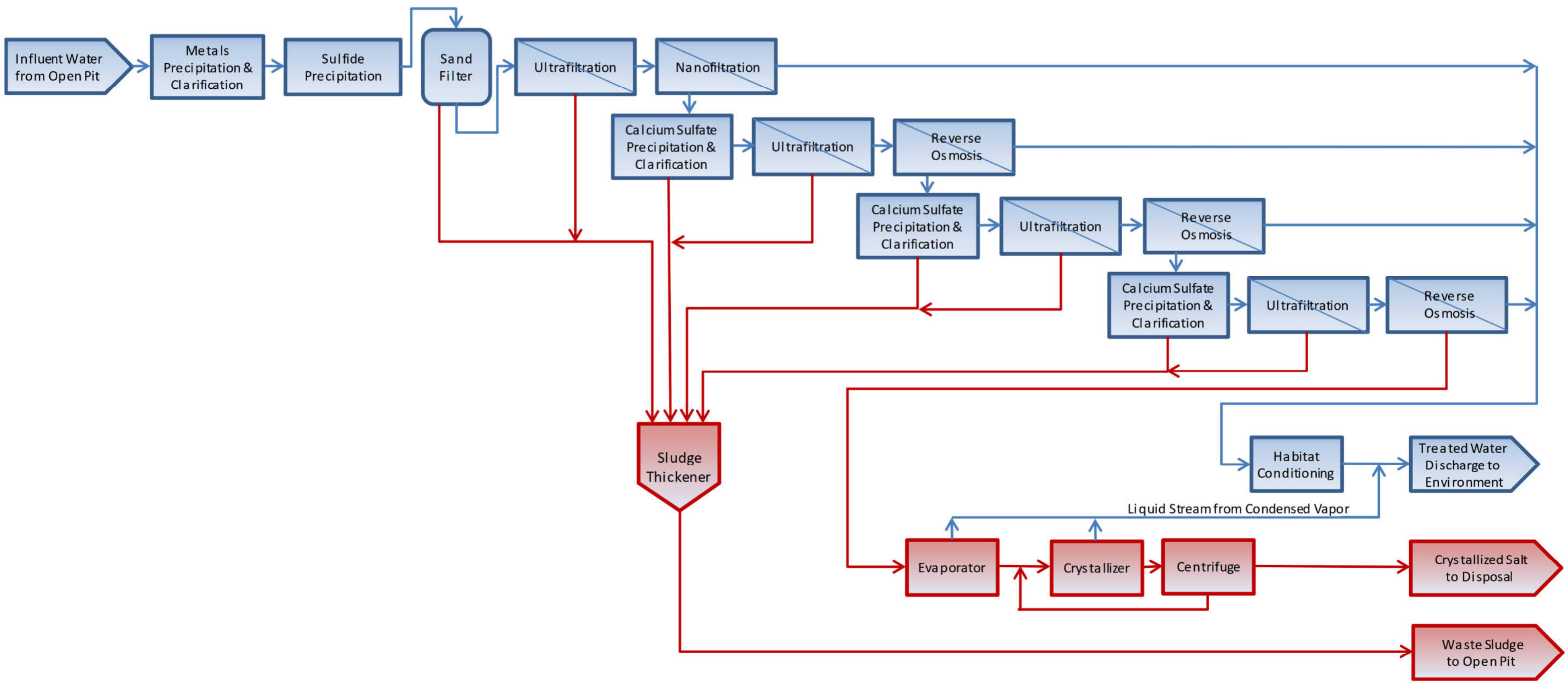
WATER TREATMENT PLANT #2 PROCESS SCHEMATIC - CLOSURE PHASE 1



Sources: PLP 2019d

Notes
1) Arrows show water flow through treatment process.
2) Diagonal line indicates membrane process step, with segregation of outflow.
3) Blue cells indicate treated water stream; red cells indicate reject/waste stream.
4) Habitat Conditioning means adjustment of parmeters such as temperature and dissolved oxygen if required.

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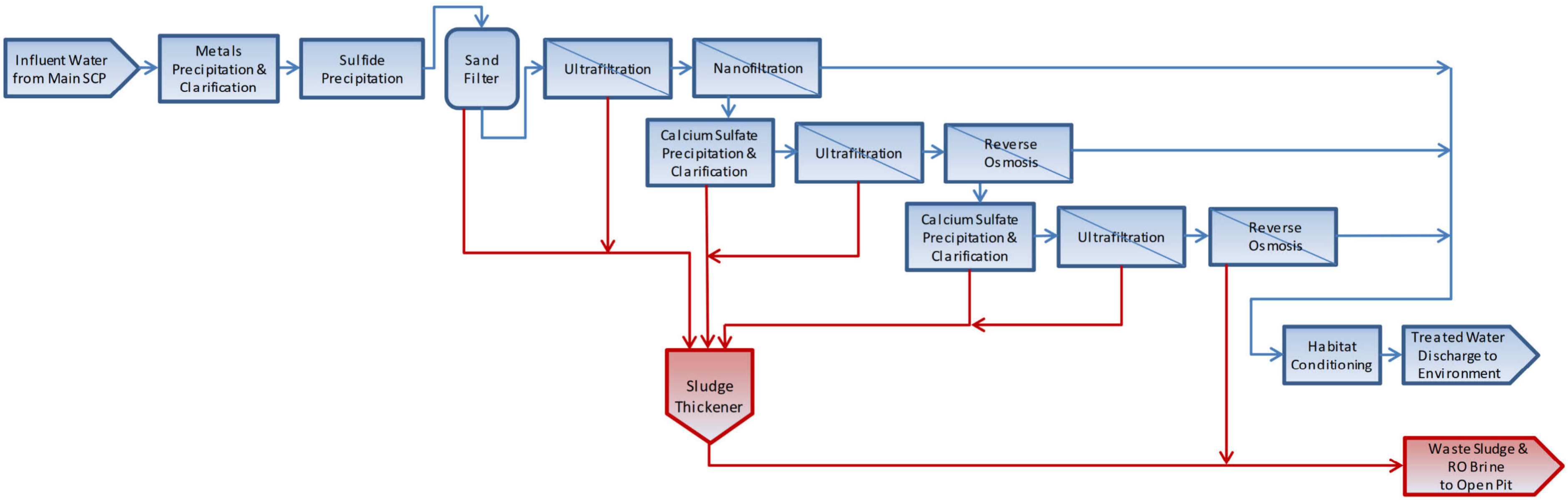
WATER TREATMENT PLANT #3 PROCESS SCHEMATIC - CLOSURE PHASE 1



Sources: PLP 2019d

Notes
1) Arrows show water flow through treatment process.
2) Diagonal line indicates membrane process step, with segregation of outflow.
3) Blue cells indicate treated water stream; red cells indicate reject/waste stream.
4) Habitat Conditioning means adjustment of parmeters such as temperature and dissolved oxygen if required.

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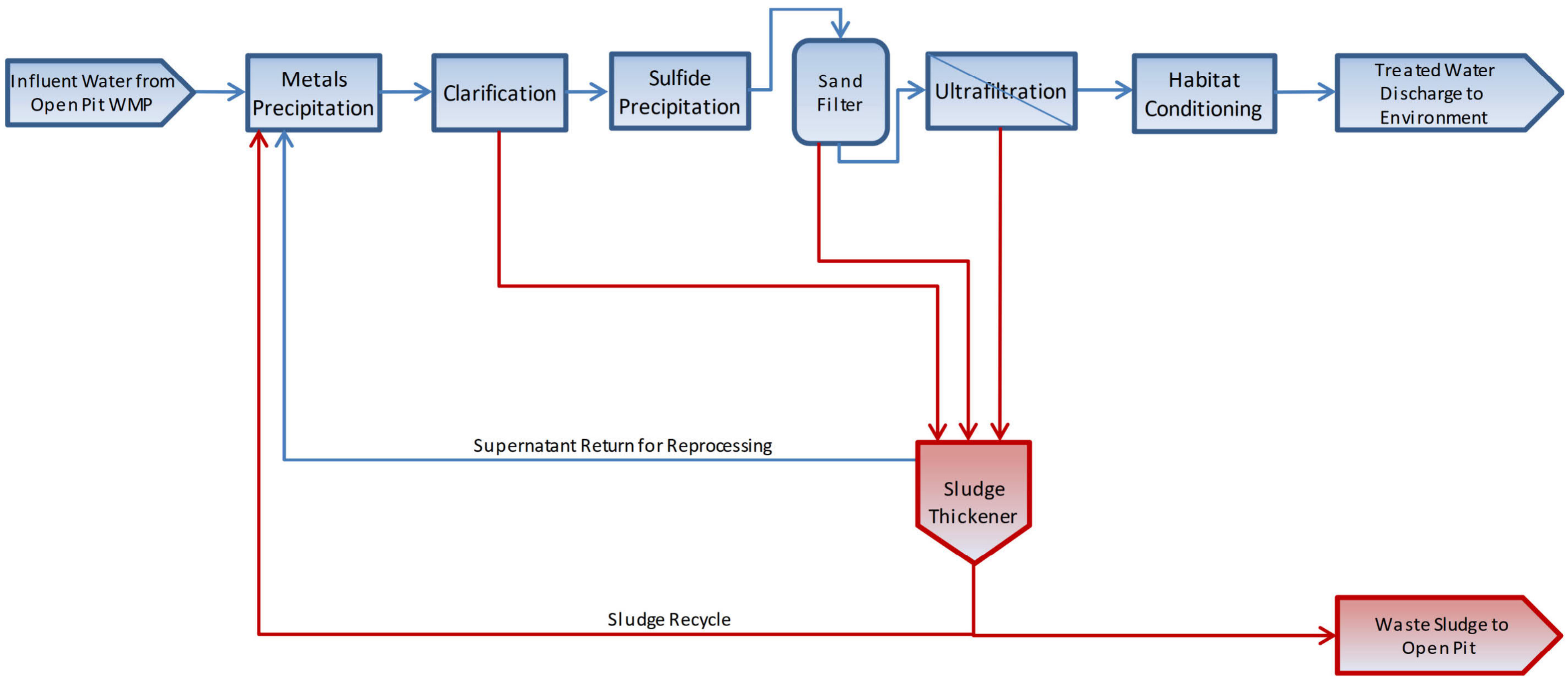
WATER TREATMENT PLANT #3 PROCESS SCHEMATIC - CLOSURE PHASES 3 AND 4 (MAIN SCP STREAM)



Sources: PLP 2019d

Notes
1) Arrows show water flow through treatment process.
2) Diagonal line indicates membrane process step, with segregation of outflow.
3) Blue cells indicate treated water stream; red cells indicate reject/waste stream.
4) Habitat Conditioning means adjustment of parmeters such as temperature and dissolved oxygen if required.

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WATER TREATMENT PLANT #3 PROCESS SCHEMATIC - CLOSURE PHASES 3 AND 4 (OPEN PIT STREAM)

Waste Management and Disposal

A landfill and incinerator would be constructed and operated at the mine site for domestic waste handling (Figure 2-4). Domestic refuse would be disposed of in the on-site landfill, or shipped off site to appropriate disposal sites. Wastes suitable for burning, including putrescible wastes, would be incinerated on site.

Used tires and rubber products would be reused to the extent practicable. Additional used tires, along with other damaged parts and worn pipes, would be packaged for shipment and disposal off site. Wood pallets and packaging would be incinerated with domestic waste. Scrap steel would be shipped off site to appropriate disposal sites.

Waste oils not suitable for burning, including lubricants, would be collected into drums; sealed; and stored in containers for shipment to be recycled or disposed of off site at an approved facility. Miscellaneous hazardous wastes that may accumulate on site, such as paint, used solvents, and empty reagent containers with residual chemicals, would be managed and shipped off site to approved facilities according to applicable BMPs and regulations.

Separate sewage treatment plants would be at the camp and the process plant. Plans for each plant would be reviewed and approved by the Alaska Department of Environmental Conservation (ADEC) prior to construction. The camp sewage treatment plant would be designed to remove biological oxygen demand, total suspended solids, total phosphate, total nitrogen, and ammonia to meet ADEC domestic waste-discharge criteria. The process plant sewage treatment plant would receive effluent that may have metallic residues from the workers' change house and associated laundry, and therefore would also be designed for metals removal. Sludge from both plants would be stabilized and disposed of in the proposed on-site landfill.

The disposal plan for closure would be developed in accordance with state regulations. At closure, inert mine site materials, such as geomembrane material, piping, and pumps, would be drained and cleaned, as appropriate, and either 1) placed into the open pit with the PAG waste rock (described above); or 2) disposed of in an on-site monofill that would be sited in the disturbed footprint of the mine site. Material that has residual value or is not suitable for on-site disposal would be hauled off site for disposal (PLP 2018-RFI 055a).

Reclamation and Closure

Reclamation and closure of the project would fall under the jurisdiction of ADNR, Division of Mining, Land, and Water; and ADEC. The Alaska Reclamation Act (Alaska Statute 27.19) is administered by ADNR; it applies to state, federal, municipal, and private land and water subject to mining operations. PLP has prepared a Reclamation and Closure Plan (SRK 2019d; PLP 2019-RFI 115) providing guidelines for implementing stabilization and reclamation procedures for the various facilities associated with the project, included as Appendix M4.0. Revisions to the plan may be necessary to address changes during preliminary and detailed design work and state permitting.

At the end of operations, mine facilities would be closed and reclaimed. Project closure has been broken down into three closure phases, Phases 1 through 3, and one post-closure phase (Phase 4). Physical reclamation is scheduled for a period of 20 years.

Closure would include the following major actions:

- All production-related facilities would be decommissioned.
- Waste rock and tailings material would be removed from the pyritic TSF and placed in the pit; the facility would be reclaimed by removing the liner, breaching and regrading the embankments, and covering the disturbed area with growth medium.
- The bulk TSF would be covered with a low-permeability cover and would be capped with a layer of non-potentially acid-generating waste rock sourced from the embankments of pyritic TSF and a layer of growth medium.

- The water management pond would be reclaimed by removing the liner, breaching and regrading the embankment, and covering the disturbed area with growth medium.
- The quarries would be reclaimed by sloping, covering with growth medium, and revegetating the disturbed area.

Post-closure activities would include:

- Operation of water treatment plant(s).
- Care and maintenance of water treatment plant(s).
- Care and maintenance of water management facilities.
- Monitoring of revegetation, surface water and groundwater.

The estimated schedule for reclamation of the project is shown in Table 4.1 of PLP's Reclamation and Closure Plan (SRK 2019d; PLP 2019-RFI 115) and summarized below:

<u>Phase 1 Closure Activities (Closure Years 0 to 15)</u>:

- WTP #3 would be newly constructed. Once WTP #3 is operational at the beginning of closure phase 1, WTP #1 would be decommissioned (HDR 2019g).
- Reclaim quarries B and C.
- Remove and reclaim the sediment pond north of Quarry B.
- Start transfer of PAG waste rock and pyritic tailings to the open pit.
- Pump surplus water from the bulk TSF to the main WMP throughout Phase 1.
- Begin reclamation of the bulk TSF in approximately Year 10 with regrading and capping of the surface.[12] The closure cover would contain a low-permeability layer constructed of either compacted overburden or a synthetic liner, the selection of which would be based on a trade-off study in final design (PLP 2019-RFI 130).
- Pump water from the bulk TSF south and east seepage collection and recycle ponds to the bulk TSF main SCP.
- Pump water in the bulk TSF main SCP to the main WMP.
- Pump surface runoff from the pyritic TSF embankment and water collected in the seepage collection ponds to the main WMP.
- Treat surplus water from the main WMP at WTP #2 and release to the downstream environment once it meets discharge criteria.
- Pump surplus water from the open pit at WTP #3 to maintain a place to actively dump PAG waste rock in dry conditions.
- Release treated water from WTP #3 to the downstream environment once it meets discharge criteria.
- Decommission and reclaim the Open Pit Water Management Pond and allow surface runoff to flow to the downstream environment.
- Reclaim those mining facilities not needed for future care and maintenance activities, including the mill site, laydowns, and haul roads. The on-site monofill would be closed and reclaimed at the end of physical closure once all the facilities have been reclaimed.

[12] Reclamation of the bulk TSF by covering and grading its surface so that all drainage would be directed off the TSF, and then capping to prevent water from ponding on the TSF surface is known as a dry closure. Dry closure is a method of storing mine tailings (after mining is complete) in which tailings are not covered with ponded water, as in a traditional pond or lagoon.

<u>Phase 2 Closure Activities (Closure Year 16 until the pit is full (approximately Year 20)</u>:

- Decommission WTP #2 once it is no longer required.
- Decommission the open-pit clean-water diversion channel and allow surface water to drain naturally into the pit.
- Complete backhauling of tailings and PAG waste rock from the pyritic TSF to the open pit; reclaim the TSF by removing the liner, removing or remediating impacted soils, and covering the disturbed area with growth medium, and implementing the revegetation program.
- Reclaim the pyritic TSF seepage collection ponds by covering the disturbed area with growth medium and implementing the revegetation program.
- Send surface water runoff from the pyritic TSF and seepage ponds to the downstream environment without further treatment (once runoff from the reclaimed area meets discharge criteria).
- Reclaim the main WMP by removing the liner, removing or remediating impacted soils, and covering the disturbed area with growth medium, and revegetating. Send surface water runoff to the downstream environment without further treatment (once runoff meets discharge criteria).
- Pump surplus water from the bulk TSF supernatant pond to the open pit.
- Pump water from the bulk TSF south and east seepage collection and recycle ponds to the bulk TSF main SCP.
- Pump water from bulk TSF main SCP to the open pit.
- Decommission and reclaim WTP #2 once it has been demonstrated that surface water runoff from the reclaimed pyritic TSF and main WMP surfaces meet discharge criteria.
- Allow the open pit to fill to the Maximum Management Level (MM Level) of 890 feet above mean sea level.
- Monitor revegetation and release areas that meet regulatory standards.
- Monitoring surface and groundwater as required.

<u>Phase 3 Closure Activities (Closure Years 20 to 50)</u>:

- Continue to pump surplus water from the bulk TSF to the open pit.
- Pump water from the bulk TSF south and east seepage collection and recycle ponds to the bulk TSF main SCP.
- Pump water from the bulk TSF main SCP to the open pit.
- Maintain water levels in the open pit below the MM Level by treating surplus water from the open pit at WTP #3.
- Release treated water from WTP #3 to the downstream environment once it meets discharge criteria.
- Monitor revegetation and release areas that meet regulatory standards.
- Monitoring surface and groundwater as required.

Phase 4 Post-Closure Activities (Closure Year 50 and beyond[13]):

- Direct discharge of surface water runoff from the reclaimed bulk TSF to the NFK catchment once monitoring shows it meets discharge criteria.

[13] The long-term post-closure phase is expected to last for centuries.

- Maintain the water level in the open pit below the MM Level by treating surplus water from the open pit at WTP #3.
- Pump water from the bulk TSF south and east seepage collection and recycle ponds to the bulk TSF main SCP.
- Pump water from the bulk TSF main SCP to WTP #3.
- Decommission and reclaim all remaining freshwater diversions, except for the bulk TSF main SCP diversion and the bulk TSF south seepage collection and recycle pond.
- Release treated water from WTP #3 to the downstream environment once discharge criteria have been met.

Financial Assurance

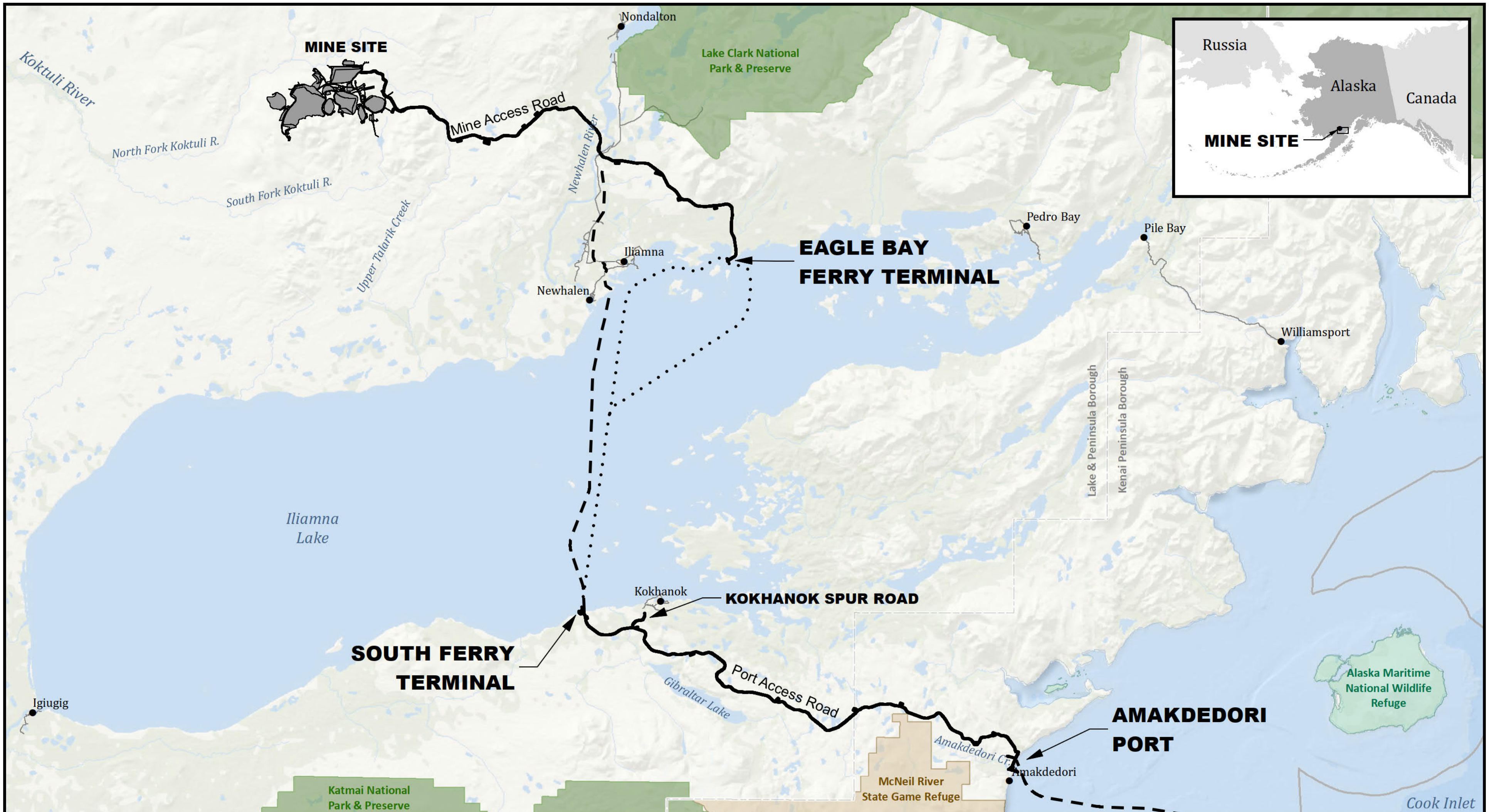
Prior to commencing construction, the project Reclamation and Closure Plan approval and associated financial assurance mechanisms would need to be in place. The ADNR would work with PLP at the appropriate time to ensure PLP submits a complete Reclamation and Closure Plan, including cost estimates, sufficient for review under applicable state statutes and regulations (SOA 2019). The State of Alaska requires Reclamation and Closure Plan and financial assurance obligations be updated on a 5-year cycle, to address any changes in closure and post-closure requirements and cost obligations.

The State of Alaska requires applicants to prepare detailed reclamation and closure cost models to address all costs for both the physical closure of the project, and the funding of long-term post-closure monitoring, water treatment, and site maintenance. Bonding estimates are prepared in compliance with state requirements using vendor-provided equipment handbook, productivity and operating cost information, current quoted equipment rental rates, State of Alaska-determined labor rates, and industry standard methodology and software. PLP’s Reclamation and Closure Plan (SRK 2019d; PLP 2019-RFI 115) states that the bonding estimate would include the costs of closure planning and design, and mobilization of third-party equipment to the 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.

2.2.4.2 Transportation Corridor

The transportation corridor, which would connect the mine site to Amakdedori port on Cook Inlet, has three main components (Figure 2-17):

- Mine access road (353 acres): A private, unpaved, two-lane road extending approximately 35 miles southeast from the mine site to a ferry terminal at Eagle Bay on the northern shore of Iliamna Lake with a connection to the existing Iliamna/ Newhalen road system (Figure 2-18).
- Ferry crossing: An ice-breaking ferry to transport materials, equipment, and concentrate 28 miles across Iliamna Lake to a ferry terminal on the southern shore near the village of Kokhanok. Two vessel approaches are proposed for the north shore ferry terminal, and the design allows use of either approach depending on ice or wind conditions (PLP 2019-RFI 121).
- Port access road (411 acres): A private, unpaved, two-lane road extending approximately 37 miles southeast from the south ferry terminal to Amakdedori port on Cook Inlet (Figure 2-19).



Sources: PLP 2019-RFI153; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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N

5 0 5 10
Miles

Alternative 1a
- Ferry Route
- Natural Gas Pipelines
- Transportation Corridor
- Mine Site

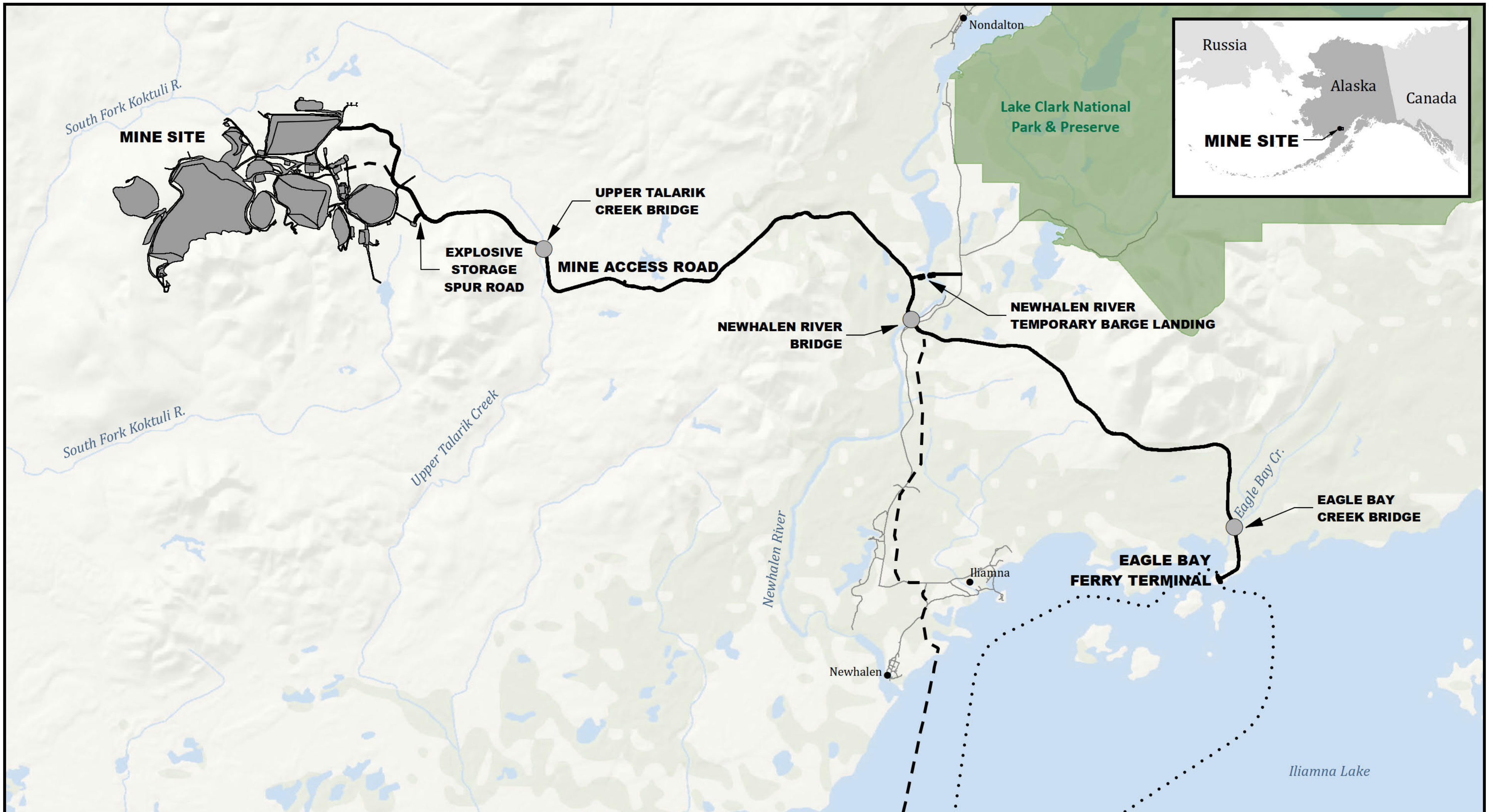
Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line

- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1A - TRANSPORTATION FACILITIES OVERVIEW

PEBBLE PROJECT EIS

FIGURE 2-17



Sources: PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

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2 0 2 4

Miles

Alternative 1a

- Bridge
- Ferry Route
- Natural Gas Pipelines
- Transportation Corridor
- Mine Site

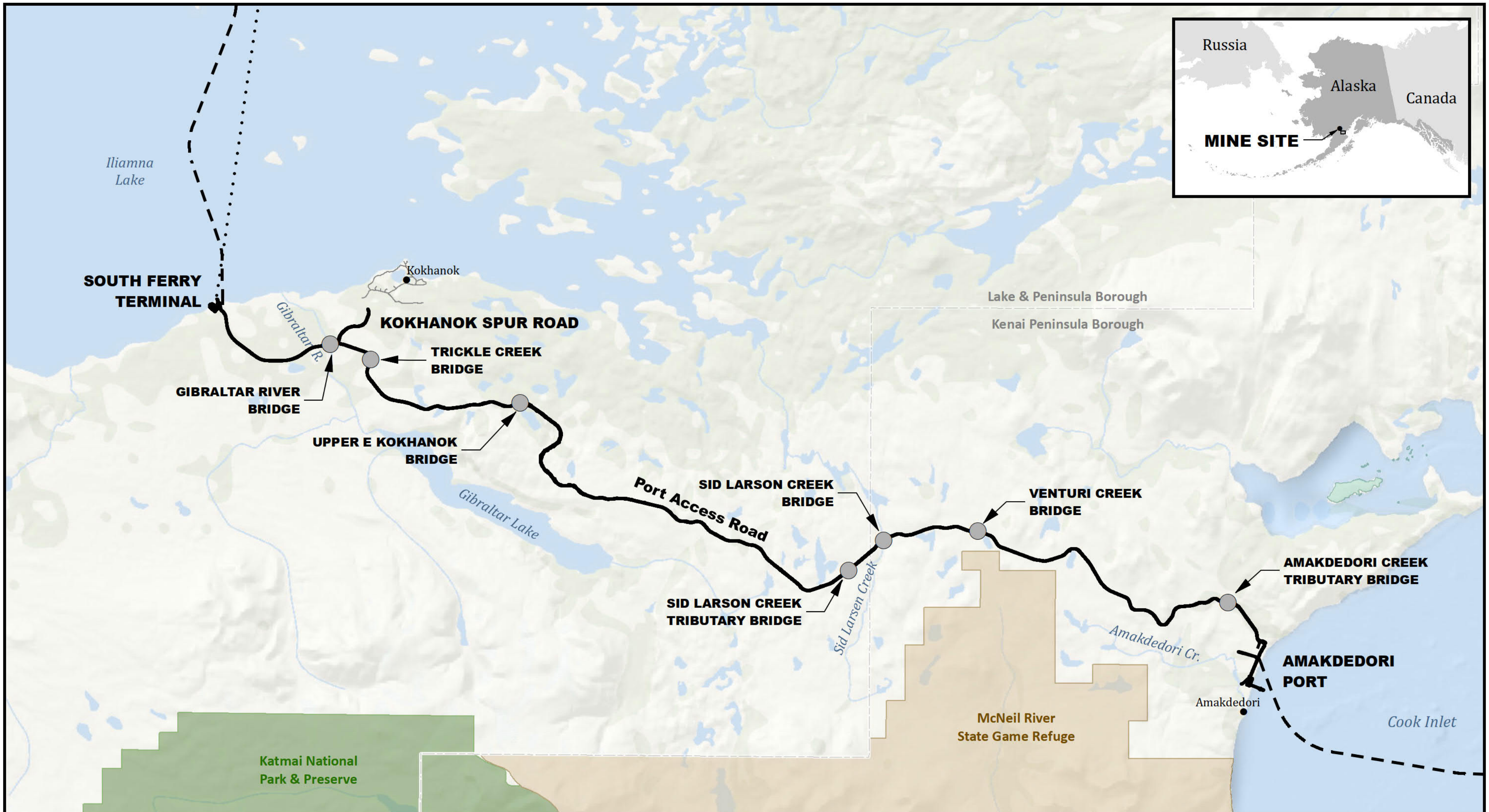
Other Features

- Local Roads
- National Park

ALTERNATIVE 1A - MINE ACCESS ROAD

PEBBLE PROJECT EIS

FIGURE 2-18



Sources: PLP 2019-RFI153; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

2 0 2 4
Miles

Alternative 1a
- Bridge
- Ferry Route
- Natural Gas Pipelines
- Transportation Corridor

Other Features
- Local Roads
- Borough Boundary
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1A - PORT ACCESS ROAD AND KOKHANOK SPUR ROAD

PEBBLE PROJECT EIS

FIGURE 2-19

Separate short spur roads (approximately 1 mile or less in length) would connect with the main access road of the transportation corridor. Spur roads under Alternative 1a include:

- Kokhanok spur road (15 acres): An unpaved spur road from the port access road to the community of Kokhanok (Figure 2-19).
- Explosives storage spur road (4 acres): An unpaved spur road from the mine access road to a storage pad near the mine site (Figure 2-18).

Figure 2-20 shows the typical access road cross sections. Apart from a small network of local roads near these communities, the transportation corridor area is undeveloped.

Road System

The main mine and port access roads would be designed as private gravel roads with a 30-foot-wide driving surface to enable two-way traffic, and capable of supporting anticipated development and operational activities during construction and truck haulage of concentrate from the mine to the port. The maximum width of the permanent road from toe-to-toe would be 300 feet. Temporary construction-related activities would occur within a 30-foot zone on either side of the permanent road footprint (PLP 2018-RFI 082 and PLP 2020-RFI 056a). PLP has prepared a restoration plan outlining short-term and long-term restoration objectives for restoring temporarily impacted areas to a condition that resembles the pre-construction condition or that of adjacent lands undisturbed by the project (Owl Ridge 2019a; PLP 2019-RFI 123) (see Appendix M3.0). Where technically feasible, coarse granular road base construction materials and additional culverts would be used to facilitate the flow of water through segmented wetlands (PLP 2019-RFI 071b). A summary of permanent and temporary construction footprints can be found in Appendix K2.

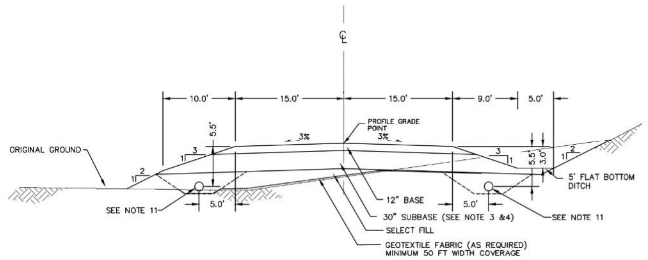
The road system would include 10 bridges (PLP 2020g), eight of which would be single-span, two-lane bridges that range in length from approximately 60 to 90 feet. There would be one large (510 feet) multi-span, two-lane bridge across the Newhalen River, which would have a minimum of 32 feet of vertical clearance in the navigation channel, with 96 feet between each piling. There would be one large (300 feet) multi-span, two-lane bridge across the Gibraltar River that would have a minimum of 43 feet of vertical clearance in the navigation channel, with 100 feet between each piling. The Newhalen River crossing is proposed at a southern crossing location instead of the north crossing evaluated in the DEIS.

Road culverts at stream crossings would be divided into categories based on whether the streams are fish-bearing. Culverts at streams without fish would have a typical diameter of 3 to 4 feet, because they would be designed and sized for drainage only. Culverts at streams with fish would be designed to meet the US Fish and Wildlife Service's culvert design guidelines for ecological function (USFWS 2020). Preliminary design of culverts varies in size from an 8-foot-diameter corrugated metal pipe to an 8-foot-tall by 14-foot-wide pipe arch. Inlet/outlet protection may be installed at some streams, as necessary, to protect the soil surface from erosive forces; which would expand beyond the toe of the fill.

Figure 2-21, Figure 2-22, and Figure 2-23 depict typical waterbody crossing structures. Plan, profile, and typical section drawings for each bridge crossing as well as the various categories of culverts can be found in the Pebble Project Department of the Army Application for Permit POA-2017-271 (PLP 2019h).

Blasting to remove rock material would be necessary at locations along the transportation corridor to prepare the road bed and pipeline trench (PLP 2018-RFI 084).

ROAD TYPICAL SECTION FOR GLACIAL FLUVIAL & MORAINE SOILS
(TYPICAL SECTION 1)

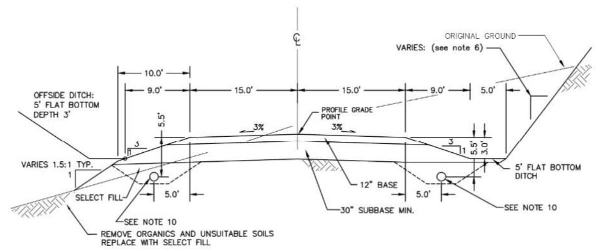


NOTES:

1. CLEARING LIMITS MIN. TO TOP OF CUT OR TOE OF FILL.
2. BASE TO CONSIST OF 2 in MINUS, DURABLE, WELL GRADED, CRUSHED ROCK WITH 6 TO 10% PASSING THE 200 SIEVE. 12" MIN DEPTH.
3. SUBBASE TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL. NON-FROST-SUSCEPTIBLE. 30" MIN DEPTH
4. SELECT FILL MATERIAL: TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL, AS APPROVED BY ENGINEER.
5. DEPTH OF FILL WILL VARY DEPENDING ON SOIL TYPE AND CONDITION. 3.5 ft TOTAL EMBANKMENT DEPTH WILL TYPICALLY BE THE MINIMUM. 6 FT EMBANKMENT DEPTH WILL BE TYPICAL IN WETLAND AREAS
6. BACKSLOPES WILL VARY DEPENDENT UPON SOIL OR ROCK TYPE AND CHARACTER
   TYPICAL: 2:1 FOR GLACIAL MORAINE SOILS
   1.5:1 FOR COARSE ROCK SIDE SLOPES
   0.25:1 TO 1:1 FOR ROCK
7. FORESLOPE TO EXTEND AT 3:1 FOR MIN. 10 FT BEYOND SHOULDER, THEN BREAK TO SLOPE THAT WILL VARY DEPENDING ON SOIL TYPE AND EXTENT OF FILL. IF GUARDRAIL IS INSTALLED, FORESLOPE TO BE REDUCED TO MIN. 2:1 FROM SHOULDER.
8. ACCOMMODATE EXCESS EXCAVATION AND WASTE DISPOSAL BY FLATTENING AND/OR EXTENDING INSLOPE
9. INSTALL GUARDRAIL WHERE WARRANTED
10. SURFACE ORGANIC MATERIAL AND UNSUITABLE SOILS TYPICALLY REMOVED UNLESS SPECIFIED OTHERWISE BY ENGINEER
11. NATURAL GAS PIPELINE TO BE INSTALLED EITHER RIGHT OF LEFT CENTERLINE DEPENDING ON PIPELINE FINAL DESIGN. LOCATION TO BE 20 FT FROM CENTERLINE OF ROAD OR MIN. 5 FT BEYOND ROAD SHOULDER. MINIMUM COVER TO BE 3 FT. REFER TO TRENCH DETAILS.
12. HIGHLY PERMEABLE COARSE ROCK TO BE SPECIFIED BY ENGINEER IN AREAS REQUIRING A "FLOW-THROUGH" EMBANKMENT.

WEST KOKHANOK TO AMAKDEDORI Sta. A-0+00 to A-477+00 & Sta. A-1882+00 to A-1932+96 (EOP)
MINE TO EAGLE BAY ALTERNATE Sta. EA-0+00 to 1849+11 (EOP)
EXPLOSIVES STORAGE ROAD Sta. T-0+00 to T-19+03 (EOP)
KOKHANOK AIRPORT SPUR ROAD Sta. K-0+00 to K-73+75 (EOP)

ROAD TYPICAL SECTION FOR MODERATE TERRAIN WITH ROCK CUTS
(TYPICAL SECTION 2)

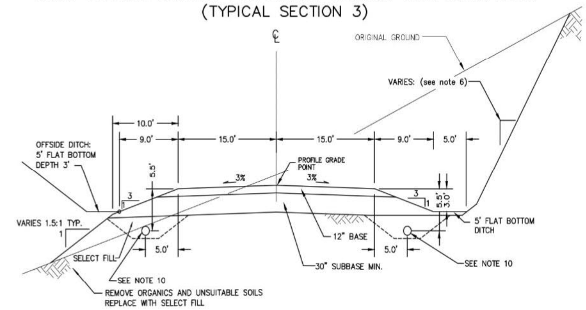


NOTES:

1. CLEARING LIMITS MIN. TO TOP OF CUT OR TOE OF FILL.
2. BASE TO CONSIST OF 2 in MINUS, DURABLE, WELL GRADED, CRUSHED ROCK WITH 6 TO 10% PASSING THE 200 SIEVE. MATERIAL TO BE DURABLE. 12" MIN DEPTH.
3. SUBBASE TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL. NON-FROST-SUSCEPTIBLE. 30" MIN DEPTH
4. SELECT FILL MATERIAL: TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL, AS APPROVED BY ENGINEER.
5. DEPTH OF FILL WILL VARY DEPENDING ON SOIL TYPE AND CONDITION. 3.5 ft TOTAL EMBANKMENT DEPTH WILL TYPICALLY BE THE MINIMUM.
6. HIGHLY PERMEABLE COARSE ROCK TO BE SPECIFIED BY ENGINEER IN AREAS REQUIRING A "FLOW-THROUGH" EMBANKMENT.
7. BACKSLOPES WILL VARY DEPENDENT UPON SOIL OR ROCK TYPE AND CHARACTER
   TYPICAL: 2:1 FOR GLACIAL MORAINE SOILS
   1.5:1 FOR COARSE ROCK SIDE SLOPES
   1:1 FOR ROCK
8. FORESLOPE TO EXTEND AT 3:1 FOR MIN. 10 FT BEYOND SHOULDER, THEN BREAK TO SLOPE THAT WILL VARY DEPENDING ON SOIL TYPE AND EXTENT OF FILL. IF GUARDRAIL IS INSTALLED, FORESLOPE TO BE REDUCED TO MIN. 2:1 FROM SHOULDER.
9. ACCOMMODATE EXCESS EXCAVATION AND WASTE DISPOSAL BY FLATTENING AND/OR EXTENDING INSLOPE
10. INSTALL GUARDRAIL WHERE WARRANTED
11. NATURAL GAS PIPELINE TO BE INSTALLED EITHER RIGHT OR LEFT OF CENTERLINE DEPENDING ON PIPELINE FINAL DESIGN. LOCATION TO BE 20 FT FROM CENTERLINE OF ROAD OR MIN. 5 FT BEYOND ROAD SHOULDER. MINIMUM COVER TO BE 3 FT. REFER TO TRENCH DETAILS.

WEST KOKHANOK TO AMAKDEDORI Sta. A-1783+00 to A-1882+00

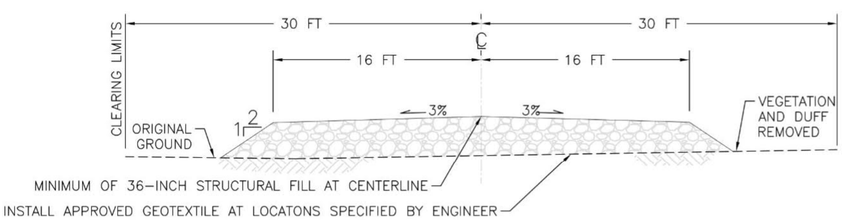
ROAD TYPICAL SECTION FOR ROUGH TERRAIN WITH ROCK CUTS
(TYPICAL SECTION 3)



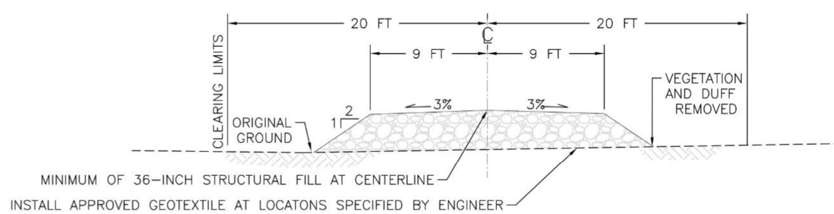
NOTES:

1. CLEARING LIMITS TYPICALLY TO TOP OF CUT OR TOE OF FILL.
2. BASE TO CONSIST OF 2 in MINUS, DURABLE, WELL GRADED, CRUSHED ROCK WITH 6 TO 10% PASSING THE 200 SIEVE. MATERIAL TO BE DURABLE. 12" MIN DEPTH.
3. SUBBASE TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL. NON-FROST-SUSCEPTIBLE. 30" MIN DEPTH.
4. SELECT FILL MATERIAL; TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL, AS APPROVED BY ENGINEER.
5. DEPTH OF FILL WILL VARY DEPENDING ON SOIL TYPE AND CONDITION. 3.5 ft TOTAL EMBANKMENT DEPTH WILL TYPICALLY BE THE MINIMUM.
6. HIGHLY PERMEABLE COARSE ROCK TO BE SPECIFIED BY ENGINEER IN AREAS REQUIRING A "FLOW-THROUGH" EMBANKMENT.
7. BACKSLOPES WILL VARY DEPENDENT UPON SOIL OR ROCK TYPE AND CHARACTER
   TYPICAL: 2:1 FOR GLACIAL MORAINE SOILS
   1.5:1 FOR COARSE ROCK SIDE SLOPES
   0.25:1 TO 1:1 FOR ROCK
8. FORESLOPE TO EXTEND AT 3:1 FOR MIN. 10 FT BEYOND SHOULDER, THEN BREAK TO SLOPE THAT WILL VARY DEPENDING ON SOIL TYPE AND EXTENT OF FILL. IF GUARDRAIL IS INSTALLED, FORESLOPE TO BE REDUCED TO MIN. 2:1 FROM SHOULDER.
9. ACCOMMODATE EXCESS EXCAVATION AND WASTE DISPOSAL BY FLATTENING AND/OR EXTENDING INSLOPE
10. INSTALL GUARDRAIL WHERE WARRANTED
11. NATURAL GAS PIPELINE TO BE INSTALLED EITHER RIGHT OR LEFT OF CENTERLINE DEPENDING ON PIPELINE FINAL DESIGN. LOCATION TO BE 20 FT FROM CENTERLINE OF ROAD OR MIN. 5 FT BEYOND ROAD SHOULDER. MINIMUM COVER TO BE 3 FT. REFER TO TRENCH DETAILS.

WEST KOKHANOK TO AMAKDEDORI Sta. A-477+00 to A-1783+00



ROAD TYPICAL SECTION
MATERIAL SITE ACCESS HAUL ROAD



ROAD TYPICAL SECTION
OVERLAY CONSTRUCTION FOR ACCESS ROAD TO WATER EXTRACTION SITES

Sources: PLP 2019h

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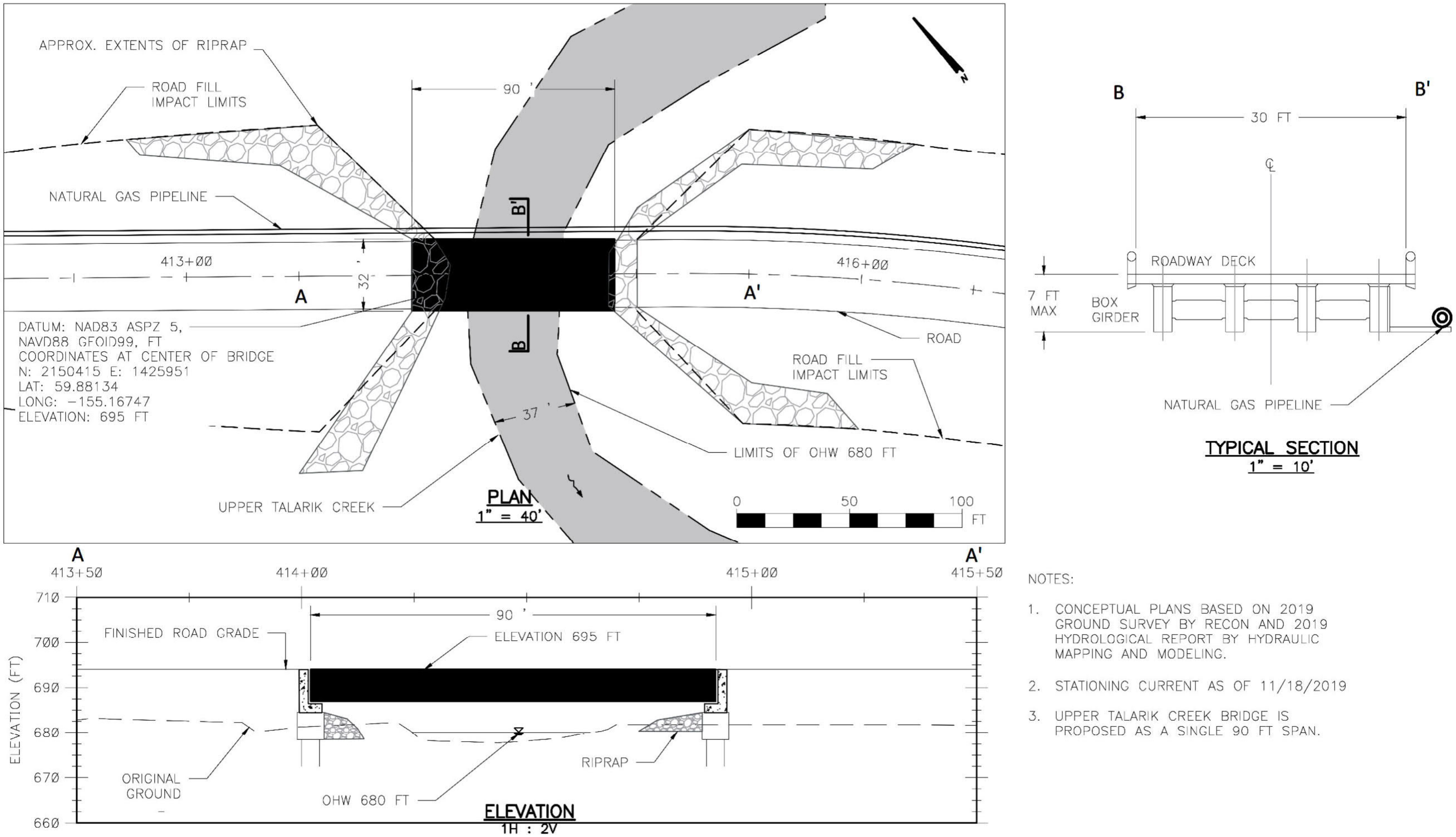
TYPICAL ROAD SECTIONS



NOTES:

1. CONCEPTUAL PLANS BASED ON 2019 GROUND SURVEY BY RECON AND 2019 HYDROLOGICAL REPORT BY HYDRAULIC MAPPING AND MODELING.
2. STATIONING CURRENT AS OF 11/18/2019
3. UPPER TALARIK CREEK BRIDGE IS PROPOSED AS A SINGLE 90 FT SPAN.

Sources: PLP 2019h

Note: The displayed features are the permanent footprint unless otherwise specified.

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TYPICAL BRIDGE CROSSING

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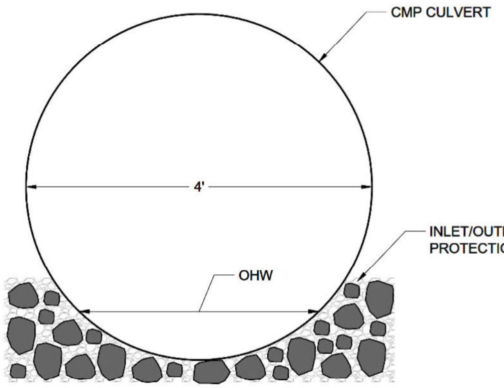
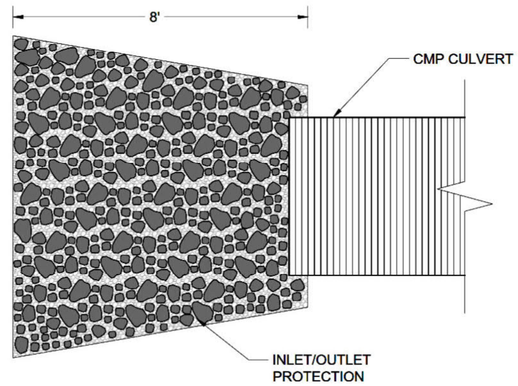
FIGURE 2-21



TYPICAL SECTION
NTS



TYPICAL INLET/OUTLET PROTECTION
NTS

NOTES:

CATEGORY 2 CULVERTS SHALL BE INSTALLED ON MAPPED STREAMS THAT HAVE A STREAM WIDTH OF UP TO 2' AT THE ORDINARY HIGH WATER (OHW) MARK.

CULVERTS SHALL SPAN ENTIRE TOE OF FILL WIDTH PLUS ONE HALF CULVERT DIAMETER BEYOND TOE OF FILL.

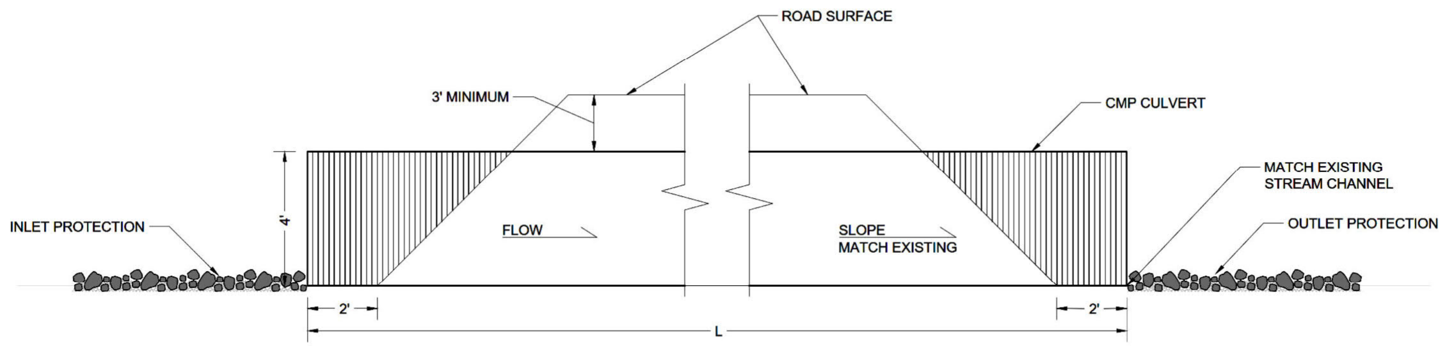
DIAMETER SHALL BE 4'.

STREAM IMPACT AREA EQUALS STREAM WIDTH TIMES CULVERT LENGTH PLUS THE AREA ASSOCIATED WITH INLET/OUTLET PROTECTION.

STREAM BED SLOPE THROUGH CULVERT SHALL MATCH STREAM SLOPE TO MAXIMUM EXTENT PRACTICABLE.

FILL DEPTH WILL BE DETERMINED BASED ON EQUIPMENT LOADING AND CMP DESIGN.

INLET/OUTLET PROTECTION SHALL BE CONSTRUCTED PER ALASKA DOT HIGHWAY DRAINAGE MANUAL.



TYPICAL PROFILE
NTS

Sources: PLP 2019h

Note: The displayed features are the permanent footprint unless otherwise specified.

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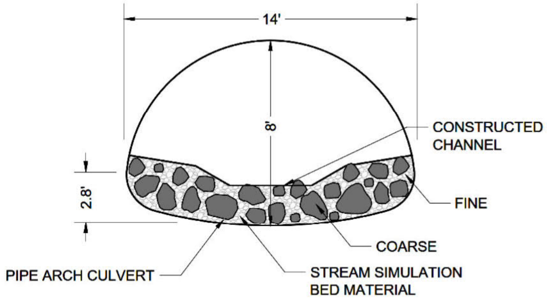
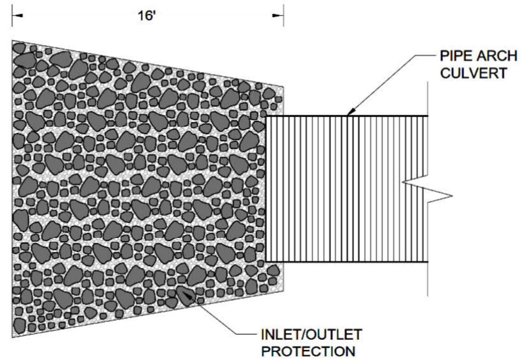
TYPICAL CULVERT CROSSING

FIGURE 2-22



TYPICAL SECTION
NTS



TYPICAL INLET/OUTLET PROTECTION
NTS

NOTES:

CATEGORY 6 CULVERTS SHALL BE INSTALLED IN MAPPED STREAMS WHERE FISH PASSAGE IS REQUIRED AND THAT HAVE A STREAM WIDTH GREATER THAN 6' UP TO 10' AT THE ORDINARY HIGH WATER (OHW) MARK.

CULVERTS SHALL SPAN ENTIRE TOE OF FILL WIDTH PLUS ONE HALF CULVERT DIAMETER BEYOND TOE OF FILL.

CULVERT SHALL BE PIPE ARCH THAT IS 8' TALL BY 14' WIDE.

STREAM IMPACT AREA EQUALS STREAM WIDTH TIMES CULVERT LENGTH.

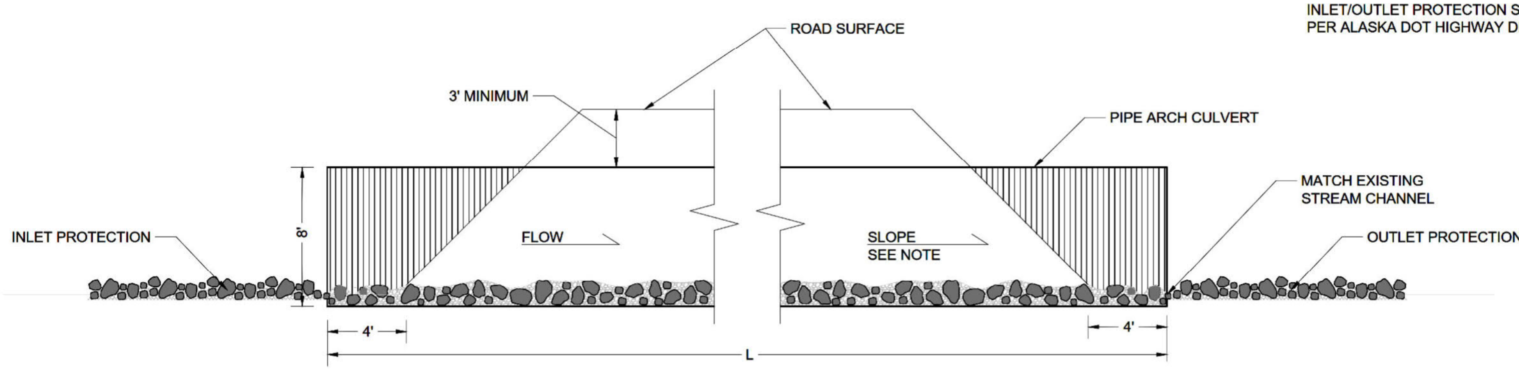
STREAM BED SLOPE THROUGH CULVERT SHALL MATCH CHANNEL BED SLOPE TO MAXIMUM EXTENT PRACTICABLE, BUT NO GREATER THAN CHANNEL BED SLOPE +1%.

FILL DEPTH WILL BE DETERMINED BASED ON EQUIPMENT LOADING AND CMP DESIGN.

CONSTRUCTED CHANNEL INSIDE CULVERT TO HAVE DIMENSIONS SIMILAR TO ADJACENT CHANNEL REACHES.

SUBSTRATE DESIGNED PER MEMORANDUM OF AGREEMENT STREAM SIMULATION DESIGN REQUIREMENTS.

INLET/OUTLET PROTECTION SHALL BE CONSTRUCTED PER ALASKA DOT HIGHWAY DRAINAGE MANUAL.



TYPICAL PROFILE
NTS

Sources: PLP 2019h

Note: The displayed features are the permanent footprint unless otherwise specified.

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TYPICAL FISH PASSAGE CULVERT CROSSING

PEBBLE PROJECT EIS

FIGURE 2-23

Ferry

The location of the mine site is physically separated from the marine terminal location (Amakdedori port) by Iliamna Lake, which is roughly 75 miles long and up to 20 miles across. Existing roads are limited to nearby communities, but do not encircle the lake. Alternative 1a includes use of an all-season ice-breaking ferry to cross the lake, which would reduce the miles of roadbed that would be required for construction of a new road around the lake.

A custom-designed ferry would transit Iliamna Lake, carrying inbound supplies from Amakdedori port to the mine site, and returning with copper-gold and molybdenum concentrates, backhauled waste material, and empty shipping containers. The one-way ferry trip is about 28 miles and would take approximately 2.5 hours to complete in open water, or 4.5 hours in ice conditions. Ferry transit speeds would range from 6 knots (approaching landing) to 11 knots (in open water) (PLP 2018-RFI 013). On average, one round trip per day across the lake would be required. Figure 2-24 presents a digital simulation of the ferry vessel.

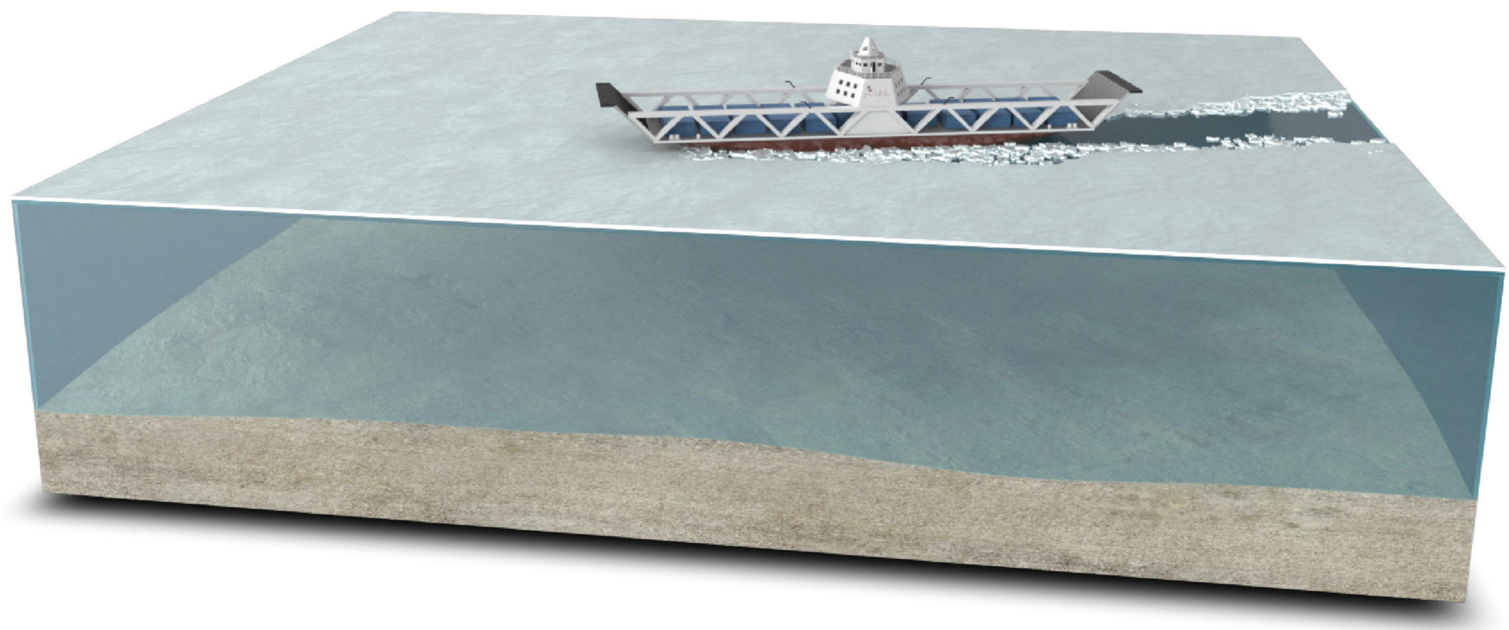
The vessel would be designed to operate year-round, in all ice conditions. Cargo would be carried on the vessel deck. The vessel would be symmetrical forward and aft, with two ice-breaking bows, allowing operation in open water or ice in either direction without the need to turn the vessel around at each terminal. The vessel would be approximately 344 feet in length, with a breadth of approximately 72 feet. The ferry would be diesel electric, with two independent engine rooms to power the four electrically driven propellers.

The hull would be subdivided by watertight bulkheads so that even if one compartment is damaged and flooded, the vessel would remain afloat, upright, stable, and operational; capable to return to shore facilities for repairs. Fuel and other potential contaminants would 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.

Two ferry terminals are proposed: one on the north shore (Eagle Bay ferry terminal [7 acres]); and one on the south shore (south ferry terminal [23 acres]). The ferry terminals would 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 would include a ferry assembly site. The ferry would be assembled from pre-fabricated components barged to Amakdedori port, and then transported across the road. The assembly site would remain intact to enable regular vessel surveys and maintenance as required. Figure 2-25 and Figure 2-26 present digital simulations of the Eagle Bay ferry terminal and the south ferry terminal, respectively. Figure 2-27 and Figure 2-28 show the Eagle Bay ferry terminal layout and cross sections, respectively. Figure 2-29 and Figure 2-30 show the south ferry terminal layout and cross sections, respectively.

The permanent facilities at the ferry terminals would include container handling and storage facilities, office and maintenance buildings, day use facilities, and local power supply. Each ferry terminal facility would have space for a minimum of 2 days of storage of the average concentrate container traffic. Sewage from the day use facilities and waste water from the ferry, including any bilge water, would be collected in holding tanks at the ferry terminals and transported to one of the water treatment plants at the mine site or Amakdedori port (PLP 2019-RFI 087a).

A ferry landing and access ramp would 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. The ramps at each terminal would extend below the ordinary high water (OHW) mark of the lake (a maximum of 115 feet wide by 155 feet long). No permanent infrastructure would be mounted on the ramps. Two mooring buoys with navigational lights would be installed near the



Sources: PLP 2018-RFI 034d.

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DIGITAL SIMULATION OF FERRY VESSEL

PEBBLE PROJECT EIS

FIGURE 2-24

Sources: PLP 2018-RFI 034e.

US Army Corps of Engineers®

DIGITAL SIMULATION OF EAGLE BAY FERRY TERMINAL

PEBBLE PROJECT EIS

FIGURE 2-25

Sources: PLP 2018-RFI 034d.

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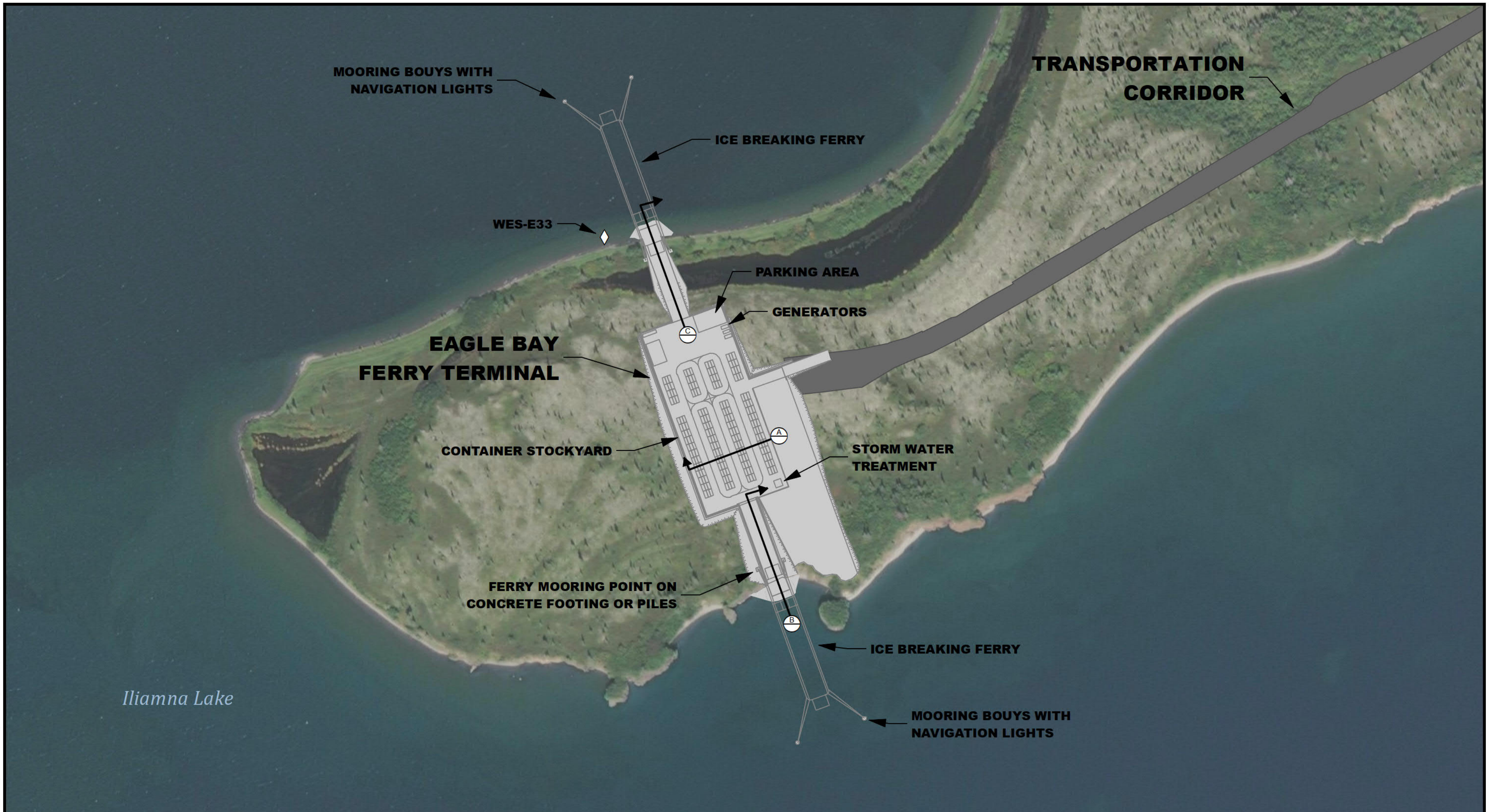
DIGITAL SIMULATION OF SOUTH FERRY TERMINAL

PEBBLE PROJECT EIS

FIGURE 2-26



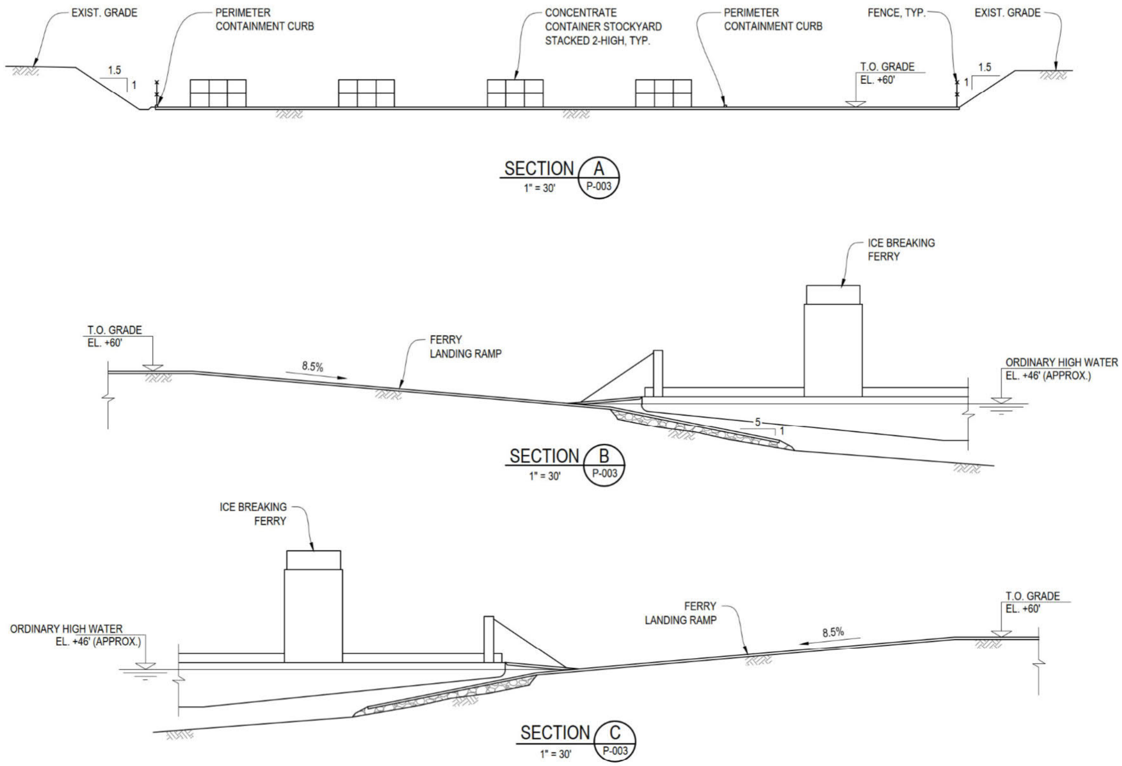
Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

200 0 200 400
Feet

Alternative 1a
- Water Extraction Site
- Eagle Bay Ferry Terminal
- Transportation Corridor

ALTERNATIVE 1A - EAGLE BAY FERRY TERMINAL



NOTES:

1. DIMENSIONS IN FEET.
2. ELEVATIONS ARE IN FEET TO GEODETIC DATUM (GEOID 99).
3. HORIZONTAL DATUM TO UTM NAD83, ALASKA STATE PLANE ZONE 5, US SURVEY FEET.

Sources: PLP 2019h

Note: The displayed features are the permanent footprint unless otherwise specified.

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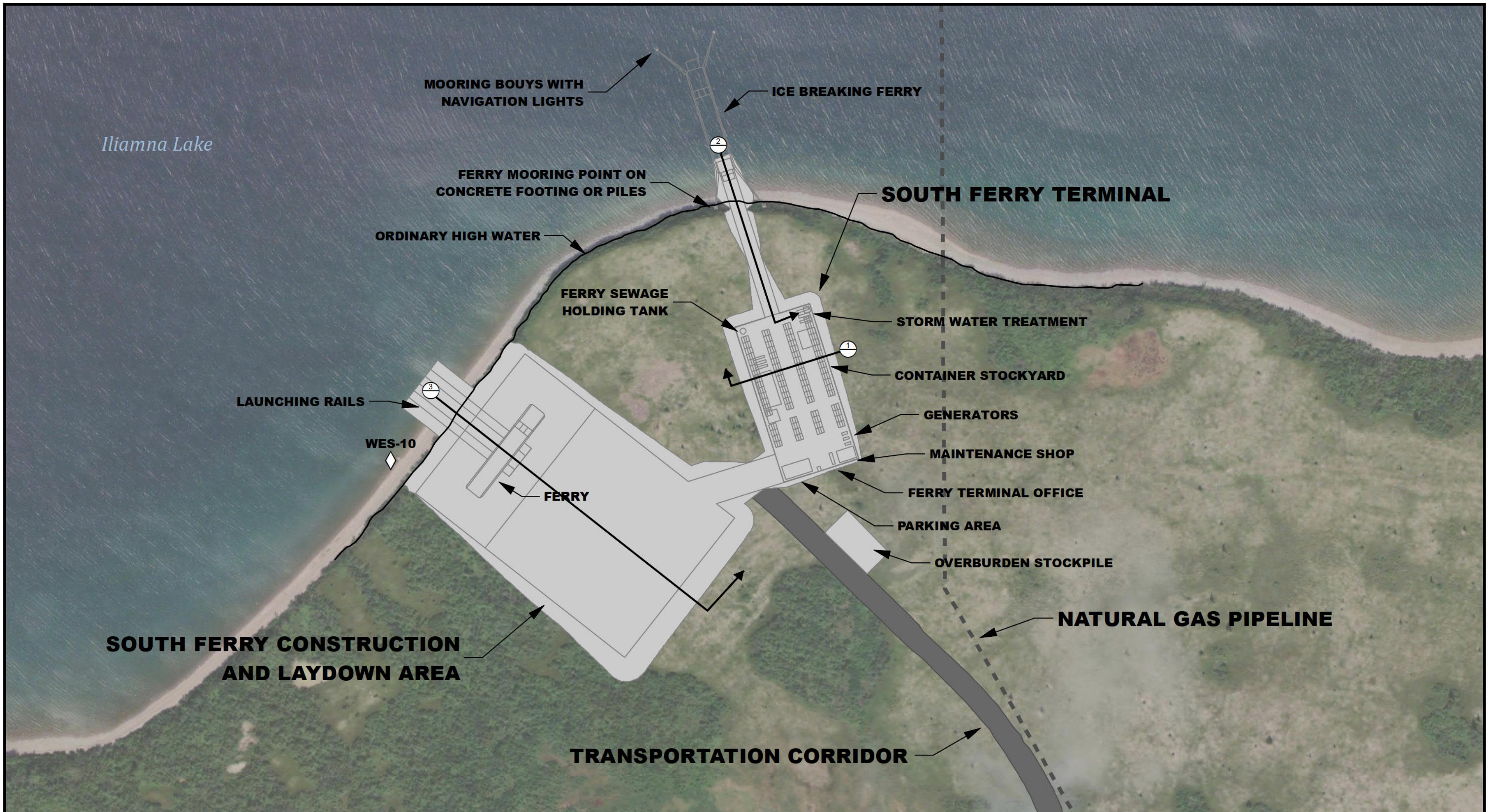
ALTERNATIVE 1A - EAGLE BAY FERRY TERMINAL CROSS SECTIONS



Sources: PLP 2019-RFI153

Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

200 0 200 400

Feet

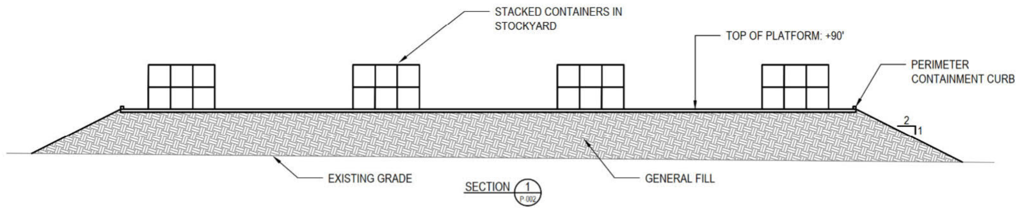
Alternative 1a

- Water Extraction Site
- Natural Gas Pipeline
- South Ferry Terminal
- Transportation Corridor

Other Features

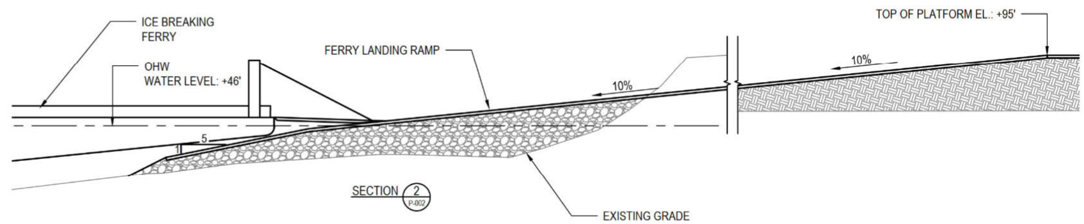
- Ordinary High Water

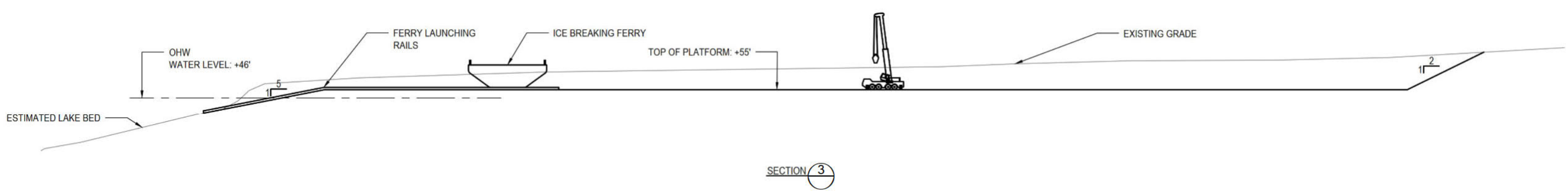
ALTERNATIVE 1A - SOUTH FERRY TERMINAL



NOTES:

1. DIMENSIONS IN FEET
2. ELEVATIONS ARE IN FEET TO GEODETIC DATUM (GEOID 99)
3. HORIZONTAL DATUM TO UTM NAD83, ALASKA STATE PLANE ZONE 5, US SURVEY FEET
4. ORDINARY HIGH WATER (OHW) ELEVATION BASED ON AERIAL PHOTO INTERPRETATION AND USGS TOPO
5. PLATFORM FOR FERRY TERMINAL TO BE CONSTRUCTED WITH ONSITE FERRY CONSTRUCTION





Sources: PLP 2019h

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ALTERNATIVE 1A - SOUTH FERRY TERMINAL CROSS SECTIONS landing approach at each ferry terminal. The buoys would be attached to the lake bed using two anchors; the anchors would be 2-foot-diameter screw anchors, or drilled anchors, dependent on lake bed conditions. The footprint below OHW at the Eagle Bay ferry terminal would be less than 1 acre.

At the south ferry terminal, the construction and laydown area pad would extend below OHW (approximately 200 feet wide by 160 feet long) for launching the ferry. Five launching rails would also extend out to a depth of 36 feet below the OHW mark to move the cradle used to launch and retrieve the ferry. The five rails would be steel crane rail material mounted on concrete sleepers placed every 2 feet. The cradle would be kept onshore when not used for launching or retrieving (PLP 2018-RFI 093). The footprint below OHW at the south ferry terminal would be approximately 1 acre.

During normal operations, the ferry would be moored with a pair of lines to bollards at the end of the causeway. When the ferry is parked, it would be moored to the set of buoys outside of the causeway.

Material Sites

Construction materials would be excavated from borrow material sites along the transportation corridor. An estimate of up to 19 material sites (380 acres) would be required for construction and maintenance of access roads and the natural gas pipeline for Alternative 1a. Appendix K2 provides information for each material site, including the location, estimated quantities, size, type of material, use of material, and if blasting is required. For material sites that require blasting, PLP proposes to use ANFO explosives with a density of 68.7 pcf. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved to another location (PLP 2018-RFI 035). The amount of material estimated to be required for the road and pipeline is approximately 7.5 million cubic yards (yd^3). Final volumes of these gravel materials, and specific location of material sites and development plans for these sites, would be part of the final project design.

Material source sites were located as follows:

1. Minimize placement of material sites in waterbodies and wetlands.
2. Avoid sites of known environmental or cultural significance.
3. Optimize haul distances to locations where they would be used along the road corridor.
4. Suitability of the material for the required purpose (e.g., rock, gravel).

Water Extraction Sites

Twenty-one potential water extraction sites have been identified to support project construction and operations of Alternative 1a. Appendix K2 provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The proposed annual volume of water that would be extracted for all water extraction sites is 64 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022). Temporary water use authorizations would be applied for by either the appropriate contractor or PLP.

Many of the proposed water extraction sites are immediately adjacent to the main access road and would be accessed from a pullout consisting of a 10-foot-wide pad extending from the road shoulder. For water extraction sites not accessible from the main access road, single-lane (18-foot driving surface) access roads would be constructed from the main access road to the water source. The access road design would be a gravel surface road with a structural embankment suitable for all-season use. Road fill slopes are typically constructed at 2H:1V, and the width of the road footprint from toe-to-toe would range from 30 to 60 feet depending on the terrain. A cul-de-sac or tee-type turnaround and pump pad would be situated at the end of each access road (PLP 2019-RFI 107). Tables and figures in Appendix K2 provide details on the location and approximate length and acreage of each planned access road. Water extraction site access roads would be less than 1 mile in overall length and would encompass approximately 1 acre.

Temporary Facilities and Initial Site

A key component of the construction plan is to establish year-round access across Iliamna Lake using the permanent ice-breaking ferry. A pioneer road would be constructed in the permanent alignment from the Amakdedori port site to the first material site, approximately 3 miles from the port site, to support construction. Pioneer road construction would extend the road toward the south ferry terminal near Kokhanok.

Once access is gained to Iliamna Lake, small barging equipment would be used on the lake to establish beachheads at the two ferry terminal sites to enable road construction to advance from those points.

Temporary bridges, installed in the area proposed for the permanent footprint, would be used at the smaller crossings. Temporary work trestles would be installed parallel to the access road bridges over the Newhalen and Gibraltar rivers, as described in RFI 157 (PLP 2019-RFI 157) to facilitate construction of the permanent bridges by providing temporary access for workers, materials, and equipment (e.g., crane). Preliminary design assumes a temporary work trestle would be approximately 24 feet wide and nearly as long as the proposed permanent bridges. The work trestle would be supported on pier bents consisting of two or three pile each and spaced 30 to 60 feet apart depending on contractor's choice of trestle spans. The Gibraltar River work trestle may include up to 12, 24-inch-diameter temp piles installed below OHW. The Newhalen River work trestle may include up to 39, 24-inch-diameter piles install below OHW. The temporary piles would likely be installed by drilling or use of vibratory and/or impact hammer and would be removed by pulling with a vibratory hammer when construction of the bridge is complete.

Bridge construction duration would be up to 18 months, with the final duration dependent on the project start date and any permit stipulations that could impact the timing of construction activities. Work on both crossings would commence as early as practicable in the summer of Year One of project construction with the objective of having the temporary work trestle installed early in the first summer and bridge construction completed by end of the following summer. Work trestle and bridge construction would not interfere with navigation on the rivers. For safety reason, temporary short duration partial channel closures may be required during craning operations. Horizontal clearance between work trestle piers would be a minimum of 28 feet and may be as great as 58 feet. Vertical clearance would be a minimum of 12 feet above OHW. The Newhalen River crossing would include the construction of two temporary barge landings approximately 2 miles upstream of the proposed bridge location for operation of a short-term ferry to access the mine site while the Newhalen River bridge is under construction. See Appendix K2 for a summary of permanent and temporary construction footprints.

Temporary camps would be established at the ferry landings to support road construction; and at the south ferry landing the camp would also support ferry assembly. These camps would be constructed in the area proposed for the permanent footprint and would remain in place until the permanent facilities are established (see proposed construction schedule in Appendix K2). The temporary camps would be provided with potable water from groundwater wells. The ADEC oversees public water systems and requirements may include settling tanks, sand filters, chlorination or ozonation, or other standard techniques for water treatment. The groundwater wells would be retained for operations. Sewage would be processed using a modular (containerized) treatment system. Solid waste from the modular system would be incinerated in the camp incinerator or transported off site to an appropriate disposal facility (PLP 2019-RFI 087a).

During construction, the north ferry landing camp would likely be augmented using existing housing facilities in Iliamna and Newhalen. Until the access road crossing the Newhalen River is complete, the crews would be shuttled to their workplaces by boat or by helicopter.

All temporary construction facilities would be removed after construction; and the sites, unless being used for permanent facilities, would be reclaimed. Temporary impact areas would be restored as outlined in PLP's Restoration Plan for Temporary Impacts (Owl Ridge 2019a; PLP 2019-RFI 123).

Transportation Corridor Operations and Materials/Personnel Transport

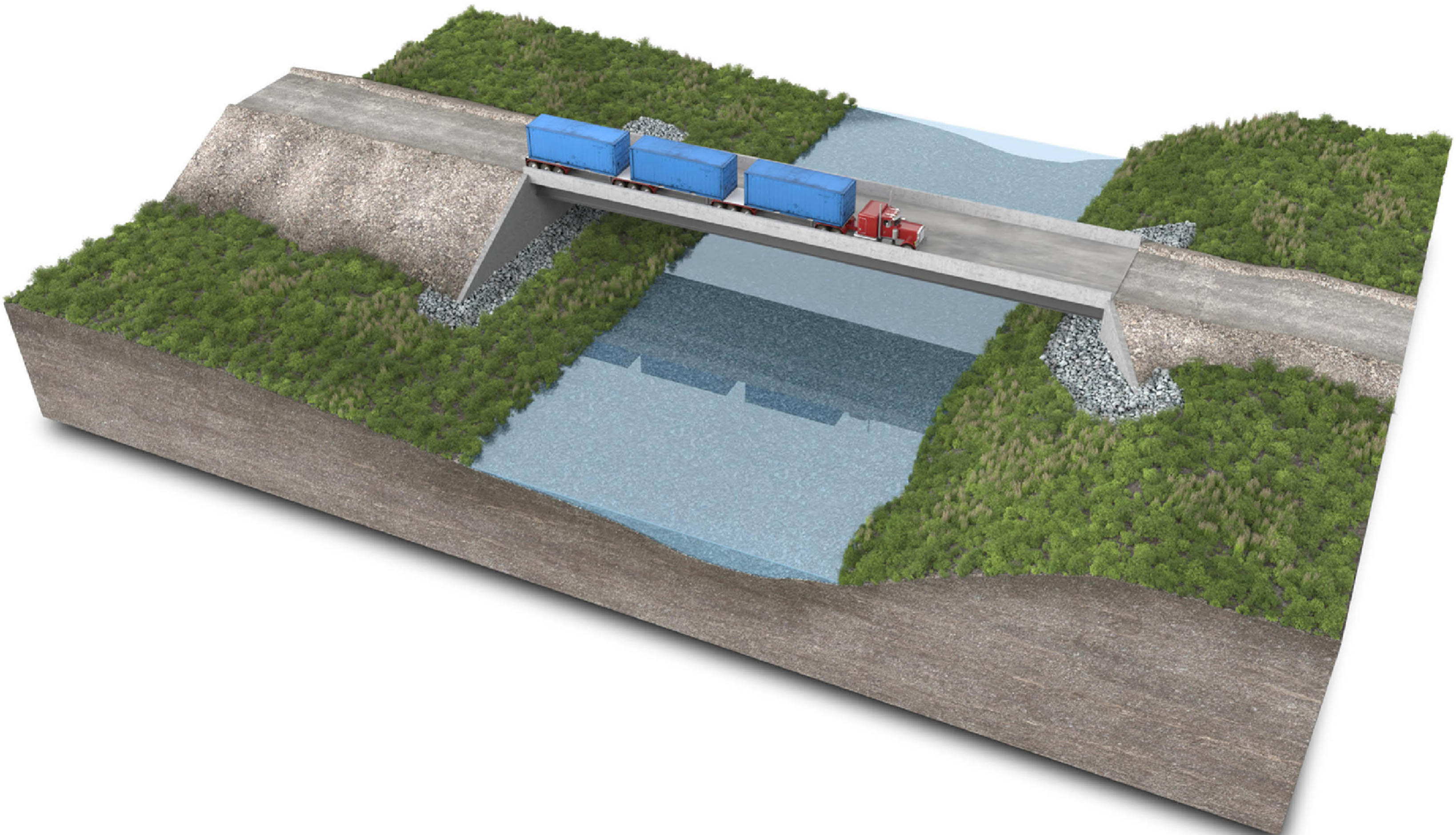
To facilitate efficient cargo movement and optimize ferry space, most material would be transported in shipping containers. At each ferry terminal, a container yard with forklift trucks would be provided to stage empty and loaded containers for loading on/off the ferry, and truck transfer. Some cargo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

Inbound project cargo and consumables would be transported using standard International Organization for Standards (ISO) containers for ocean freight (either 20- or 40-foot size). Diesel fuel would be transferred from the port to the mine site using ISO tank-container units, which have a capacity of 6,350 gallons. Copper-gold concentrate would be loaded into specialized bulk cargo containers, each with about 38 tons of concentrate capacity, with removable locking lids. The full containers would be washed after loading at the mill, and the empty containers would be washed after unloading from the lightering barges to remove any concentrate dust that may have settled on the containers during loading and unloading. Truck/trailer units would be designed to haul up to three loaded containers per trip.

Daily transportation of concentrate, fuel, reagents, and consumables would require up to 35 truck trips (round trip) per day for each leg of the road, including three loads of fuel per day. There would also be additional low-volume light vehicle traffic. The ferry would require one round trip across the lake per day. Figure 2-31 presents a digital simulation of a haul truck on the proposed access road.

Employees would be flown in from surrounding communities (if not connected to Iliamna or Kokhanok by roads) and from Anchorage or Kenai. All employees would be bussed between Iliamna and the mine site, or between Kokhanok and the port site. Perishables and other consumables would be flown from Anchorage (PLP 2018-RFI 027).

The Iliamna airport is capable of handling all aircraft anticipated to be used for the project, and no improvements are expected. PLP expects the facility at Kokhanok would be used to provide commuter service for work rotations for the port, ferry terminal, and road facility crews. Some minor freight flights may be required, but large freight shipments would either land directly at the port or be transported via Iliamna and the ferry. The existing runway is capable of handling the types of aircraft required for this duty (e.g., de Havilland/Viking Twin Otter and Pilatus PC-12). Lighting and navigation aid improvements would be required, and air radio service may be required during periods when Pebble aircraft are using the facility. During operations, employees would be housed at the permanent mine site camp (discussed above), and ferry crews may be housed on the ferry.



Sources: PLP 2018-RFI 034d.

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DIGITAL SIMULATION OF HAUL TRUCK

PEBBLE PROJECT EIS

FIGURE 2-31

Physical Reclamation and Closure

The road system would be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. Once the roads are no longer needed, the alignments would be recontoured if required, stabilized, and overburden would be placed as appropriate.

The Iliamna Lake ferry facilities would be reclaimed after closure activities are completed (PLP 2018-RFI 024). At that time, the Iliamna Lake ferry facilities would be removed, and all supplies would be transported across the lake using a summer barging operation.

State requirements pertaining to permitting and ROW easement processes prior to construction include preparing a detailed reclamation plan. Reclamation of lands privately owned by Alaska Native corporations would be established in lease and surface use agreements that PLP would negotiate with the land owner.

2.2.4.3 Amakdedori Port and Lightering Locations

Port Design

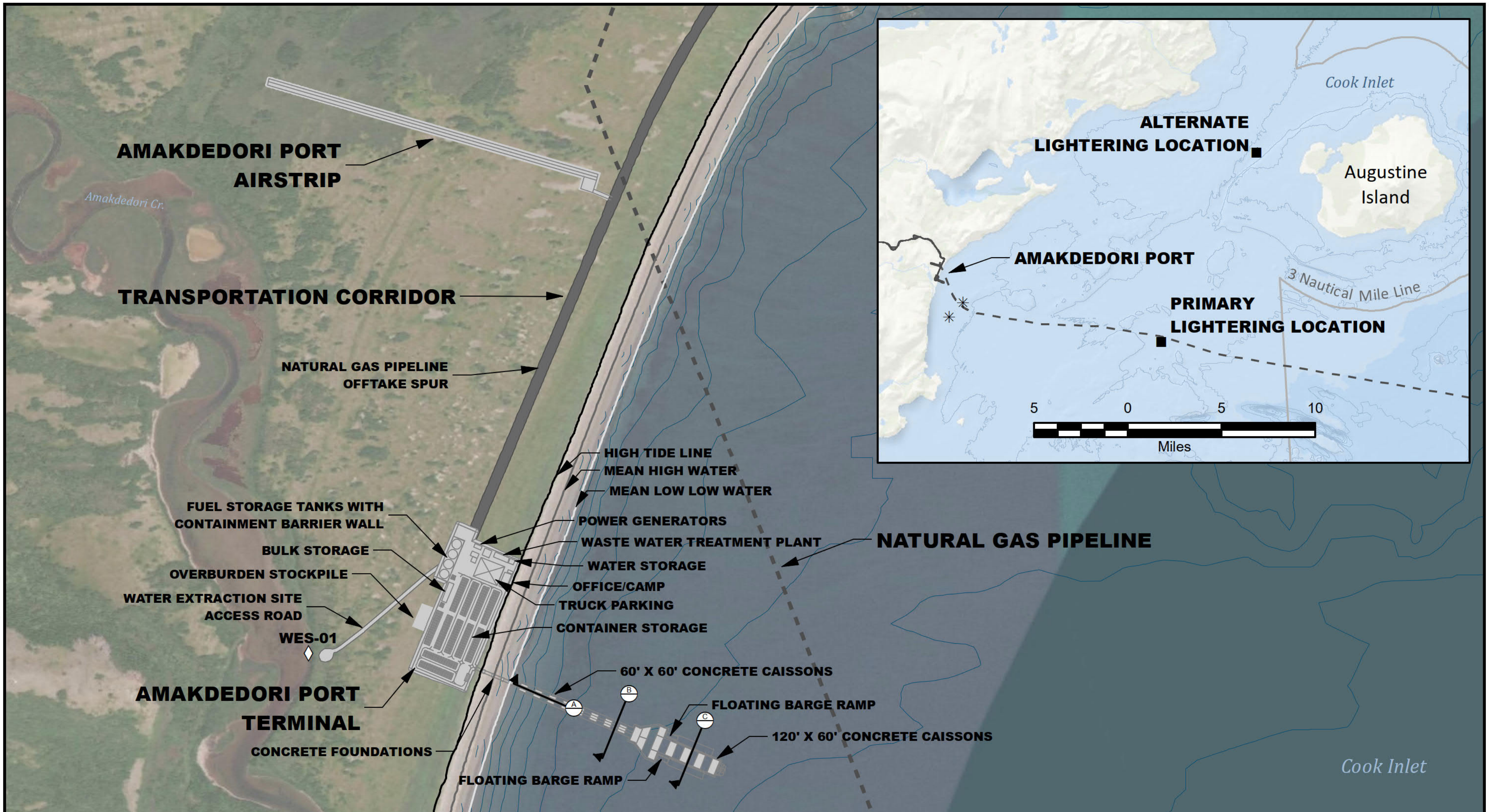
The proposed project includes construction of Amakdedori port, a year-round port near Amakdedori Creek on the western shore of Cook Inlet (Figure 2-32). The port site area is undeveloped and not served by any transportation or utility infrastructure.

The proposed port site (17 acres) would include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project. The shore-based facilities (15 acres) would include a container storage area for receipt and storage of containers for concentrate and freight. Other facilities would include fuel storage and transfer facilities, power generation and distribution facilities, maintenance facilities, employee accommodations, and offices. The shore-based complex would be constructed on an engineered fill pad at an elevation of 40 feet to address tidal surge from major storms and potential tsunamis. The port would be supported by a permanent airstrip (6 acres) that would be used primarily for construction, but retained for emergency access.

Marine facilities[14] (2 acres) would include a causeway/access trestle extending out to a marine jetty/main wharf. The causeway/access trestle would be constructed using 60-foot by 60-foot concrete caissons. The caisson footprints would be leveled, and the caissons placed 60 feet apart to allow for the free flow of sediment and water parallel to the shoreline. The concrete deck of the causeway would rest on the top of the caissons, and would be 24 feet wide by 1,340 feet long, extending out to the marine jetty/main wharf. The marine jetty/wharf would be constructed using 60-foot by 120-foot concrete caissons, separated by 60 feet to allow for the free flow of sediment and water parallel to the shoreline. The jetty/main wharf would be 120 feet wide and 720 feet long, except for a section where floating dock ramps would be attached on both sides of the jetty; that section would be up to 240 feet wide (additional caissons would be used to support the wider jetty section). A floating dock, on the jetty but separate from the cargo handling berths, would be provided for ice-breaking tug moorage. Dredging of the port site would not be required. Figure 2-33 depicts cross sections of the Amakdedori port.

The caisson height from the seabed would vary depending on the water depth, with the tallest caissons being placed at the maximum water depth (15 feet below mean lower low water [MLLW]) to allow for a flat deck on the jetty and a causeway back to shore. Each caisson would be separated from the next caisson by 60 feet in a direction perpendicular to the shore. The concrete deck that rests on the caissons would be well above the water surface under all tidal conditions, allowing for the free flow of water and sediment and free passage for any fish or surface wildlife between the caissons (PLP 2020-RFI 165).

[14] Dimensions for marine facilities included in this paragraph represent the dimensions for construction below the mean high water mark (MHW) of Cook Inlet.



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

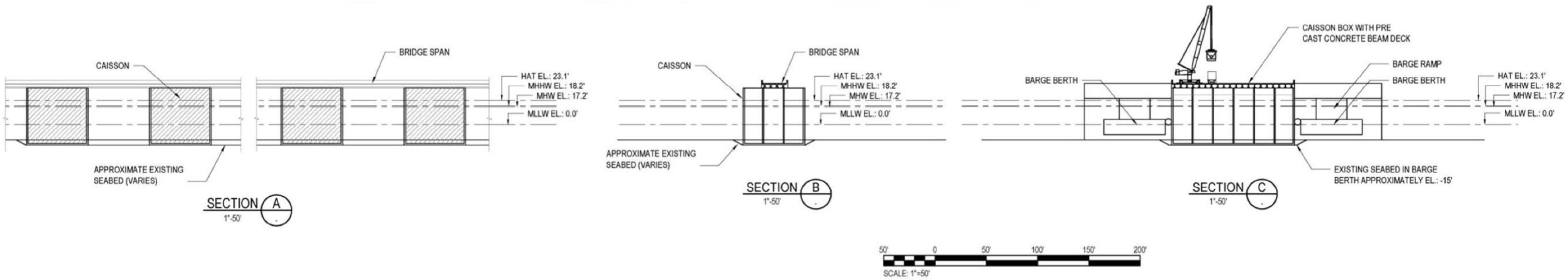
US Army Corps of Engineers

500 0 500 1,000
Feet

Alternative 1a
- ◊ Water Extraction Site
- ■ Lightering Location
- ✳ Lighted Navigation Buoys
- Natural Gas Pipeline
- Amakdedori Port
- Transportation Corridor

Other Features
- High Tide Line
- Mean High Water
- Mean Low Low Water
- Bathymetric Contour (1m)

ALTERNATIVE 1A - AMAKDEDORI PORT AND LIGHTERING LOCATIONS



Sources: PLP 2019h

Note: The displayed features are the permanent footprint unless otherwise specified.

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ALTERNATIVE 1A - AMAKDEDORI PORT CROSS SECTIONS

PEBBLE PROJECT EIS

FIGURE 2-33

Two lighted navigation buoys (3 feet in diameter) would be on the reefs framing the entrance to the Amakdedori port (Figure 2-32). The buoys would be anchored to the reef using screw anchors or 3-foot-cubed concrete-block anchors, with an anchoring design that prevents excessive anchor chain drag or swinging (PLP 2018-RFI 093).

Permanent structures mounted on the causeway and or dock would include a fuel pipeline for unloading barges, a powerline for vessel shore power, a water supply line for firefighting, and illumination and navigation lights. No permanent cranes or fuel storage would be located on the dock. Mobile cranes would be used on the dock for some operations.

The natural gas pipeline from the Kenai Peninsula (discussed below) would come ashore at Amakdedori port. An offtake would distribute natural gas to the port power generation facility. The pipeline would follow the access road to the port and would be buried in a trench adjacent to the road bed shoulder.

One water extraction site (WES-01), identified to support project construction, is adjacent to the port site. A short (i.e., less than 1-mile) single-lane access road would be constructed from the port terminal to the water source. Water extraction sites and access roads are discussed in the preceding Transportation Corridor section; Appendix K2 tables and figures provide additional details for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes.

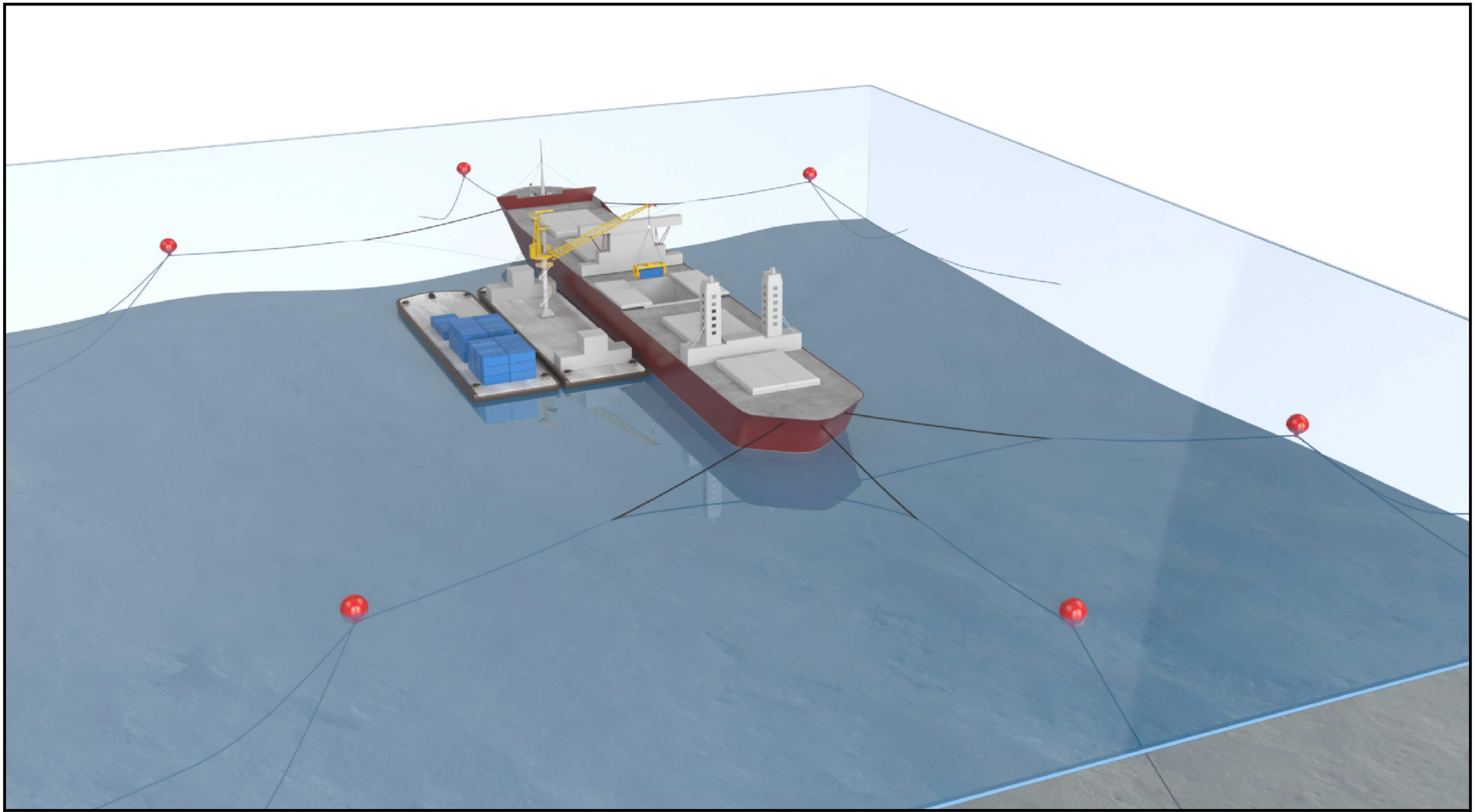
Lightering Locations

Copper-gold concentrate containers would be loaded onto lightering barges at Amakdedori port, and then transported to one of two lightering locations for transfer to bulk carriers. The primary lightering location is approximately 12 miles offshore east of the Amakdedori port; an alternate lightering location is approximately 18 miles east-northeast of the port between Augustine Island and the mainland. Wave heights in this area are reduced by Augustine Island, and it would be used when required by sea conditions. Figure 2-34 presents a digital simulation of concentrate transfer operations at a lightering site.

Figure 2-35 shows the proposed mooring system and typical anchoring system that would be installed at each lightering location. Vessels would not drop anchor each time they return to the location. Six floating mooring buoys would be used to secure the bulk vessel during loading, and each of these buoys would be attached to permanent anchors (10 total) set on the sea floor using a pattern similar to that shown on Figure 2-35. On arrival, the bulk carriers would attach mooring lines to the buoys, anchoring themselves in place (PLP 2018-RFI 081). The layout for permanent anchors set on the seabed would be finalized in detailed design, but typically consists of a large weight, such as a rock/concrete-filled 40-foot by 8-foot by 8-foot shipping container that is lowered to the sea floor (PLP 2018-RFI 081 and PLP 2019-RFI 071b). To prevent excessive drag and swinging of the anchor chains, an approximately 3-foot by 3-foot by 3-foot concrete positioning block (station-keeping mass anchor labeled on Figure 2-35) would be set on the sea floor at each of the six mooring buoy locations.

Temporary Facilities and Initial Site Access

During the initial construction effort at Amakdedori port, a beachhead would be established using small landing craft–style barges for access. It would consist of a temporary camp, the permanent port site airstrip, and service facilities. All temporary facilities at the port would be in the area that would be used for port operations and would not require a separate footprint. Temporary diesel generators would be used for power supply. While this work is under way, crews would be housed on vessels moored near the site.



Sources: PLP 2018-RFI 034d.

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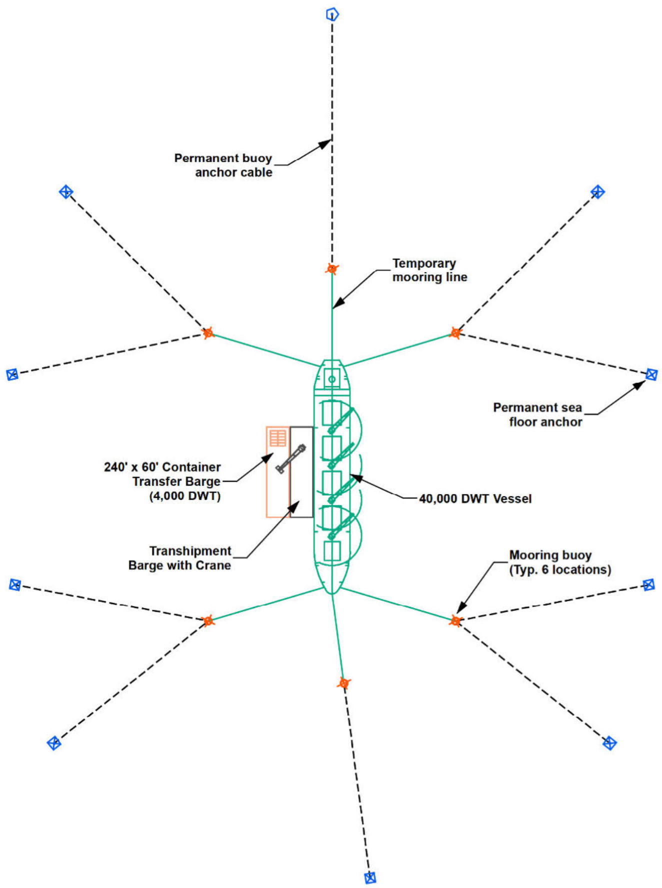
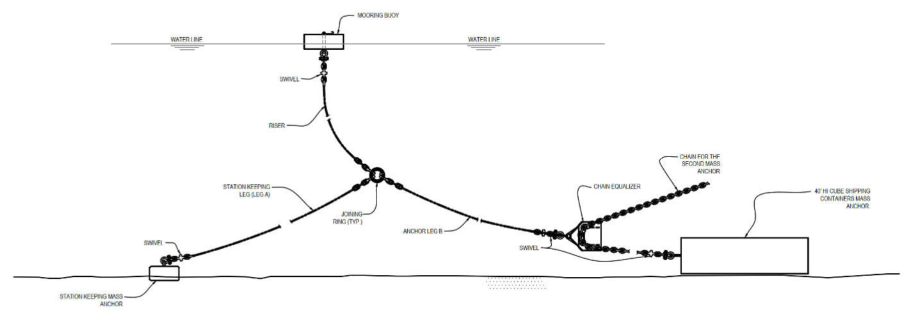
DIGITAL SIMULATION OF CONTAINER TRANSFER AT LIGHTERING SITE

PEBBLE PROJECT EIS

FIGURE 2-34



LIGHTERING SPREAD MOORING SYSTEM ARANGEMENT



TYPICAL ANCHOR DESIGN

Sources: PLP 2018-RFI-081

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LIGHTERING SPREAD MOORING SYSTEM ARRANGEMENT AND TYPICAL ANCHOR DESIGN

The temporary construction camp would house the crews for the pioneer road construction. Once the road is through to Iliamna Lake, an existing camp at Kokhanok would be used for road crews and for the crew establishing the ferry landings. The temporary camp would be provided with potable water from a groundwater well. ADEC oversees public water systems; requirements may include settling tanks, sand filters, chlorination or ozonation, or other standard techniques. The groundwater well would be retained for operations. Sewage would be processed using a modular (containerized) treatment system. Solid waste from the modular system would be incinerated in the camp incinerator or transported off site to an appropriate disposal facility (PLP 2019–RFI 087a).

The airstrip at Amakdedori would be used primarily through the first year of construction until the road connection to the Kokhanok airstrip is completed (see proposed construction schedule in Appendix K2). Following this, the airstrip would only be used for emergency access. It is anticipated that between 20 and 40 flights per month by a Twin Otter, or similar type aircraft, may be required for the periods from May through September of Year 1 and Year 2 until initial access to Kokhanok is completed. For the period from October Year 1 through April Year 2, up to 20 flights per month may be required (PLP 2020-RFI 041).

During construction, supply barges would transport materials, supplies, and equipment to Amakdedori port. The construction of the natural gas pipeline Cook Inlet crossing (discussed below) would be expected to take 30 to 40 days to install the pipe, plus an additional 30 to 60 days of pre- and post-pipe laying activities, and would include approximately 10 construction, support, and survey vessels (Owl Ridge 2020).

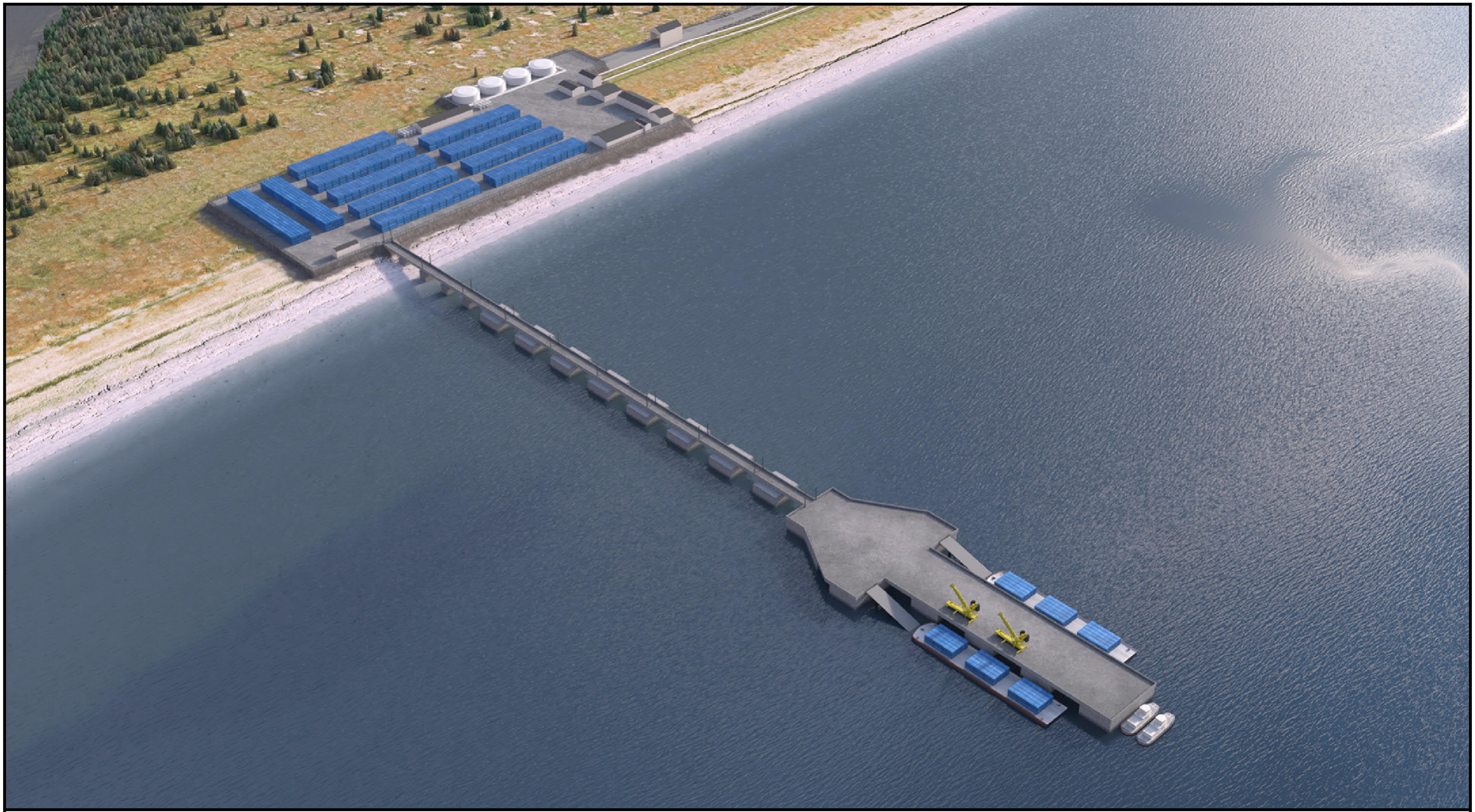
PLP's proposed construction schedule is provided in Appendix K2. All temporary construction facilities would be removed after construction; and the sites, unless used for permanent facilities, would be reclaimed. Temporary impact areas would be restored as outlined in PLP's Restoration Plan for Temporary Impacts (Owl Ridge 2019a; PLP 2019-RFI 123).

Port Operations and Materials Transport

Incoming supplies such as equipment, reagents, and fuel would be barged to Amakdedori port, and then transported by truck and ferry to the mine site. To a lesser extent, some supplies, such as perishable food, may be transported by air to the Iliamna Airport and Kokhanok Airport and trucked to the mine site and port, respectively. Figure 2-36 shows a digital simulation of barges at Amakdedori port.

Copper-gold concentrate would be transported from the mine site to Amakdedori port by truck and ferry in covered bulk cargo containers that are commonly used in the mining industry (PLP 2019-RFI 009c). The containers would be stored between vessel sailings on a dedicated laydown pad adjacent to the jetty. The concentrate would be lightered by barge from Amakdedori port to Handysize bulk carriers at offshore mooring points described above. The containers would be lifted by crane into the open hold of the receiving ship. Once the container has been lowered into the hold, the container lid would be opened, and the container turned upside down to unload the concentrate into the ship's hold. The container would 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. Due to the high density of the concentrate, the holds would not be loaded to the top, further reducing potential for concentrate dust to escape the hold (PLP 2019-RFI 009c). This containerized bulk handling system minimizes dust emissions and the risk of spills.

About 10 trips by the lightering barges would be required to load a bulk carrier, which would be anchored for 4 to 5 days at the lightering location. Lightering vessels would travel at speeds less than 10 knots (PLP 2018-RFI 039). The bulk carrier ships would transport the concentrate to out-of-state smelters, including Asia (PLP 2020-RFI 163). The likely bulk carrier shipping route for transport of concentrate to Asia, the primary supply and construction barge route from the west coast to Amakdedori, as well as an alternative inland barge route that could be used under adverse conditions, are illustrated in Appendix K3.12, Transportation. These routes are based on the existing routes used for transpacific commercial shipping and traffic to Alaska (PLP 2020-RFI 163).



Sources: PLP 2019b

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DIGITAL SIMULATION OF BARGES AT AMAKDEDORI PORT

Up to 27 Handysize ships (i.e., bulk cargo ships) would be required annually to transport concentrate. Up to 33 marine linehaul barge loads of supplies and consumables would be required annually. Two ice-breaking tug boats would be used to assist the Handysize ships and barges with mooring and approach/departing the barge berths.

The Amakdedori port site would be equipped for fire and emergency response. Water for fire suppression would be stored in freshwater supply tanks at the port, and distributed via insulated pipeline system. An ambulance would be kept at the port, and a pump truck would be used to deliver fire suppression water. Equipment would be installed to respond to oil spills, and crews would be trained for such response.

Amakdedori port operations would be serviced by the proposed fiber-optic cable. Radio and/or cell service would be provided for communications at the port, with the required antennas being co-located with the port office facilities.

Water Management

A WTP at Amakdedori port would treat surface runoff from the port facilities, including truck-wash bays. The WTP would be designed to meet all applicable state requirements. The current estimate for the capacity of this WTP is 100 gallons per minute (gpm). The treatment process would include dissolved metal oxidation using potassium permanganate, followed by co-precipitation with ferric chloride. Water from the co-precipitated solids would flow into flocculators/clarifiers to separate out solids. The clarified water would then be treated with sodium hydrogen sulfide, sodium hydroxide, and ferrous sulfate to further co-precipitate remaining metals under reducing conditions. Reject and/or WTP solids from the port site would either be trucked to the mine site for disposal in the pyritic TSF using a back-hauled concentrate container, or shipped off site to a disposal facility. Treated water would be released from a discharge point at the end of the dock facility, in accordance with an APDES permit (PLP 2018-RFI 087).

The exterior of empty concentrate containers at the port would be washed after unloading inside a closed building, and then returned to the laydown pad. The container washing system would use a recycling system to recirculate wash water through the wash equipment. Filtration would be provided to remove solids from the stream, which would be handled as described above for the WTP solids. PLP proposes to treat the container wash-bay water through the WTP at Amakdedori port. It is PLP's view that this wash-bay water can be treated to meet water quality standards and then discharged (PLP 2018-RFI 066). The ADEC regulates discharges of process wastewater under the Alaska Pollutant Discharge Elimination System (APDES) program; the US Environmental Protection Agency (EPA) has oversight authority for the program. EPA commented that CWA regulations at 40 CFR Part 440, Subparts J and L, apply to the proposed port site discharges of process water, and that the wash-bay water discharge would not be an allowable discharge.[15] ADEC's position on the discharge of this process water at the port is outlined in response to RFI 158 (ADEC 2020-RFI 158); based on information provided in response to RFI 066 (PLP 2018-RFI 066), they do not dispute EPA's comments. If, during State permitting, it was confirmed to not be an allowable discharge, the wash water would be transported back to camp for use in the process. This water would be loaded into a 6,350-gallon isotainer similar to those proposed for the transportation of diesel. In total, this would be equivalent to one-third of a truckload per week, and would not result in a measurable increase in road truck traffic for the project (PLP 2019-RFI 159).

A potable WTP and a sewage treatment plant would be sited at Amakdedori port.

A groundwater well for the port site is planned. The precise location for the well would be identified during detailed design. The well would be sited on uplands far enough from the shore to avoid

[15] 40 CFR Part 440.104(b)(1) specifies "there shall be no discharge of process water to navigable waters from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores or any combination of these ores."

any potential for saltwater intrusion, and water would be piped to the site from the wellhead (PLP 2018-RFI 022a).

Physical Reclamation and Closure

Physical site closure work would commence as operations end. At that time, the Amakdedori port facilities would be removed, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. The marine port facilities would be removed and reclaimed after closure activities are completed (PLP 2018-RFI 024).

2.2.4.4 Natural Gas Pipeline

Natural gas, sourced through the existing natural gas supply infrastructure for the Cook Inlet area, would be the primary energy source for the project. The proposed natural gas pipeline would be open access; more specifically, a contract carrier. PLP has committed to providing community access to the gas line during project operations.

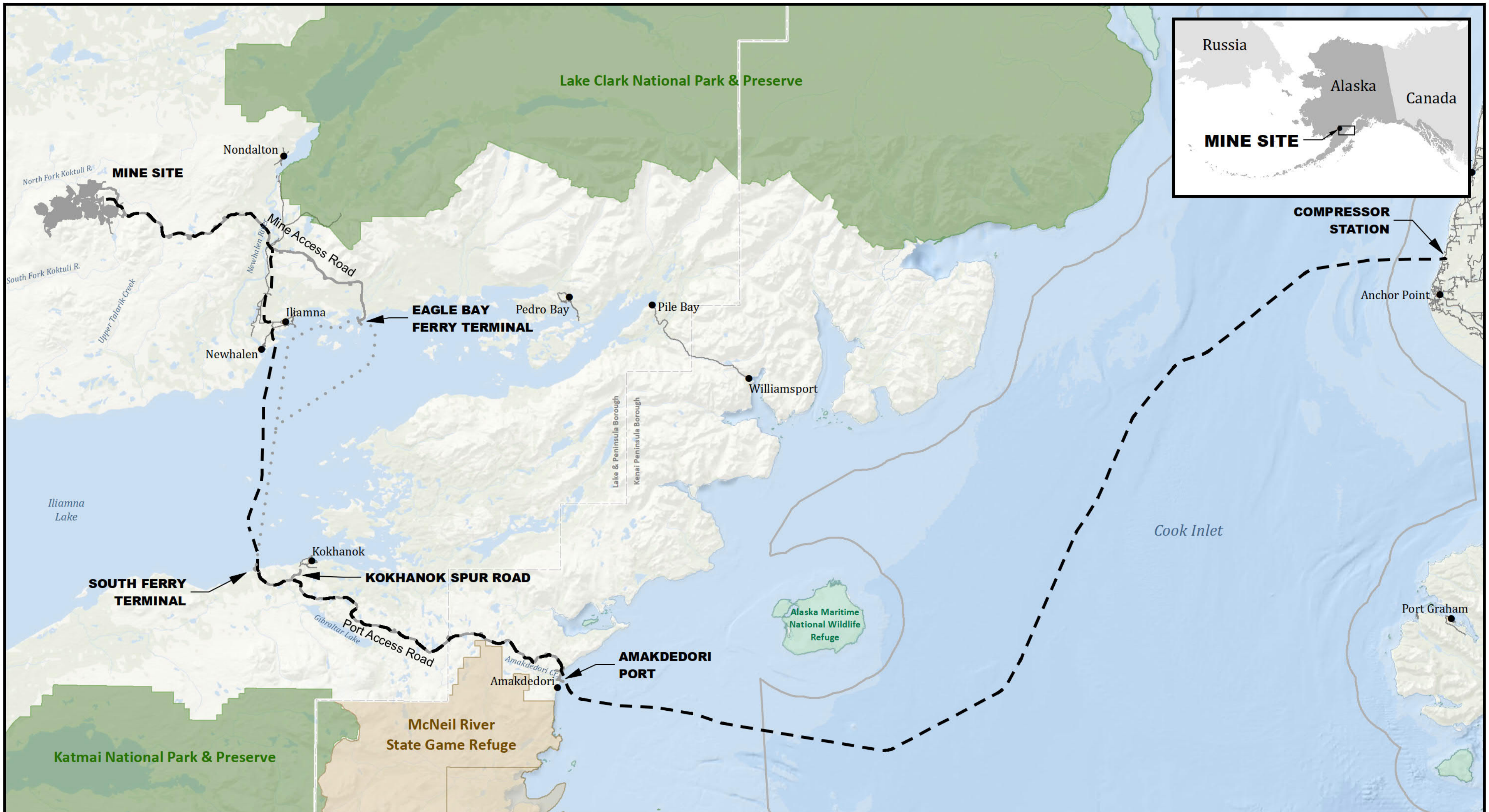
Natural Gas Pipeline Corridor and Ancillary Facilities

The natural gas would be supplied to Amakdedori port and the mine site by pipeline (Figure 2-37). The pipeline would connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula and would be designed to provide a gross flow rate of approximately 50 million standard cubic feet per day. A fiber-optic cable would be buried in the pipeline trench or ploughed in adjacent to the pipeline.

A metering station, compressor station, and pig launching/receiving facility would be located on a gravel pad (2 acres) at the offtake point, sited on a land parcel on the eastern side of the Sterling Highway (Figure 2-38). Figure 2-39 provides a simulation of the stations and facility on the gravel pad. The steel pipeline would be designed to meet all applicable state and federal regulations.

The 192-mile natural gas pipeline from the Kenai Peninsula to the mine site would consist of five main segments, described below.

Cook Inlet Crossing to Amakdedori Port—The compressor station would feed a 104-mile subsea pipeline that would be constructed using heavy-wall 12-inch-diameter pipe designed to have negative buoyancy and provide erosion protection against tidal currents. Horizontal directional drilling (HDD) would be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards (Figure 2-40). From this point, the heavy wall pipe would be trenched into the sea floor for approximately 61 miles, laid on the surface for the next approximately 11 miles, and then trenched into the sea floor for the final approximately 32 miles of the Cook Inlet crossing (PLP 2019h). Trenching and burial would occur with use of traditional cut-and-fill excavation using extended-reach backhoes for non-HDD shore crossings. Clamshell dredging/conventional excavation would be used for shallow water areas, and mechanical dredging and/or jet trenching for deepwater areas. Ploughing technology could also be used for trenching and lowering the pipeline into the trench if ploughs are available and suitable for use in the lower Cook Inlet at the time of construction; however, the use of ploughs has not been identified as a primary option. Response to RFI Bureau of Safety and Environmental Enforcement (BSEE) 1 (PLP 2019-RFI BSEE 1; NanaWP and Intecsea 2019b) provides high-level overviews of these dredging technologies, along with samples of potentially suitable equipment. The temporary construction footprint for seabed installation would vary as outlined in PLP (2019c); ranging from no trenching impact in areas where the pipeline is laid directly on the sea floor (Figure 2-41), to a maximum disturbance width of 102 feet for trenching and re-usable side-cast material (Figure 2-42). Additional potential seabed disturbance may occur from anchor placement to hold pipe-lay barges in place. Anchor placement may extend approximately 650 feet to 4,101 feet on either side of the pipeline centerline depending on depth (Owl Ridge 2020).



Sources: PLP 2019-RFI153; ADNR

US Army Corps of Engineers

5 0 5 10

Miles

Alternative 1a
- Ferry Route
- Natural Gas Pipelines
- Transportation Corridor
- Mine Site

Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1A - NATURAL GAS PIPELINE ALIGNMENT

PEBBLE PROJECT EIS

FIGURE 2-37

Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

200 0 200 400
Feet

Alternative 1a

- ENSTAR to Compressor Station
- Natural Gas Pipeline
- Compressor Station

COMPRESSOR STATION PLAN VIEW

PEBBLE PROJECT EIS

FIGURE 2-38

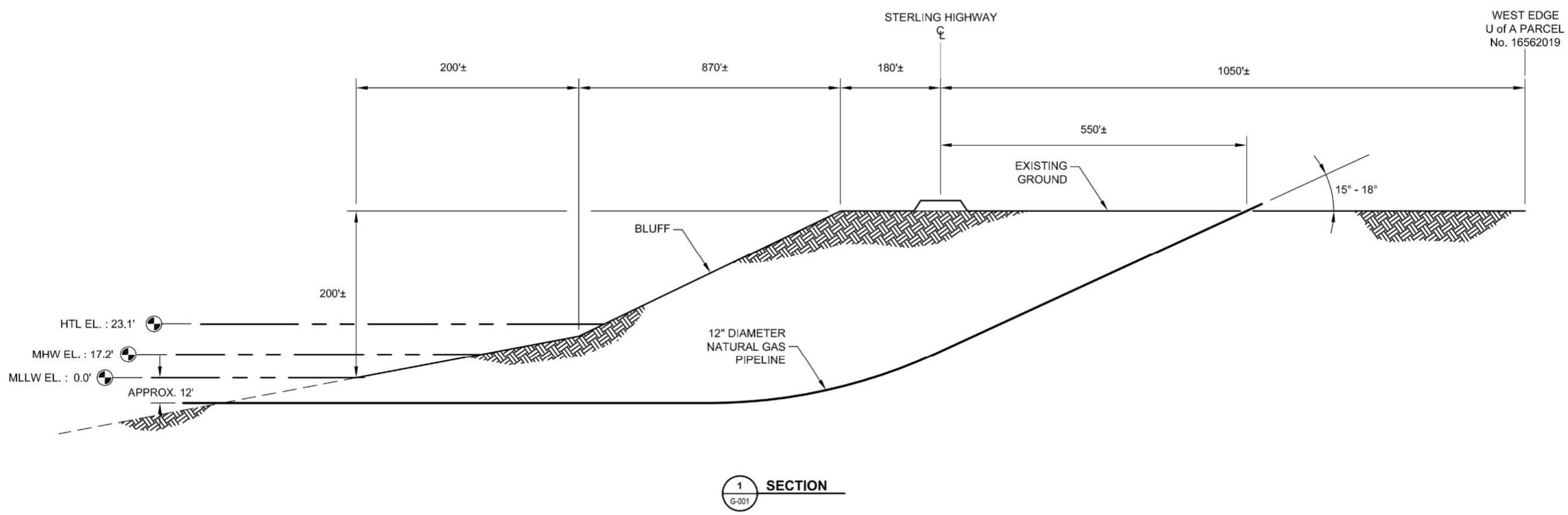
Sources: PLP 2019b

US Army Corps of Engineers®

DIGITAL SIMULATION OF COMPRESSOR STATION

PEBBLE PROJECT EIS

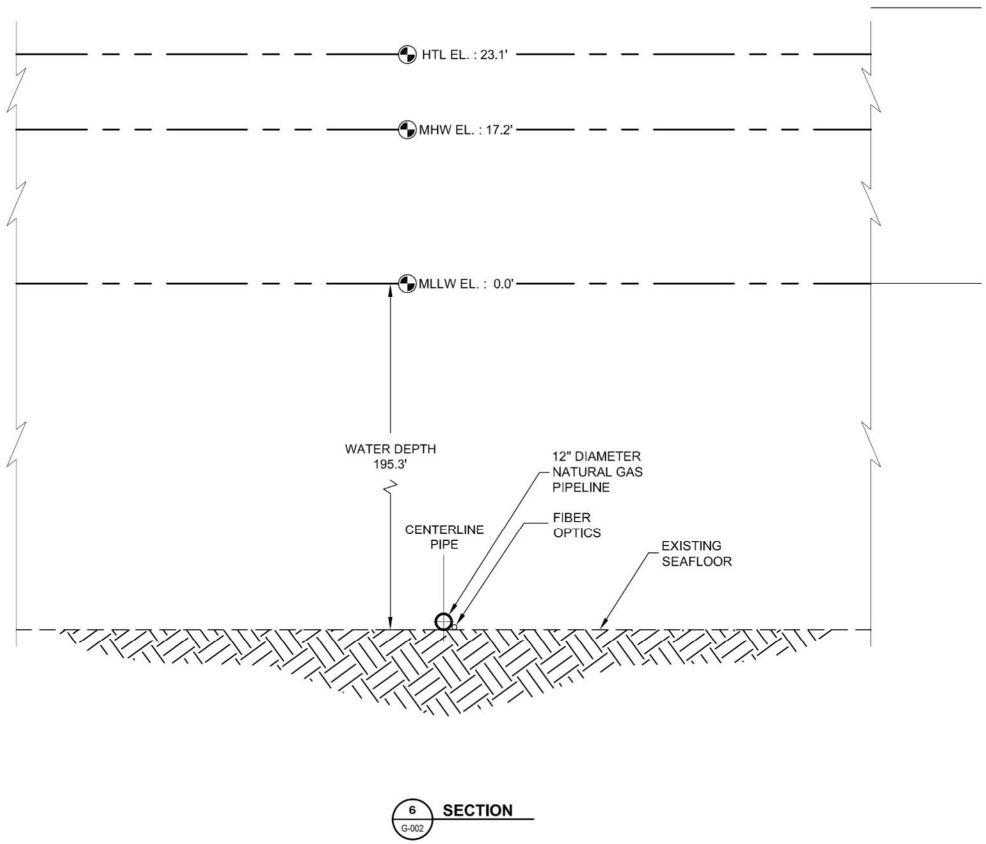
FIGURE 2-39



Sources: PLP 2019h

US Army Corps of Engineers

TYPICAL PIPELINE ANCHOR POINT BLUFF HDD



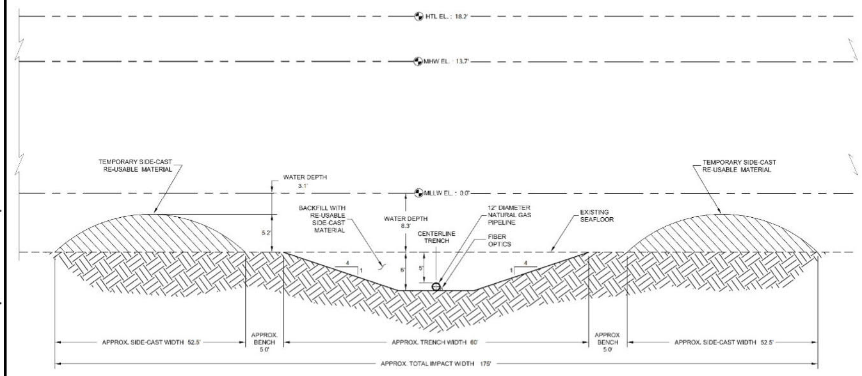
Sources: PLP 2019h

US Army Corps of Engineers

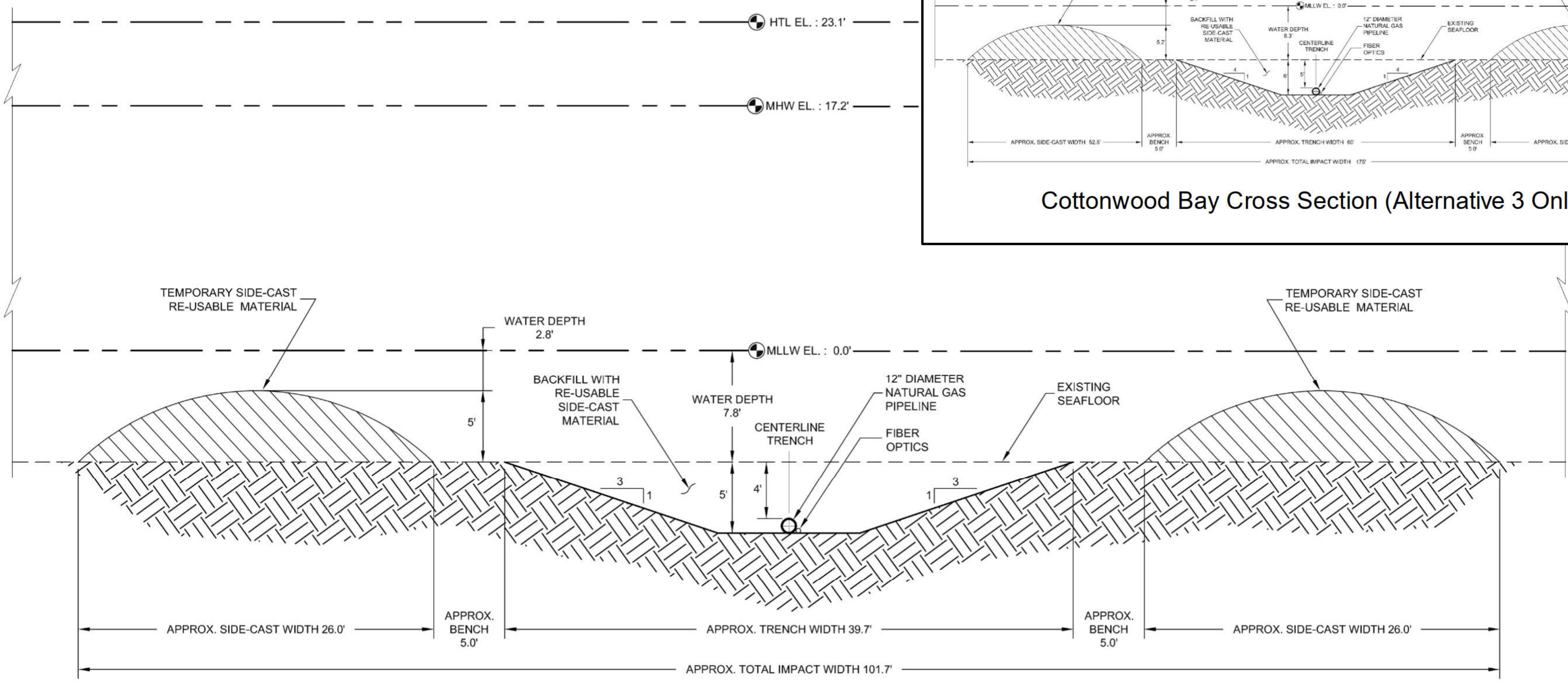
TYPICAL PIPELINE SEABED CROSS SECTION NO IMPACT

PEBBLE PROJECT EIS

FIGURE 2-41



Cottonwood Bay Cross Section (Alternative 3 Only)



Sources: PLP 2019h, 2020b

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TYPICAL PIPELINE SEABED CROSS SECTION MAXIMUM IMPACT WIDTH

Amakdedori Port to the South Ferry Terminal—The pipeline would come ashore at Amakdedori port using trenching (Figure 2-43), and natural gas would be fed to the port site power station and used for site heating. The natural gas corridor from Amakdedori port to the south ferry terminal would follow the port access road. At the south ferry terminal, gas would be fed from the pipeline to the facilities for power supply and facility heat. The segments of the natural gas pipeline and fiber-optic cable constructed along the access roads would be buried adjacent to the road bed shoulder, and the pipeline construction area would be in the construction area for the road (Figure 2-20). At bridged river crossings, the gas pipeline would either be placed beneath the rivers using HDD or trenching (Figure 2-44), or would be attached to the bridge structures.

Iliamna Lake Crossing—The pipeline would enter Iliamna Lake for the next section, an approximately 21-mile lake crossing. The placement of this section of the pipe would be similar to the Cook Inlet crossing. The shore transitions would use trenching (Figure 2-45). Surface roughness along a 0.6-mile section of the Iliamna Lake pipeline segment would require building a permanent berm to place the pipeline on (Figure 2-46). For this segment, it is estimated that approximately 10 sections, each less than 100 feet in length, would require a 13-foot-wide berm to be placed on the lake bottom; however, a permanent footprint of 1 acre conservatively assumes the berm would be placed along the entire 0.6-mile stretch (PLP 2019c). The berms would be constructed using clean, graded, engineered fill and rock. Gradation and sizing of the fill and rock would be selected to ensure the material stays in place, and is not susceptible to berm sidewall failure or long-term scour/erosion. The fill would be drawn from one of the existing onshore material sites and transported from shore using a barge, then placed using a barge-mounted clamshell dredge or extended-reach backhoe, depending on water depth.

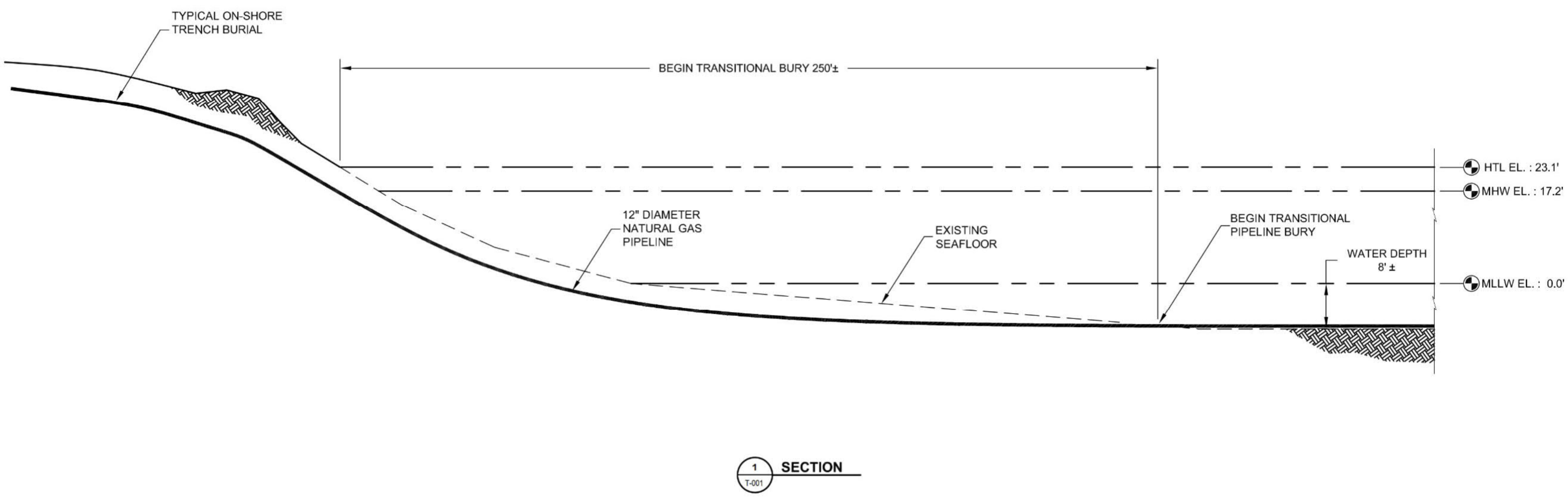
No requirements for anchoring are anticipated. If anchoring were required in future based on operational monitoring observations, concrete saddle weights or similar weight-additive methods would be used (PLP 2020-RFI 164).

The temporary construction footprint for lakebed installation of the natural gas pipeline would vary as outlined in PLP (2019c); up to a maximum width of 91 feet (Figure 2-47).

Overland Pipeline Segment from Iliamna Lake to Mine Access Road—The pipeline would come ashore on the north shore of Iliamna Lake, near the community of Newhalen, and run overland as a pipeline-only segment to a point where it would connect with the mine access road, east of the Newhalen River crossing. A 150-foot temporary construction ROW is proposed to allow for adjustment of the final route to suit terrain. The temporary construction footprint for the overland pipeline-only segments (i.e., not adjacent to an access road) would encompasses the entire 150-foot ROW to conservatively account for pipeline trenching, side-casting, and equipment operation/travel (Figure 2-48). The ROW would be reduced to a 50-foot permanent operations ROW following completion of pipeline construction. Pipeline stream crossings along this segment would use trenching or HDD to cross streams.

Mine Access Road to Mine Site—After connecting with the mine access road, just east of the Newhalen River Crossing, the pipeline would follow the mine access road to the mine site; buried in a trench adjacent to the shoulder. Stream crossings would be as described for the segment following the port access road.

Temporary impact areas described above would be restored as outlined in PLP's Restoration Plan for Temporary Impacts (Owl Ridge 2019a; PLP 2019-RFI 123). See Appendix K2 for a summary of permanent and temporary construction footprints. PLP would conduct HDD in a way that minimizes the release of drilling fluids. Response to RFI 011a (PLP 2019-RFI 011a) provides examples of how this program might be executed.



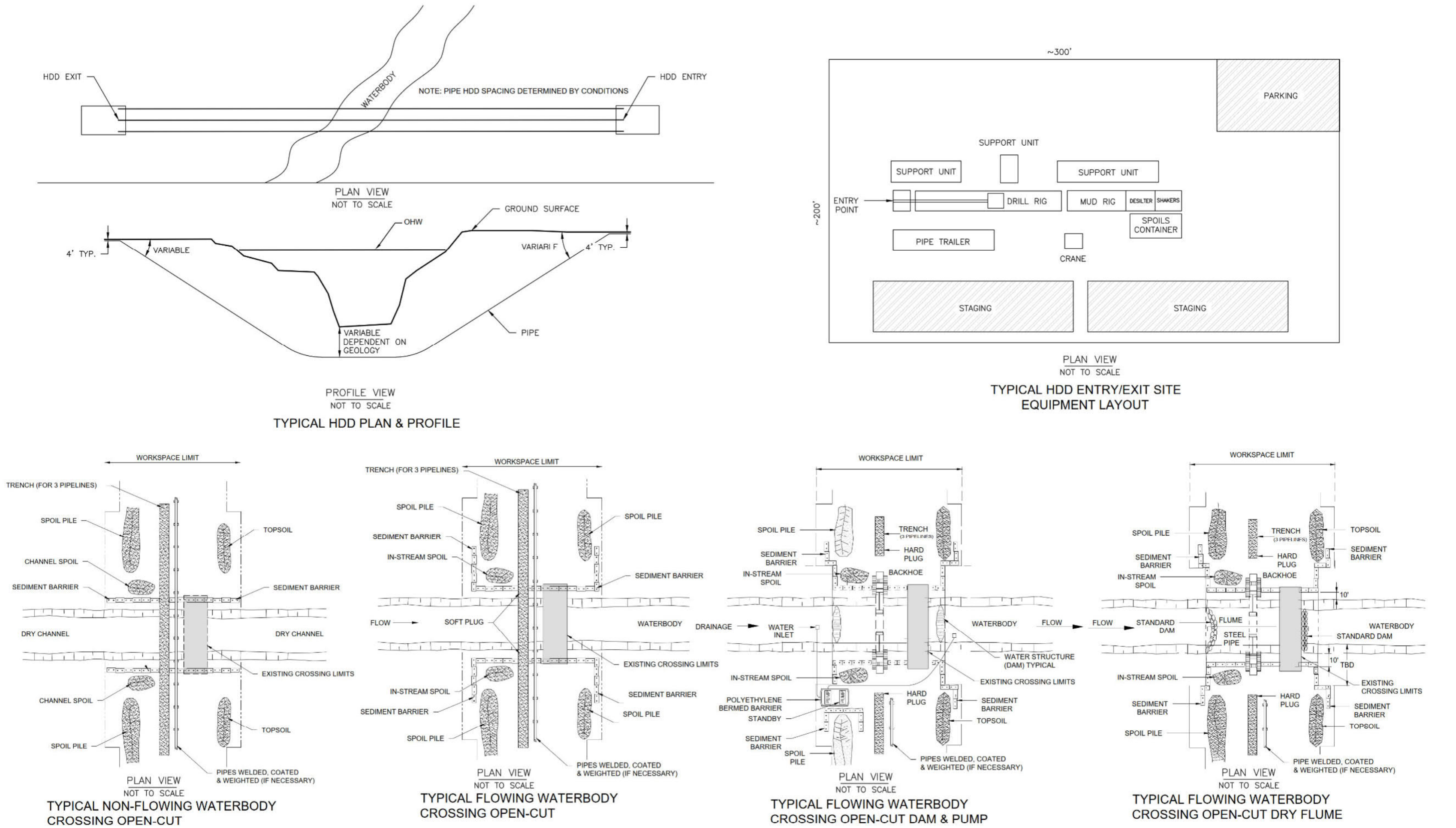
Sources: PLP 2019h

US Army Corps of Engineers

PIPELINE WEST COOK INLET SHORE TRANSITION TYPICAL PROFILE

PEBBLE PROJECT EIS

FIGURE 2-43



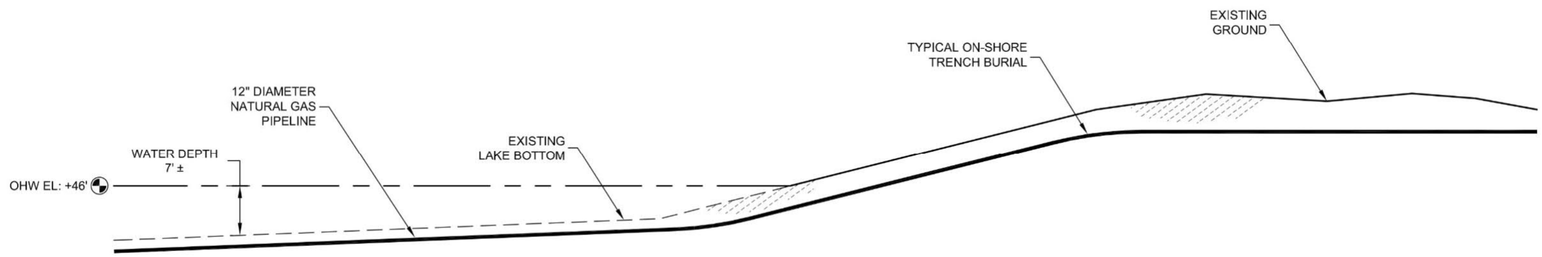
Sources: PLP 2020d

US Army Corps of Engineers®

NATURAL GAS PIPELINE WATERBODY CROSSING TYPICALS

PEBBLE PROJECT EIS

FIGURE 2-44



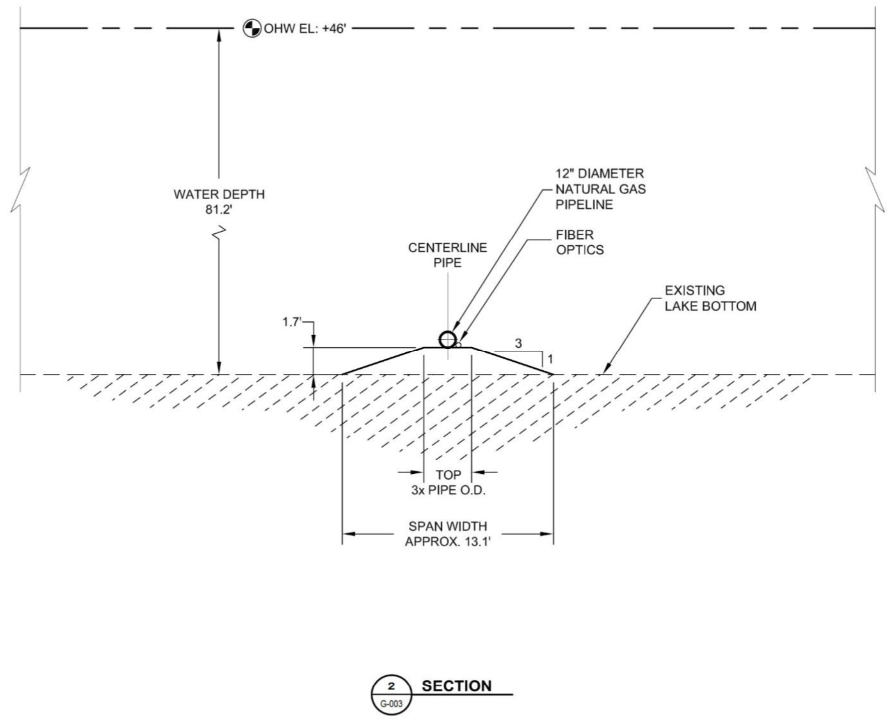
Sources: PLP 2019h

US Army Corps of Engineers

PIPELINE ILIAMNA LAKESHORE TRANSITION TYPICAL PROFILE

PEBBLE PROJECT EIS

FIGURE 2-45

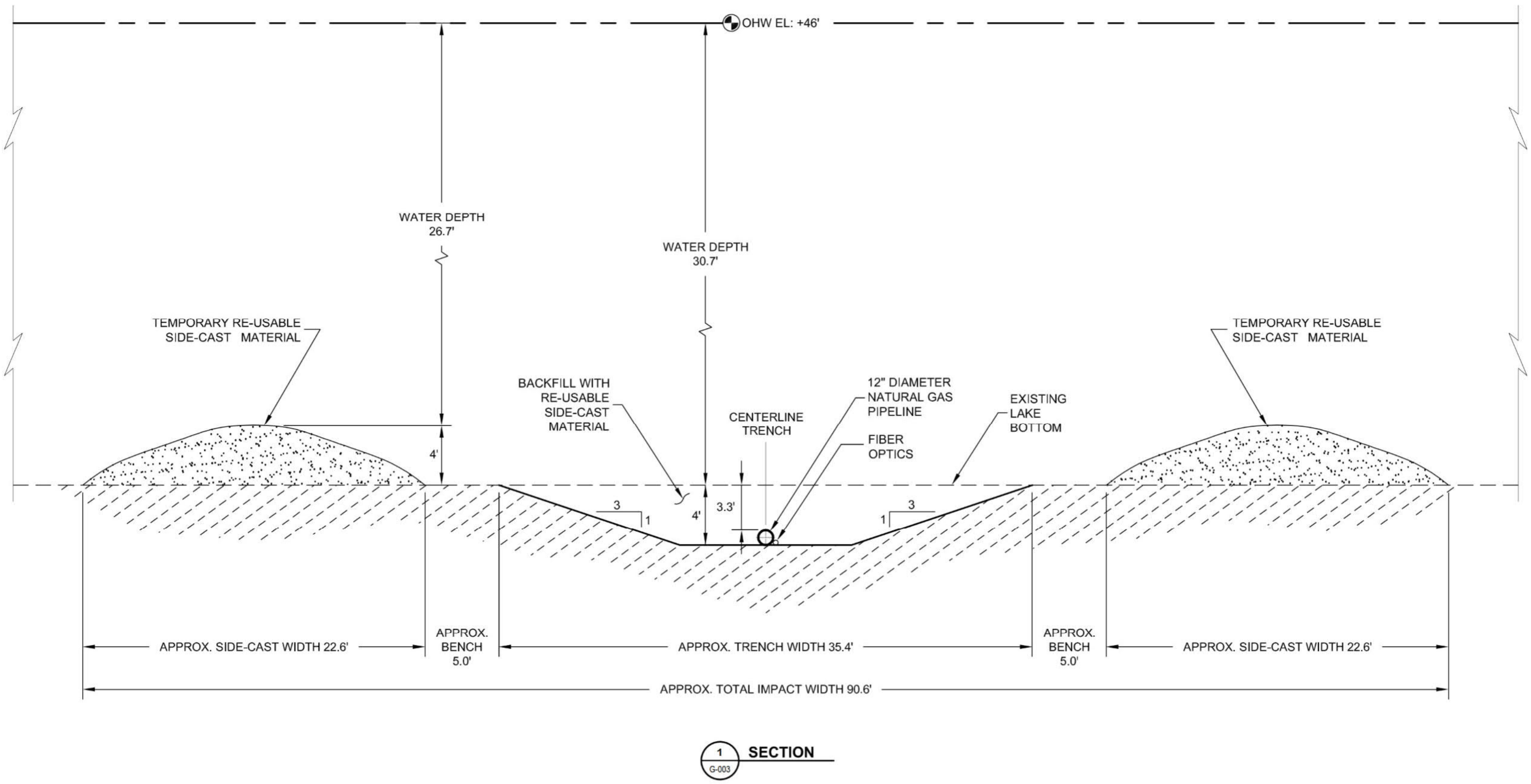


Sources: PLP 2019h

US Army Corps of Engineers®

ILIAMNA LAKE PIPELINE CROSSING SECTION WITH BERM

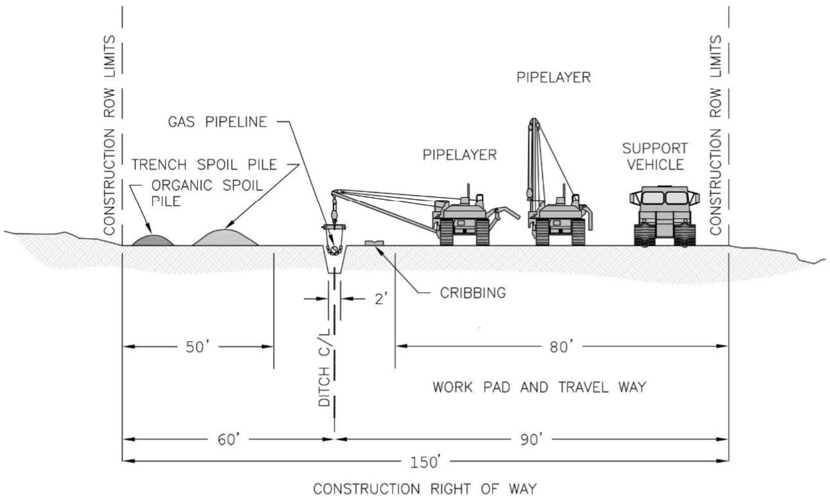
FIGURE 2-46



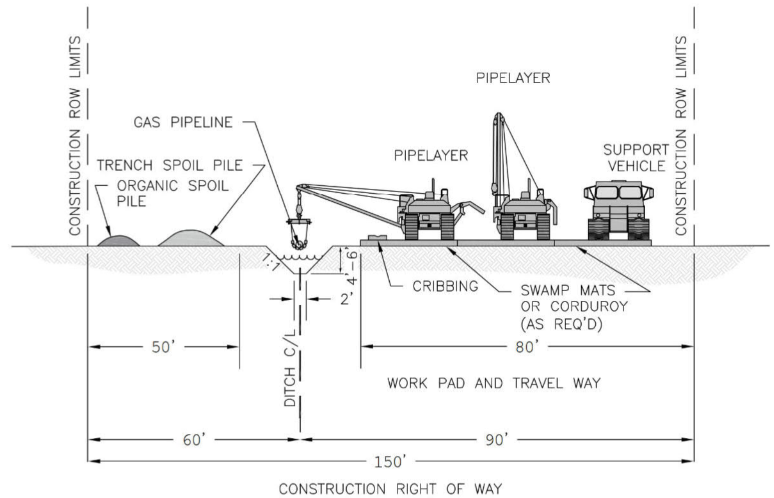
Sources: PLP 2019h

US Army Corps
of Engineers

TYPICAL PIPELINE LAKEBED CROSS SECTION MAXIMUM IMPACT WIDTH



SUMMER GRADED R.O.W. MODE



SUMMER WETLANDS R.O.W. MODE

NOTES:
1. FIBRE OPTIC CABLE INSTALLED IN COMMON DITCH.

Sources: PLP 2019h

US Army Corps of Engineers®

TYPICAL PIPELINE SECTION FOR PIPELINE-ONLY SEGMENTS

Before the pipe section is lowered into trenched segments, inspection would be conducted to verify that the trench bottom is free of rocks and other debris that could damage the external pipe coating. Dewatering may be necessary where water has accumulated in the trench. This would occur in accordance with permit requirements. Side-boom tractors would be used to lift the pipe, position it over the trench, and lower it into place. Specialized padding (soil screening equipment) machines may be used to screen previously excavated mineral soils to provide a padding and bedding material free of larger material to line the bottom of the trench before lowering-in pipe, and to provide backfill material next to the sides and the top of the pipe that would not damage the pipe coating. The coating would be inspected again just before the pipe is placed in the trench.

Long-term corrosion protection and control would 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 would be installed and activated, as soon as is practical, after pipe installation to maximize the effect of corrosion protection. Metering stations and pig launching and receiving facilities would be at the compressor station and offtake points as appropriate. Mainline sectionalizing valves would be installed as per code, with a spacing of no more than 20 miles for the onshore sections of the pipeline. Offshore segments would not be equipped with valves, as allowed by Federal Code (49 CFR Part 192.179).

On completion of construction, the natural gas pipeline would be pressure-tested, and all mechanical, civil, structural, and electrical installations would be checked to ensure that they are installed according to design, and can operate safely.

Pipeline test methods would at a minimum include hydrostatic testing and x-raying welds. No chemicals would be added to the water used for hydrostatic testing. Hydrostatic testing would be conducted during the summer construction season. Disposal methods, locations, and BMPs for the test water discharge would need to be developed to comply with the APDES General Permit AKG320000—Statewide Oil and Gas Pipelines, prior to filing a Notice of Intent for coverage.

Material sites and water extraction sites for road and pipeline construction would be shared, and are discussed above in the Transportation Corridor section. Figures in Appendix K2 show the location of material sites and water extractions sites.

The natural gas pipeline would be equipped with a leak detection system. In the event of a gas release, shut-off valves would be closed to limit the extent of the release. An automatic shut-off system would be installed on the eastern side of Cook Inlet, near the compressor station. On the western side of the Inlet, at the port site, either an automatic or manual shut-off system would be installed (see Chapter 5, Mitigation).

Industry best practices would be used for inspection and maintenance activities during operations (see Chapter 5, Mitigation). Response to RFI BSEE 2 (PLP 2019-RFI BSEE 2; NanaWP and Intecsea 2019c) provides information on inspection and maintenance for the subsea portion of the natural gas pipeline crossing Cook Inlet.

Physical Reclamation and Closure

The natural gas pipeline would be maintained through operations to provide energy to the project site. If no longer required at closure, the pipeline would be pigged and cleaned; and either abandoned in place or removed, subject to state and federal regulatory review and approval at the decommissioning stage of the project. Surface utilities associated with the pipeline would be removed and reclaimed. The BSEE would conduct a site-specific NEPA review on receipt of closure/decommissioning plans at the end of the project.

2.2.5 Alternative 1

The base case for Alternative 1 is PLP's original proposed Pebble Project, described in detail in PLP's December 2018 Project Description (PLP 2018d) and summarized in the DEIS.

Alternative 1 considers: 1) the same mine site layout and processes as Alternative 1a; 2) a different transportation corridor and natural gas pipeline route from the north ferry terminal to the mine site that traverses the UTC watershed; 3) a different north ferry terminal; and 4) the same port access road and the same port site and facilities as Alternative 1a (Amakdedori port), but with a solid fill/sheet pile dock. Figure 2-49 shows the general project layout of Alternative 1.

2.2.5.1 Mine Site

The mine site layout, footprint (approximately 8,390 acres), and processes under Alternative 1 would be the same as described for Alternative 1a (Figure 2-4 and Figure 2-5).

2.2.5.2 Transportation Corridor

The transportation corridor, which would connect the mine site to Amakdedori port on Cook Inlet, has three main components (Figure 2-50):

- Mine access road (341 acres): A private, unpaved, two-lane road extending approximately 28 miles south from the mine site to a ferry terminal on the northern shore of Iliamna Lake (Figure 2-51).
- Ferry crossing: An ice-breaking ferry to transport materials, equipment, and concentrate 18 miles across Iliamna Lake to a ferry terminal on the southern shore near the village of Kokhanok.
- Port access road (411 acres): Same as Alternative 1a (Figure 2-52).

Separate spur roads would extend from the main access roads of the transportation corridor. Spur roads under the Alternative 1 include:

- Iliamna spur road (119 acres): An unpaved spur road, approximately 9 miles long, from the mine access road to the existing road system supporting the communities of Iliamna and Newhalen (Figure 2-51).
- Kokhanok spur road (15 acres): Same as Alternative 1a (Figure 2-52).
- Explosives storage spur road (4 acres): Same as Alternative 1a (Figure 2-51).

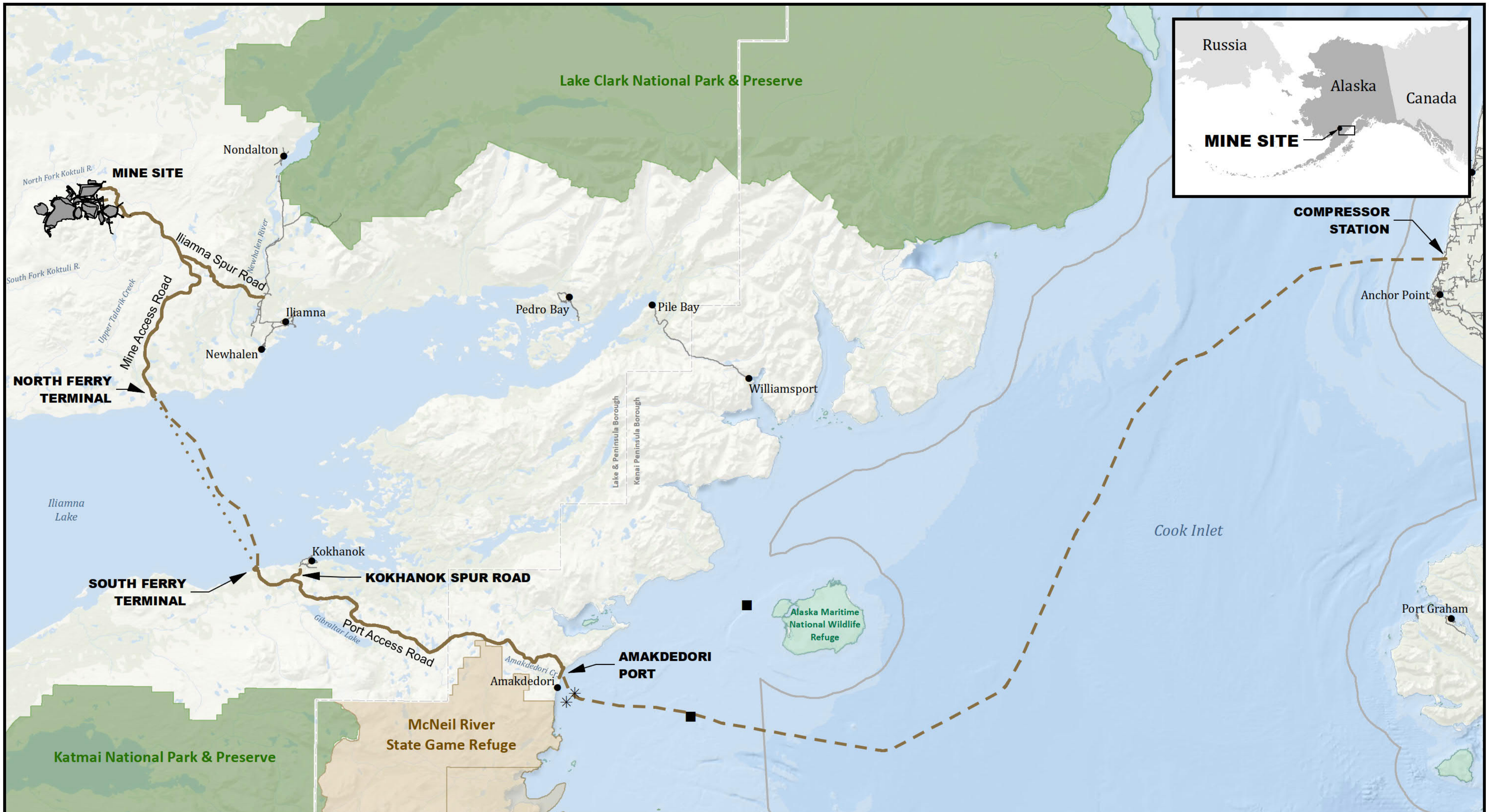
<u>Road System</u>

Design of the access roads would be the same as Alternative 1a.

The Alternative 1 road system would include 10 bridges (PLP 2020g), eight of which would be single-span, two-lane bridges that range in length from approximately 40 to 90 feet. There would be two multi-span, two-lane bridges at Newhalen River (575 feet) and Gibraltar River (300 feet). Culverts would be designed and sized as described for Alternative 1a (Figure 2-22 and Figure 2-23).

<u>Ferry</u>

The ferry vessel design and operations would be year-round, the same as Alternative 1a, but would have a different ferry terminal location on the north shore of Iliamna Lake, and a different ferry crossing route. The north ferry terminal (4 acres) would have a similar layout, facilities, and operations as Alternative 1a. Figure 2-53 and Figure 2-54 depict the north ferry terminal layout and cross sections, respectively. Figure 2-55 presents a digital simulation of the north ferry terminal.



Sources: PLP 2019-RFI153; ADNR

US Army Corps of Engineers

5 0 5 10

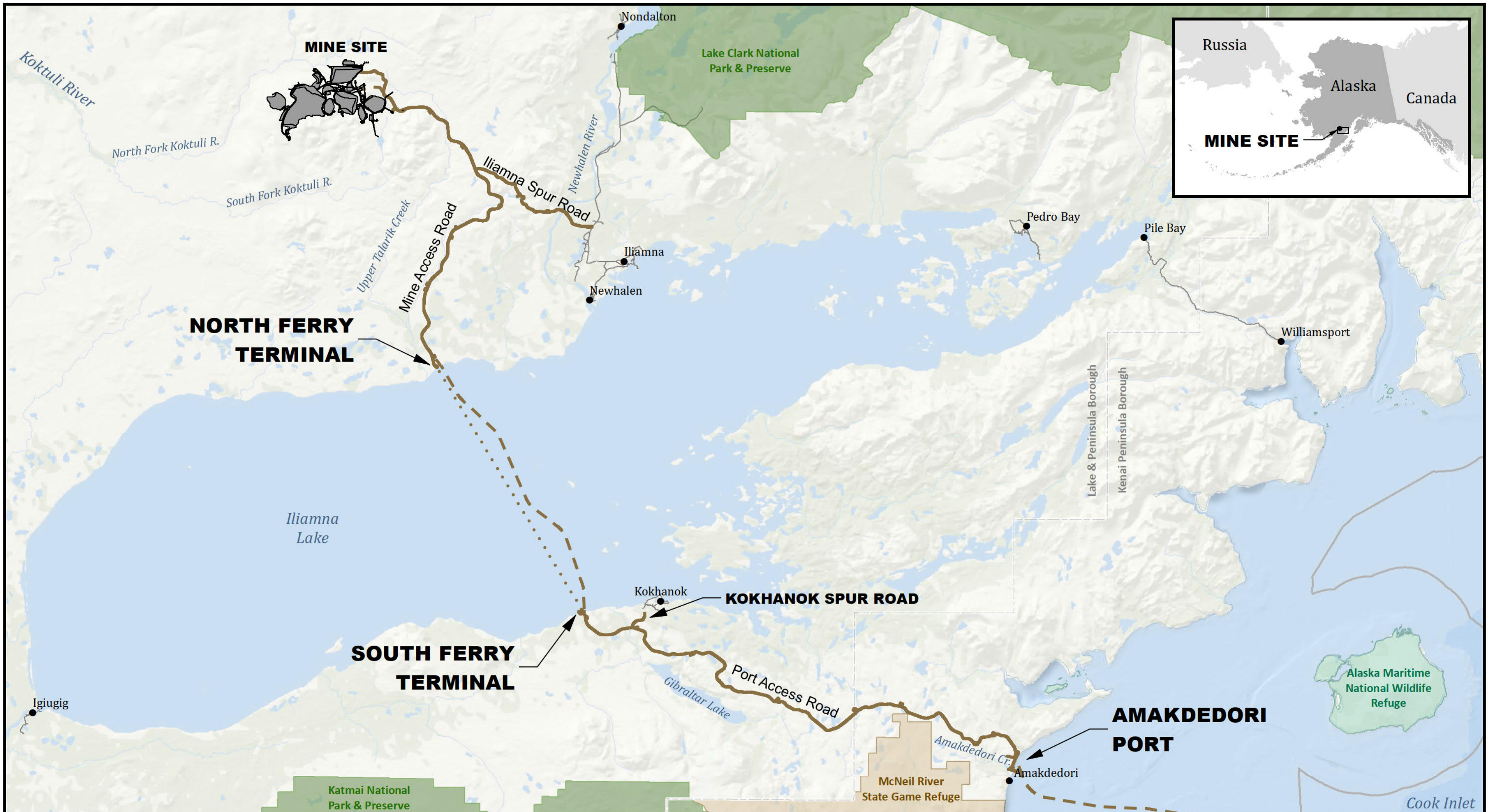
Miles

Alternative 1
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a
- Lightering Location
- Lighted Navigation Buoys
- Mine Site

Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1 - GENERAL PROJECT LAYOUT



Sources: PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

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5 0 5 10

Miles

Alternative 1

- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a

- Mine Site

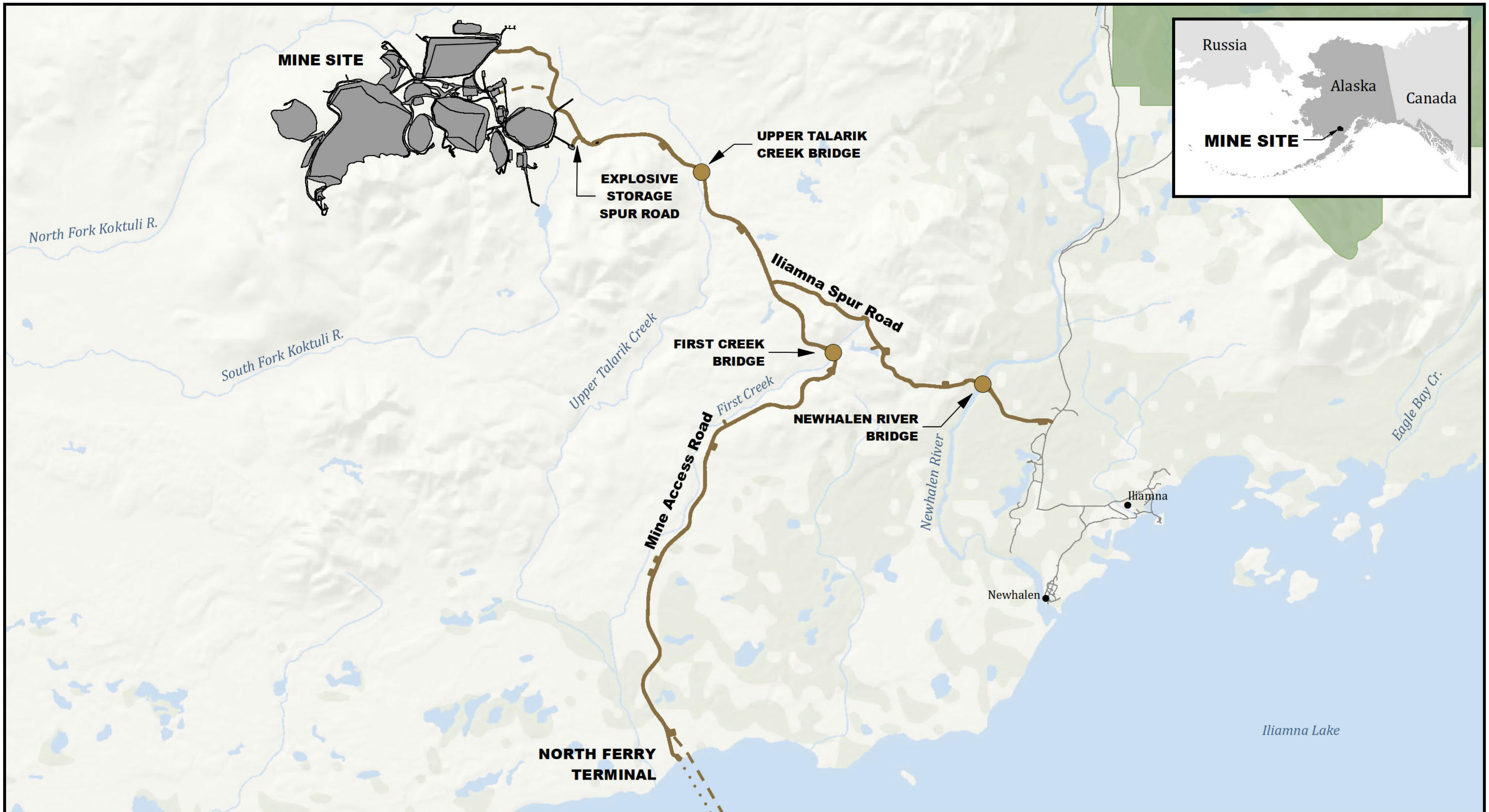
Other Features

- Local Roads
- Borough Boundary
- Three Nautical Mile Line

- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1 - TRANSPORTATION FACILITIES OVERVIEW

FIGURE 2-50



Sources: PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

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2 0 2 4

Miles

Alternative 1

- Bridge
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a

- Mine Site

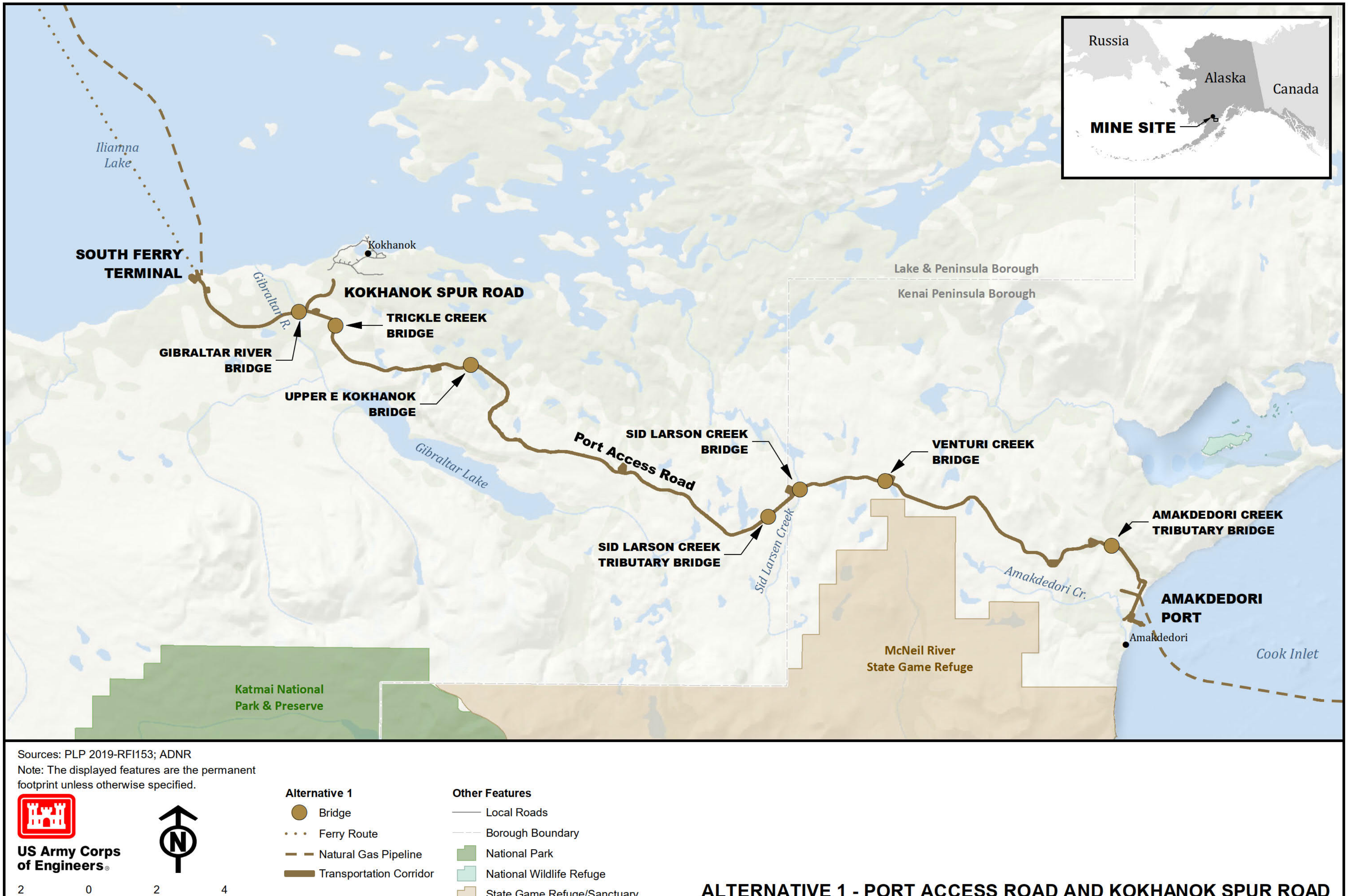
Other Features

- Local Roads
- National Park

ALTERNATIVE 1 - MINE ACCESS ROAD AND ILIAMNA SPUR ROAD

PEBBLE PROJECT EIS

FIGURE 2-51



ALTERNATIVE 1 - PORT ACCESS ROAD AND KOKHANOK SPUR ROAD

PEBBLE PROJECT EIS

FIGURE 2-52

Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

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100 0 100 200
Feet

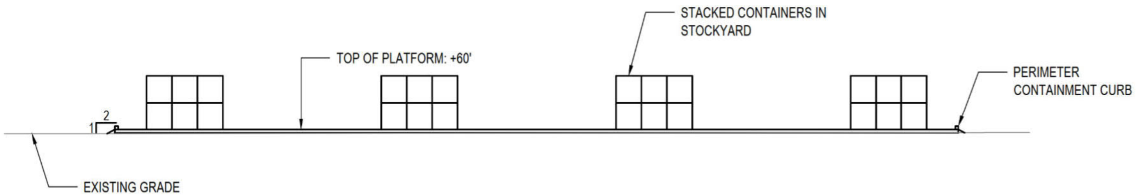
Alternative 1
- Water Extraction Site
- Natural Gas Pipeline
- North Ferry Terminal
- Transportation Corridor

Other Features
- Ordinary High Water

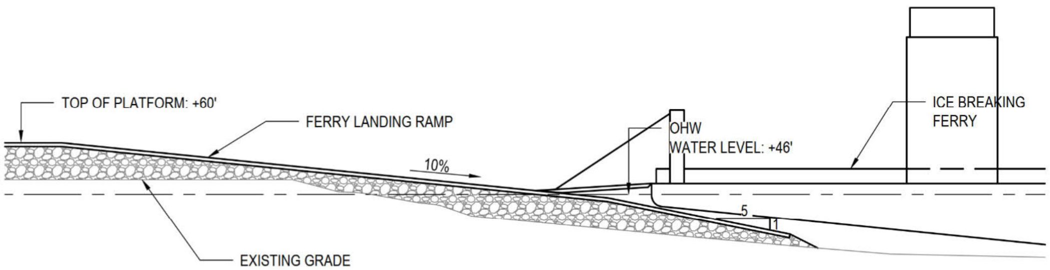
ALTERNATIVE 1 - NORTH FERRY TERMINAL

PEBBLE PROJECT EIS

FIGURE 2-53



SECTION 1 P-004



SECTION 2 P-004

NOTES:

1. DIMENSIONS IN FEET
2. ELEVATIONS ARE IN FEET TO GEODETIC DATUM (GEOID 99)
3. HORIZONTAL DATUM TO UTM NAD83, ALASKA STATE PLANE ZONE 5, US SURVEY FEET
4. ORDINARY HIGH WATER (OHW) ELEVATION BASED ON AERIAL PHOTO INTERPRETATION AND USGS TOPO

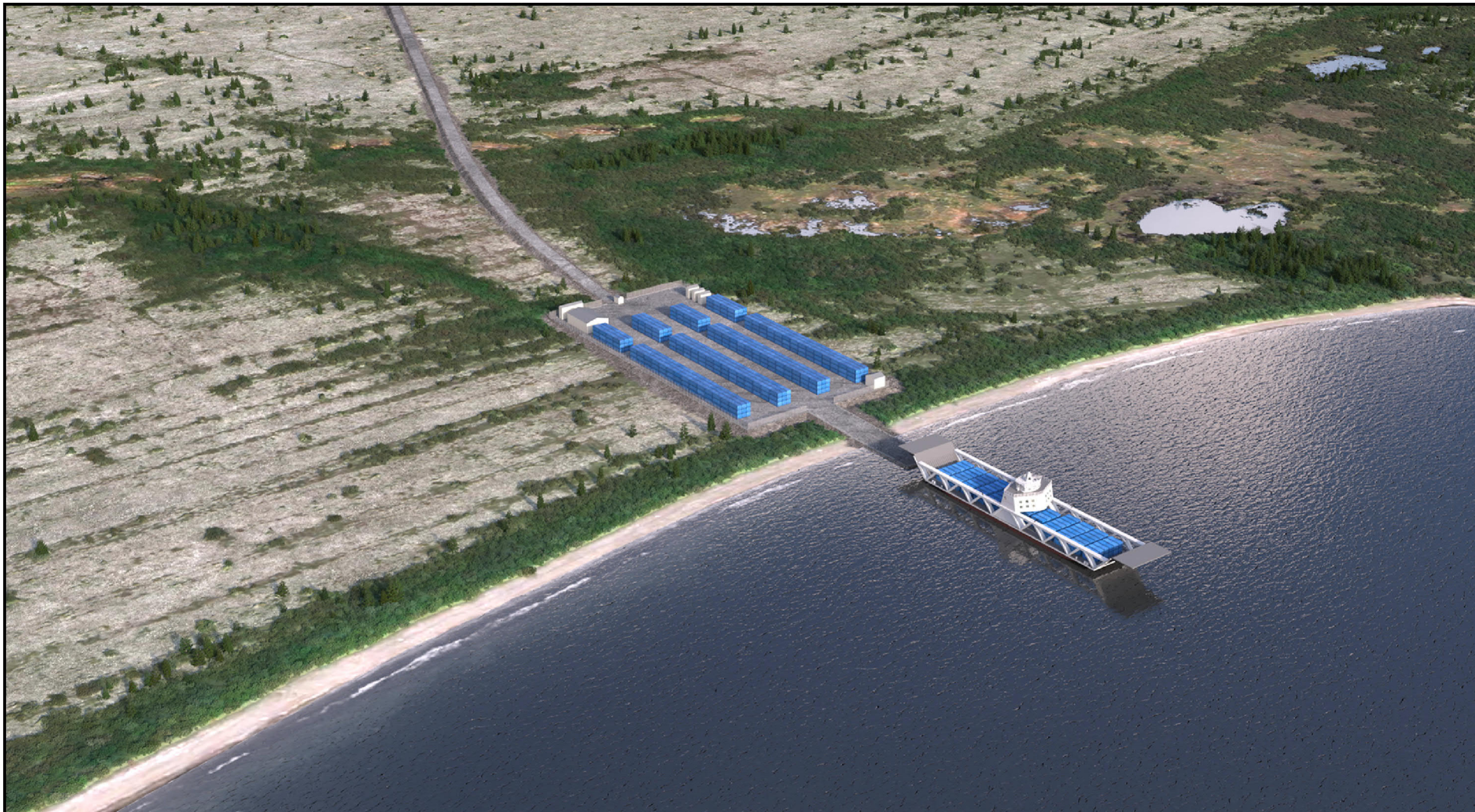
Sources: PLP 2018-RFI-093

US Army Corps of Engineers

ALTERNATIVE 1 - NORTH FERRY TERMINAL CROSS SECTIONS

PEBBLE PROJECT EIS

FIGURE 2-54



Sources: PLP 2018-RFI 034d.

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DIGITAL SIMULATION OF NORTH FERRY TERMINAL

The one-way ferry trip is about 18 miles and would take approximately 1.5 hours in open water, or 3 hours in ice conditions. On average, one round trip per day across the lake would be required, the same as Alternative 1a.

Material Sites

Construction materials would be excavated from borrow material sites along the transportation corridor. An estimate of up to 19 material sites (251 acres) would be required for construction and maintenance of access roads and the natural gas pipeline for Alternative 1. Appendix K2 provides information for each material site, including the location, estimated quantity, size, type of material, use of material, and if blasting is required. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved to another location (PLP 2018-RFI 035). The amount of material estimated to be required for the road and pipeline is approximately 7.5 million yd^3. Final volumes of these gravel materials, and specific location of material sites and development plans for these sites, would be part of the final project design.

Water Extraction Sites

Twenty potential water extraction sites have been identified to support project construction and operations of Alternative 1. Appendix K2 provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The proposed annual volume of water that would be extracted for all water extraction sites is 49 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022). Temporary water use authorizations would be applied for by either the appropriate contractor or PLP.

All-season gravel roads would be necessary to access some of the water extraction sites proposed for Alternative 1. Tables and figures in Appendix K2 provide details on the location and approximate length and acreage of each planned access road. Water extraction site access roads would be less than 1 mile in overall length, and would encompass up to 3 acres total.

Temporary Facilities and Initial Site Access

Temporary facilities associated with Alternative 1 would be the same as described for the Alternative 1a for access roads.

Transportation Corridor Traffic and Materials/Personnel Transport

Trucks, containers, and personnel traffic would be the same as Alternative 1a.

2.2.5.3 Amakdedori Port and Lightering Locations

Alternative 1 includes construction of the Amakdedori port and lightering locations, as described for Alternative 1a, but the marine facilities would include an earthen access causeway and sheet pile jetty instead of a caisson dock, as described below. All other aspects of the port facilities, operation, water management, and physical reclamation and closure would be the same as described for Alternative 1a.

Port Design

The shore-based facilities (15 acres) at Amakdedori would be similar to those described for Alternative 1a. The port would be supported by a permanent airstrip (6 acres) that would be used primarily for construction, but retained for emergency access.

Marine facilities[16] (11 acres) would include an earthen access causeway (maximum width of 500 feet by 1,200 feet long) extending out to a marine jetty at 15 feet below MLLW. One side of the jetty would be occupied by a roll-on/roll-off barge access berth; a separate berth for loading lightering barges would be on the opposite side. The jetty (maximum width of 120 feet by 700 feet long) is expected to be constructed as a sheet pile cell structure filled with granular material. A total of 1,520 linear feet of sheet pile would be installed. Two floating ramps would extend down each side of the jetty to access the barges (100 feet long by 40 feet wide). Tug moorage would be provided at the end of the jetty. Dredging of the port site would not be required. Figure 2-56 and Figure 2-57 show the layout and cross sections, respectively, of the Alternative 1 Amakdedori port design.

Permanent structures mounted on the causeway and or dock would include a fuel pipeline for unloading barges, a powerline for vessel shore power, a water supply line for firefighting, and illumination and navigation lights. No permanent cranes or fuel storage would be located on the dock. Mobile cranes would be used on the dock for some operations.

2.2.5.4 Natural Gas Pipeline Corridor

The Alternative 1 natural gas pipeline corridor is described below. All other components of the pipeline would be the same as described for Alternative 1a.

Natural Gas Pipeline Corridor and Ancillary Facilities

Natural gas would be supplied to Amakdedori port and the mine site by pipeline (187 miles) (Figure 2-58). The pipeline would connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula, and the pipeline design, fiber-optic cable, and the laydown area for the metering station, compressor station, and pig launching/receiving facility would be as described for Alternative 1a.

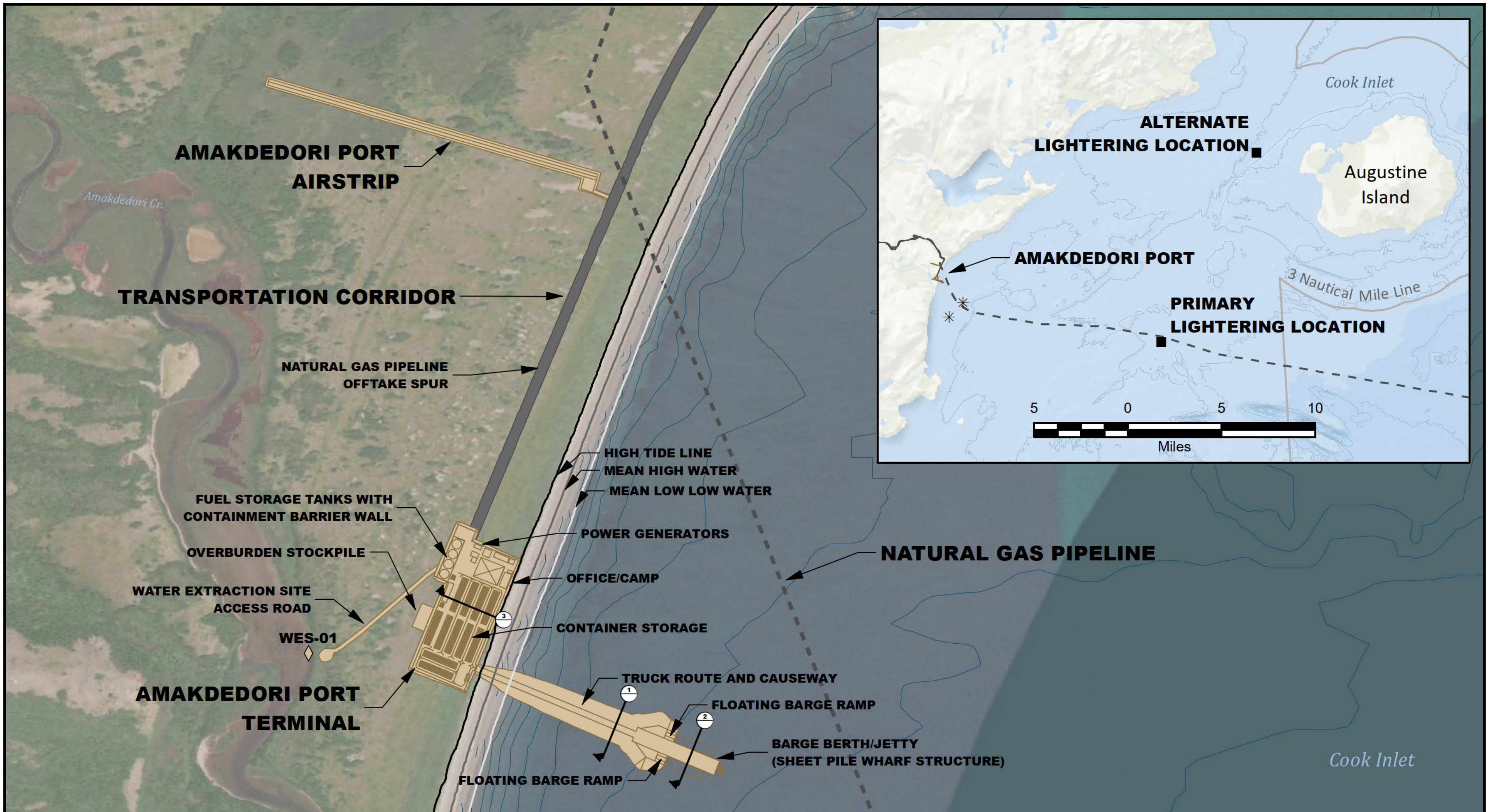
The natural gas pipeline across Cook Inlet (104 miles) would be constructed as described for Alternative 1a, coming ashore at Amakdedori port. The natural gas corridor from Amakdedori port to the mine site would consist of three sections. The first section would follow the port access road to the south ferry terminal. At the south ferry terminal, gas would be fed from the pipeline to the facilities for power supply and facility heat. At this point, the pipeline would enter Iliamna Lake for the next section, an approximately 19-mile lake crossing. The pipeline would come ashore at the north ferry terminal. Natural gas would be used to provide power and heat at ferry terminal facilities. From this point, the pipeline would follow the mine site access road to the mine site.

Surface roughness along two sections of the Iliamna Lake pipeline segment (approximately 2 miles combined) would require building permanent berms on the lakebed to place the pipeline on (Figure 2-46). The berms would be 13-feet-wide, resulting in a permanent footprint of 4 acres. The berms would be constructed as describe for Alternative 1a.

The segments of the natural gas pipeline and fiber-optic cable constructed along the access roads would be buried adjacent to the road bed shoulder, and the pipeline construction area would be in the construction area for the road (Figure 2-20). At bridged crossings, the pipeline would be attached to the bridge structures; otherwise, the pipeline would use trenching or HDD to cross streams (Figure 2-44). Cook Inlet and Iliamna Lake pipeline shore transitions would be the same as described for Alternative 1a.

Material sites used for construction of the co-located access road and pipeline are discussed under the transportation corridor component.

[16] Dimensions for marine facilities included in this paragraph represent the dimensions for construction below the mean high water mark (MHW) of Cook Inlet (PLP 2018-RFI 093).



Sources: PLP 2019-RFI153

Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

500 0 500 1,000

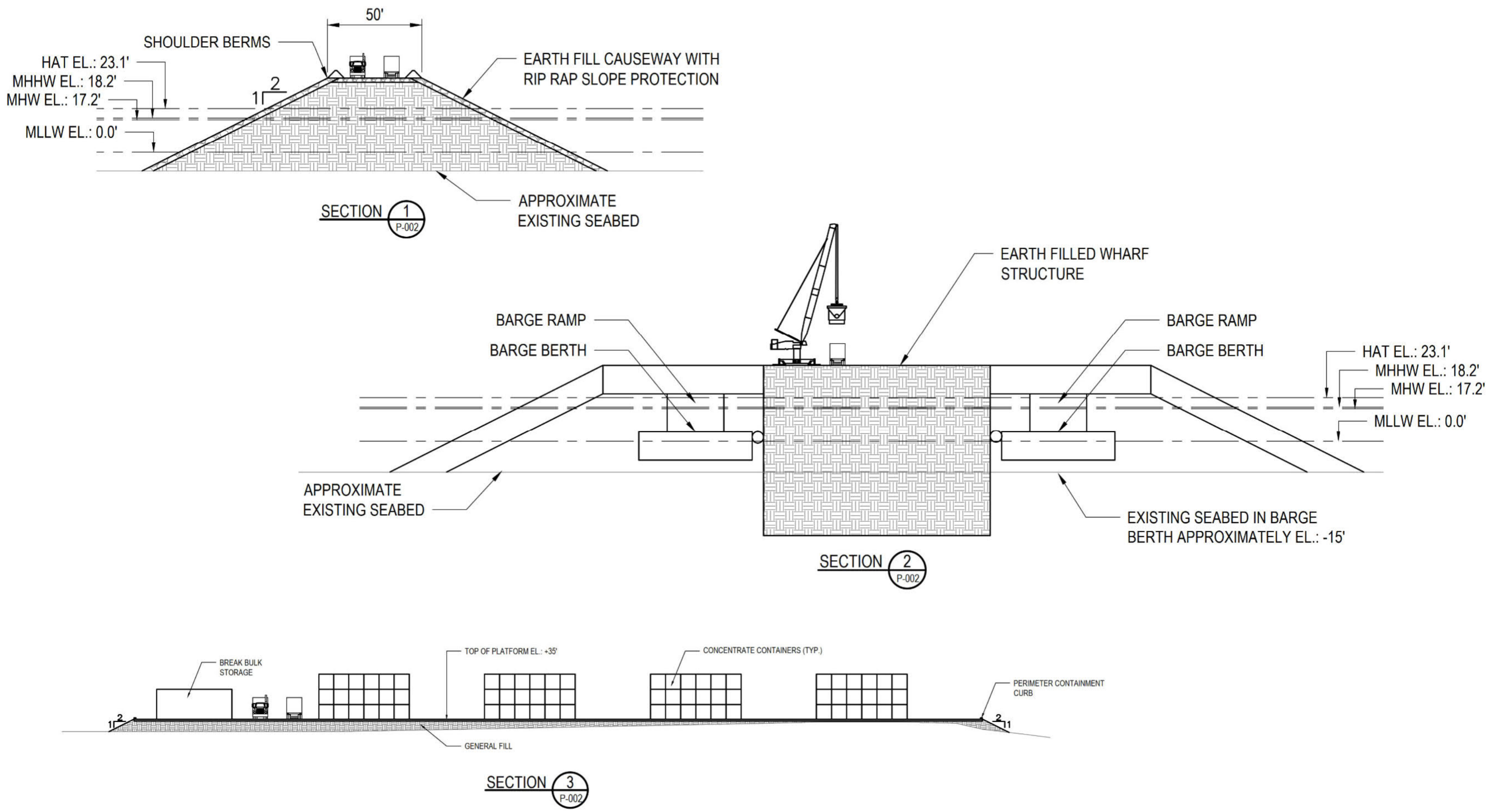
Feet

Alternative 1
- Water Extraction Site
- Amakdedori Port

Alternative 1a
- Lightering Location
- Lighted Navigation Buoys
- Natural Gas Pipeline
- Transportation Corridor

Other Features
- High Tide Line
- Mean High Water
- Mean Low Low Water
- Bathymetric Contour (1m)

ALTERNATIVE 1 - AMAKDEDORI PORT AND LIGHTERING LOCATIONS



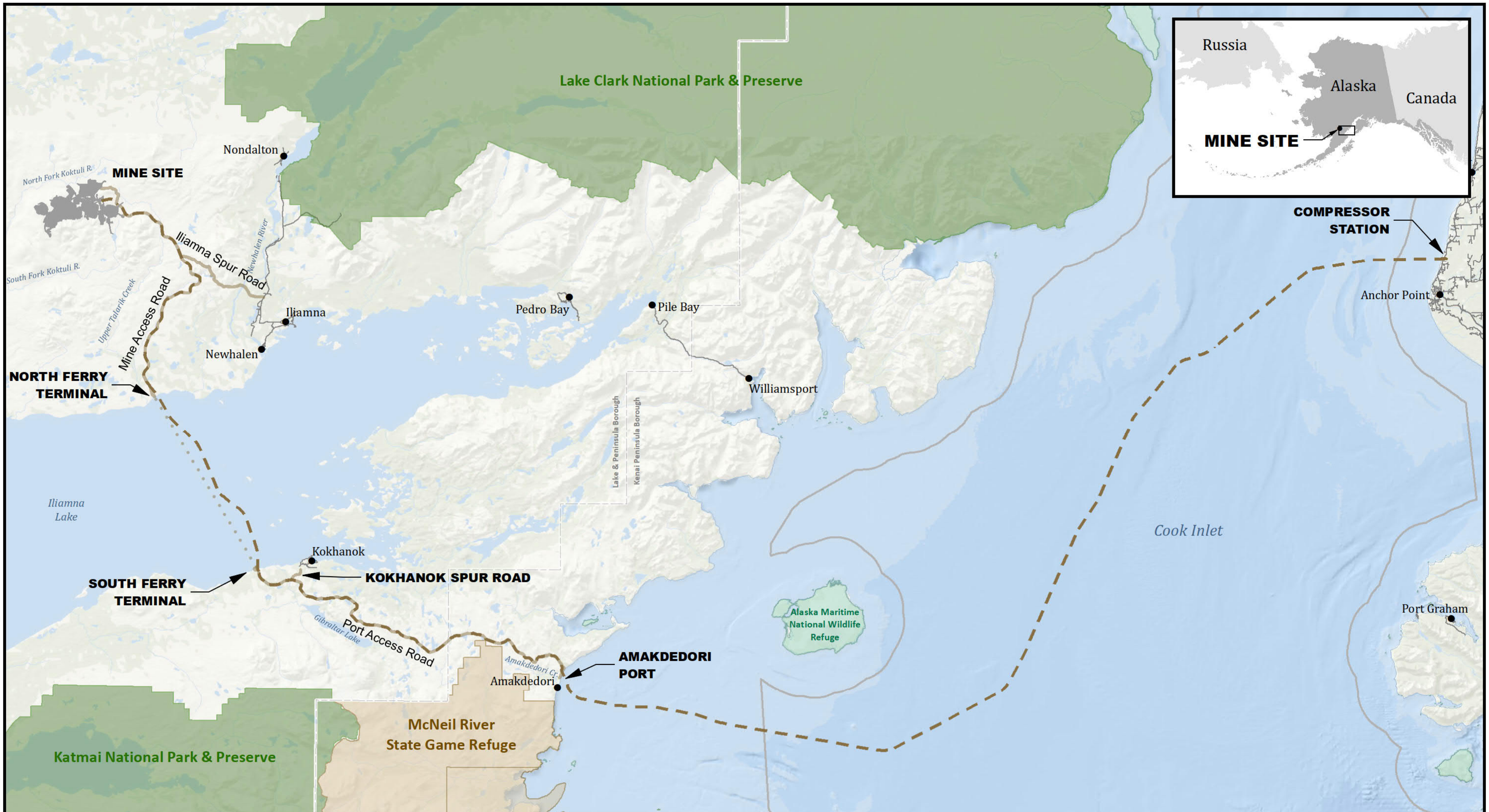
Sources: PLP 2018-RFI093

US Army Corps
of Engineers®

ALTERNATIVE 1 - AMAKDEDORI PORT CROSS SECTIONS

PEBBLE PROJECT EIS

FIGURE 2-57



Sources: PLP 2019-RFI153; ADNR

US Army Corps of Engineers

5 0 5 10

Miles

Alternative 1

- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a

- Mine Site

Other Features

- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1 - NATURAL GAS PIPELINE ALIGNMENT

PEBBLE PROJECT EIS

FIGURE 2-58

2.2.5.5 Alternative 1—Summer-Only Ferry Operations Variant

An option to restrict ferry operations to the open water season was suggested during scoping due to concerns with use of an ice-breaking ferry. With this variant, concentrate shipping at the Amakdedori port using lightering and bulk freighters would continue per the year-round schedule even though the ferry operations would be restricted to the open water season. Therefore, additional storage of containers would be needed at the mine site, to facilitate year-round processing operations; and at the port site, to accommodate the additional containers trucked when the ferry is operating. Changes to the mine site, transportation corridor, and port components with incorporation of this variant are further described below. This variant does not involve changes to the natural gas pipeline component.

Mine Site

Storage of concentrate at the mine site would be needed during the non-operating months until Iliamna Lake is free of ice, and the movement of cargo can be resumed. Storage would be through a container-based system with an additional laydown area at the mine site (PLP 2018-RFI 065). The container yard would be relocated and expanded, the sewage tank pad would be relocated to provide additional laydown space in proximity to the mill, and on-site access roads would be reconfigured slightly; resulting in an increase of the mine site footprint by about 33 acres. Figure 2-59 depicts the mine site layout showing the location of the container yard and relocated sewage tank pad.

Increased storage of consumables, reagents, and fuel would also be needed. This would likely be accommodated in the laydown areas proposed for Alternative 1, and is not expected to increase the overall footprint of the mine site. The bulk fuel storage capacity would increase to accommodate a minimum of 6- to 8-million-gallon storage.

Transportation Corridor

This variant considers ferry operations only during the open water season. To accommodate year-round movements of concentrate, fuel, and consumables during the months the ferry is in operation, a larger non-ice-breaking vessel, or possibly two vessels would be necessary (PLP 2018-RFI 065).

With this variant, the ferry(ies) would be pulled out of the water at freeze-up and launched at break-up. The ferry crew jobs would be seasonal only. During the non-operating months, the ferry(ies) would be over-wintered in cradles onshore in the ferry terminal construction area. The ferry(ies) would be winterized, and any required maintenance would be completed while the ferry is out of the water (PLP 2019-RFI 065a).

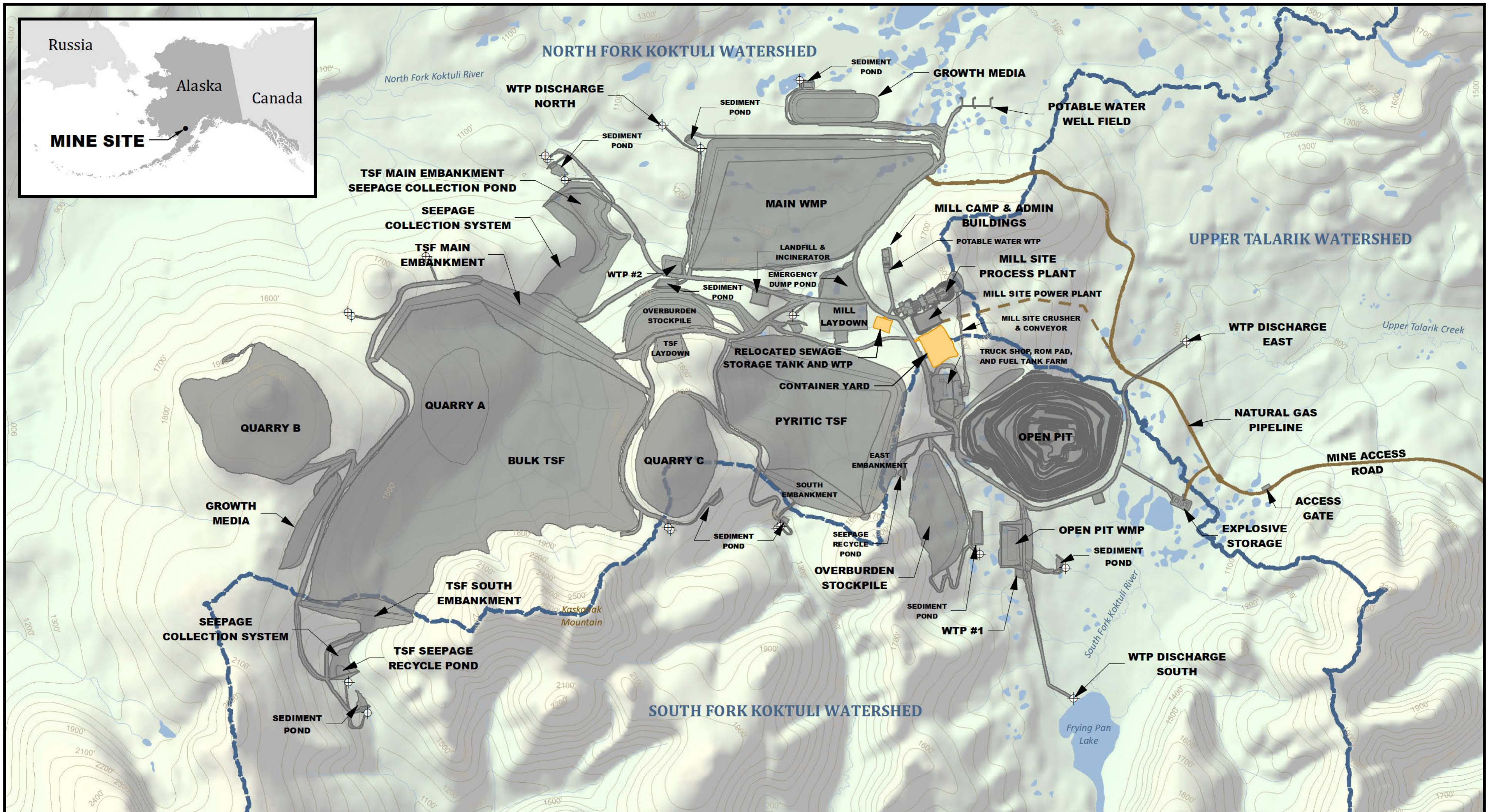
Trucks would also only operate when the ferry(ies) are running, which would double the number of round-trip truck moves to 70 per day each side of the ferry terminals (PLP 2018-RFI 065). The fleet size of truck and trailer units would also double.

Amakdedori Port

Concentrate would be transported to the port site during the operating months and stored on site, where it would be lightered out to the bulk carriers and shipped to market on a year-round basis. Storage would be through a container-based system with an expanded container storage yard (27 acres) at the port site (PLP 2018-RFI 065). Figure 2-60 shows the concentrate storage yard at Amakdedori port.

2.2.5.6 Alternative 1—Kokhanok East Ferry Terminal Variant

Evaluation of alternative ferry terminal locations was suggested during scoping. This variant considers a south ferry terminal site east of Kokhanok: the Kokhanok east ferry terminal site (Figure 2-1 and Figure 2-61). Changes to the transportation corridor and natural gas pipeline components with incorporation of this variant are described below. This variant does not involve changes to the mine site and port components.



Sources: PLP 2019-RFI153; USGS; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

0.5 0 0.5 1
Miles

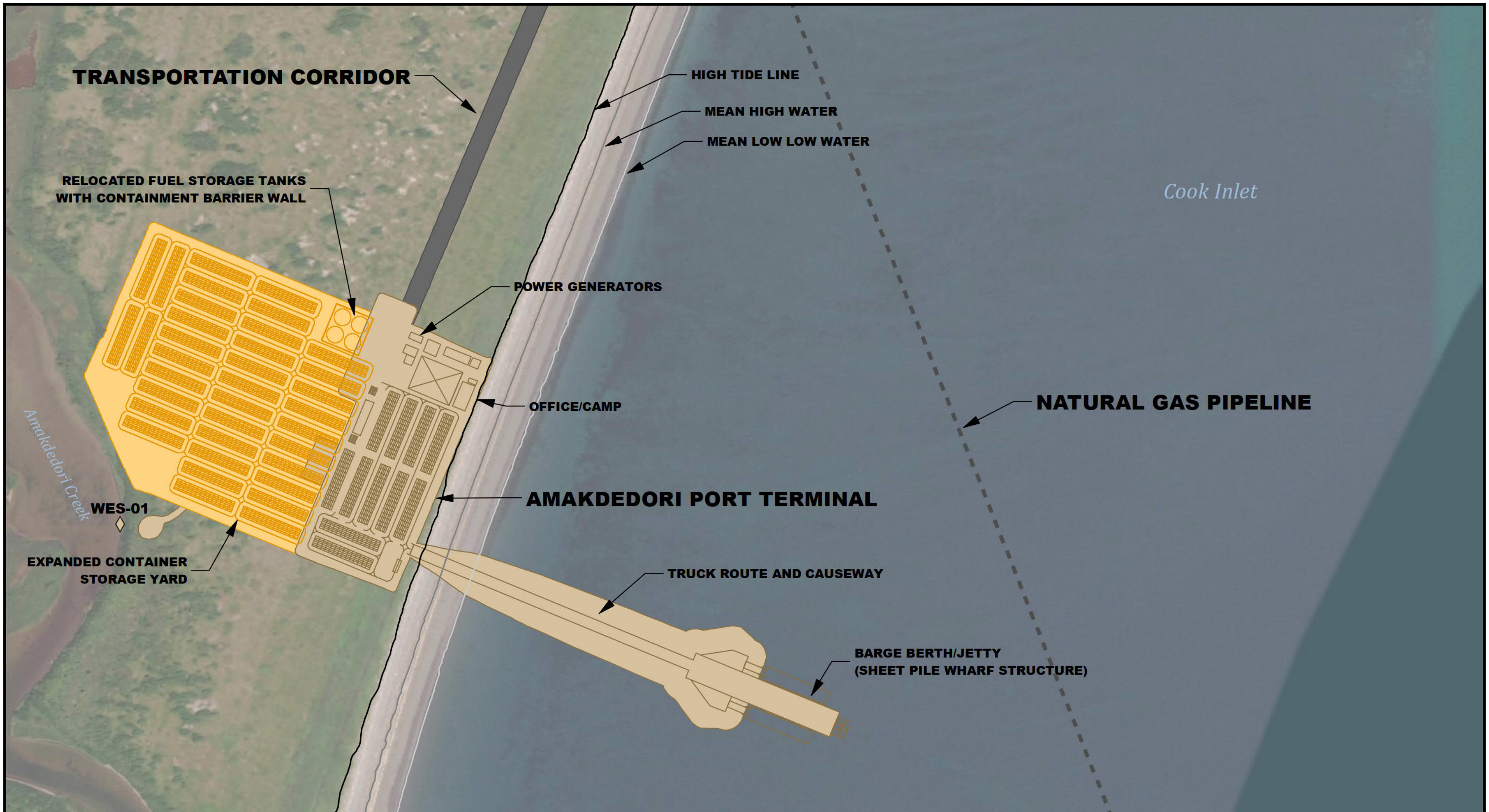
Alternative 1 Variant
- Summer-Only Ferry Operations Mine Site Arrangements

Alternative 1
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a
- Monitoring Wells
- Mine Site

Other Features
- River/Stream
- Lake/Pond
- Watershed
- 100' Contour (Existing)

ALTERNATIVE 1 - SUMMER-ONLY FERRY OPERATIONS VARIANT - MINE SITE LAYOUT



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

200 0 200 400
Feet

Alternative 1 Variant
Summer-Only Ferry Operations Amakdedori Port

Alternative 1
Water Extraction Site
Amakdedori Port

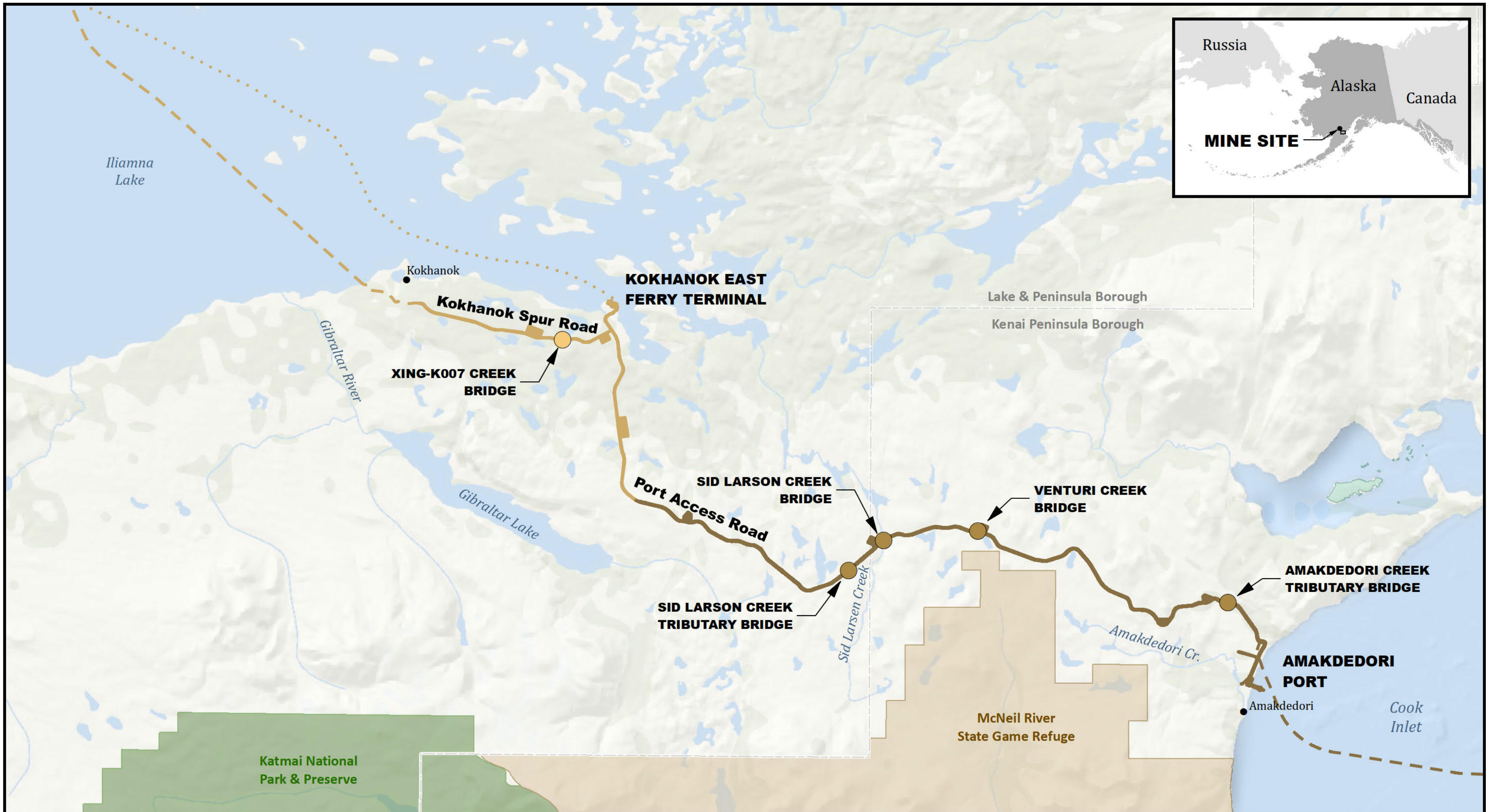
Alternative 1a
Natural Gas Pipeline
Transportation Corridor

Other Features
High Tide Line
Mean High Water
Mean Low Low Water

ALTERNATIVE 1 - SUMMER-ONLY FERRY OPERATIONS VARIANT- AMAKDEDORI PORT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-60



Sources: PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

2 0 2 4

Miles

Alternative 1 Variant

- Bridge
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1

- Bridge
- Natural Gas Pipeline
- Transportation Corridor

Other Features

- Borough Boundary
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 1 - KOKHANOK EAST FERRY TERMINAL VARIANT

PEBBLE PROJECT EIS

FIGURE 2-61

Transportation Corridor

The transportation corridor with incorporation of this variant is as follows (Figure 2-61):

- Mine access road (341 acres): Same as Alternative 1 base case.
- Ferry crossing: An ice-breaking ferry to transport materials, equipment, and concentrate 27 miles across Iliamna Lake to a ferry terminal on the southern shore east of the village of Kokhanok (Kokhanok east ferry terminal).
- Port access road (297 acres): A private, unpaved, two-lane road extending approximately 27 miles southeast from the Kokhanok east ferry terminal to Amakdedori port on Cook Inlet.

Separate spur roads would extend from the main access roads of the transportation corridor. Spur roads under this variant include:

- Iliamna spur road (119 acres): Same as Alternative 1 base case.
- Kokhanok spur road (65 acres): An unpaved spur road, approximately 5 miles long, from the port access road to the community of Kokhanok.
- Explosives storage spur road (4 acres): Same as Alternative 1 base case.

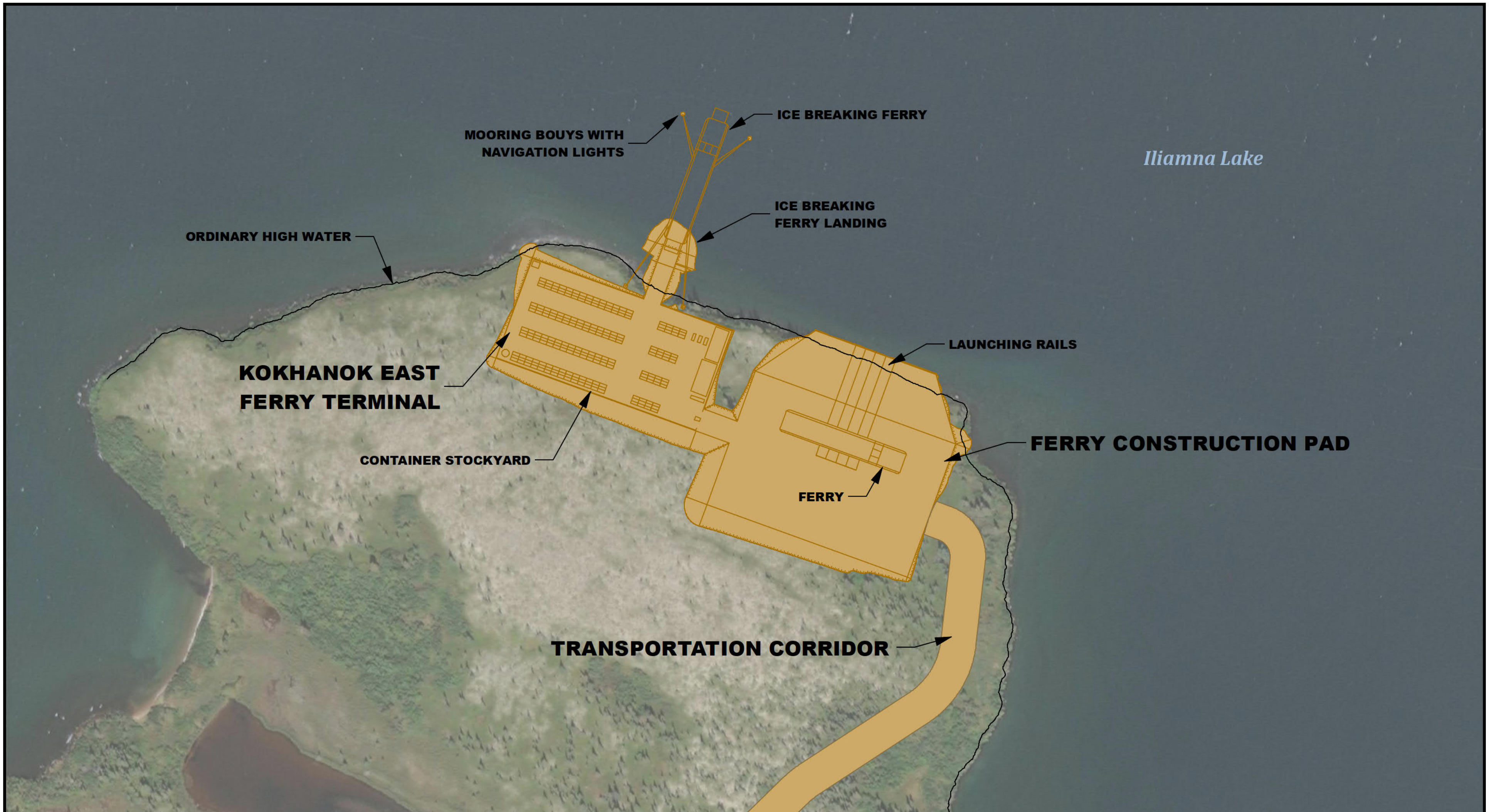
The port access road to the Kokhanok east ferry terminal site would not require a crossing of the Gibraltar River, and would also have fewer overall stream crossings. Alternative 1 access roads with incorporation of this variant would include eight bridges (PLP 2020g), seven of which would be single-span, two-lane bridges that range in length from approximately 40 to 90 feet. There would be one multi-span, two-lane bridge at the Newhalen River (575 feet). Typical bridge and culvert designs would be the same as described above for Alternative 1.

The Kokhanok east ferry terminal site (15 acres) would have a similar layout to the Kokhanok west ferry terminal (Figure 2-62). The one-way ferry trip under this variant would be longer than the Alternative 1 base case, which would add to the trip duration (PLP 2018-RFI 078). The crossing would take approximately 2.25 hours to complete in open water, or 4.5 hours in ice conditions.

Incorporation of this variant would result in a total of up to 19 material sites (up to 358 acres) for construction and maintenance of access roads and the natural gas pipeline. Appendix K2 provides information for each material site, including the location, estimated quantity, size, type of material, use of material, and if blasting is required. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved. The amount of material estimated to be required for the road and pipeline is approximately 7.6 million yd^3. Final volumes of these gravel materials and specific location of material sites and development plans for these sites would be part of the final project design.

Water extraction sites would be located along the port access road from the Kokhanok east ferry terminal site and along the Kokhanok east spur road. These would replace some water extraction sites along the port access road to the Kokhanok west ferry terminal site. Twenty potential water extraction sites have been identified to support project construction and operations of this variant. Appendix K2 provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The proposed annual volume of water that would be extracted for all water extraction sites with this variant is 55 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022).

Water extraction site access roads would be the same as described for the Alternative 1 base case.



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

200 0 200 400
Feet

Alternative 1 Variant
Kokhanok East Ferry Terminal

Other Features
Ordinary High Water

ALTERNATIVE 1 - KOKHANOK EAST VARIANT - FERRY TERMINAL LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-62

Natural Gas Pipeline

The natural gas pipeline alignment from the Amakdedori port would follow the port access road towards the Kokhanok east ferry terminal and the spur road into Kokhanok. From Kokhanok, it would follow an existing road alignment to the point where it departs the shoreline to tie into the proposed route from the Kokhanok west ferry terminal site (Figure 2-61). The total pipeline length with this variant would be 185 miles. The pipeline design and all other segments of the pipeline would be the same as described for Alternative 1.

2.2.5.7 Alternative 1—Pile-Supported Dock Variant

This variant considers construction of an access trestle and pile-supported dock at Amakdedori port, instead of an earthen access causeway and jetty, to minimize in-water impacts. Figure 2-63 depicts the conceptual pile-supported dock layout. The conceptual structure would consist of 76 trestle piles and 177 dock piles, for a total of 253 piles (PLP 2018-RFI 072). All piles would be 48 inches in diameter, with a 1.5-inch wall thickness. The steel piles would be vibrated into place and then driven to refusal with an impact hammer. The marine facilities footprint with this variant would be less than 0.1 acre (3,200 square feet). Other than pilings, no in-water fill material would be placed below MHW of Cook Inlet with this variant. All other facilities and operations at the port would be the same as described for Alternative 1.

This variant does not involve changes to the mine site, transportation corridor, or natural gas pipeline components.

2.2.6 Alternative 2—North Road and Ferry with Downstream Dams

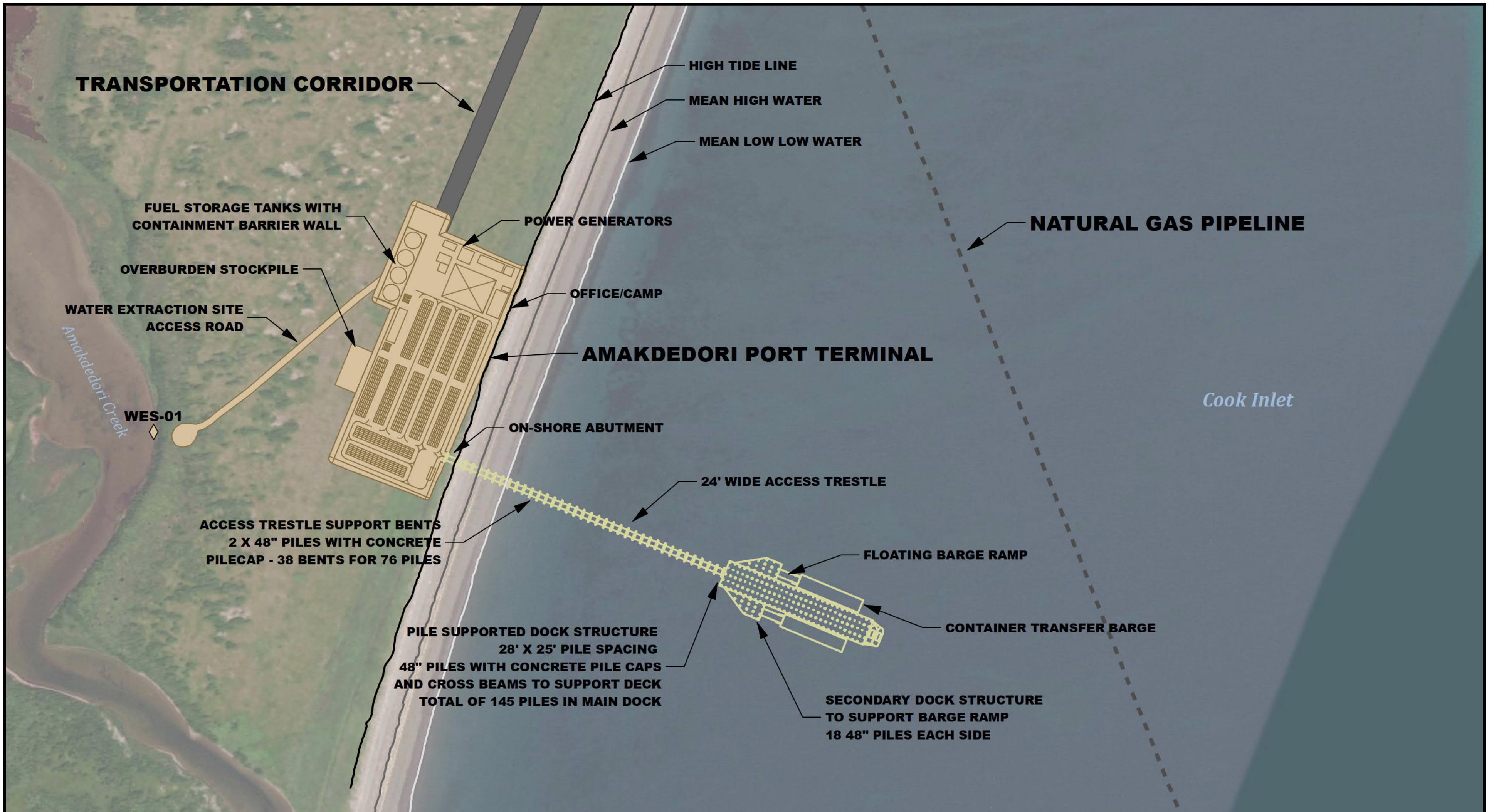
This section summarizes Alternative 2—North Road and Ferry with Downstream Dams. This alternative was developed primarily to address scoping comments suggesting that the EIS analyze alternative road corridors, ferry terminal, and port locations; and due to concerns expressed about the stability of tailings facilities.

Alternative 2 considers: 1) downstream construction methods for the north bulk TSF embankment; 2) a different transportation corridor route (access roads and ferry) on the north end of Iliamna Lake; 3) a port site at Diamond Point; and 4) a natural gas pipeline alignment on the northern end of Iliamna Lake (Figure 2-1 and Figure 2-64). Appendix K2 provides a summary of the Alternative 2 permanent footprint for each project component (mine site, transportation corridor, port, and natural gas pipeline). Additional information is provided in Appendix K2, as indicated in the discussion below.

2.2.6.1 Mine Site

The mine site layout and processes under Alternative 2 (Figure 2-65) would be the same as described for Alternative 1a, except for the construction methods for the north embankment of the bulk TSF. Under Alternative 2, the north bulk TSF embankment would be constructed using the downstream method with buttresses, instead of the centerline method described under Alternative 1a.

Under this alternative, the downstream slope would be 2.6H:1V, and the upstream slope 2H:1V. The north embankment crest would be raised approximately 25 feet to an elevation of 1,745 feet (embankment height approximately 570 feet) to provide equivalent bulk TSF storage capacity. The centerline would shift approximately 40 feet upstream (Figure 2-66). The embankment fill would increase from 78 million to 124 million yd^3 (PLP 2018-RFI 075a). The Alternative 2 bulk TSF footprint would be 2,907 acres; an increase of 110 acres compared to Alternative 1a.



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

200 0 200 400
Feet

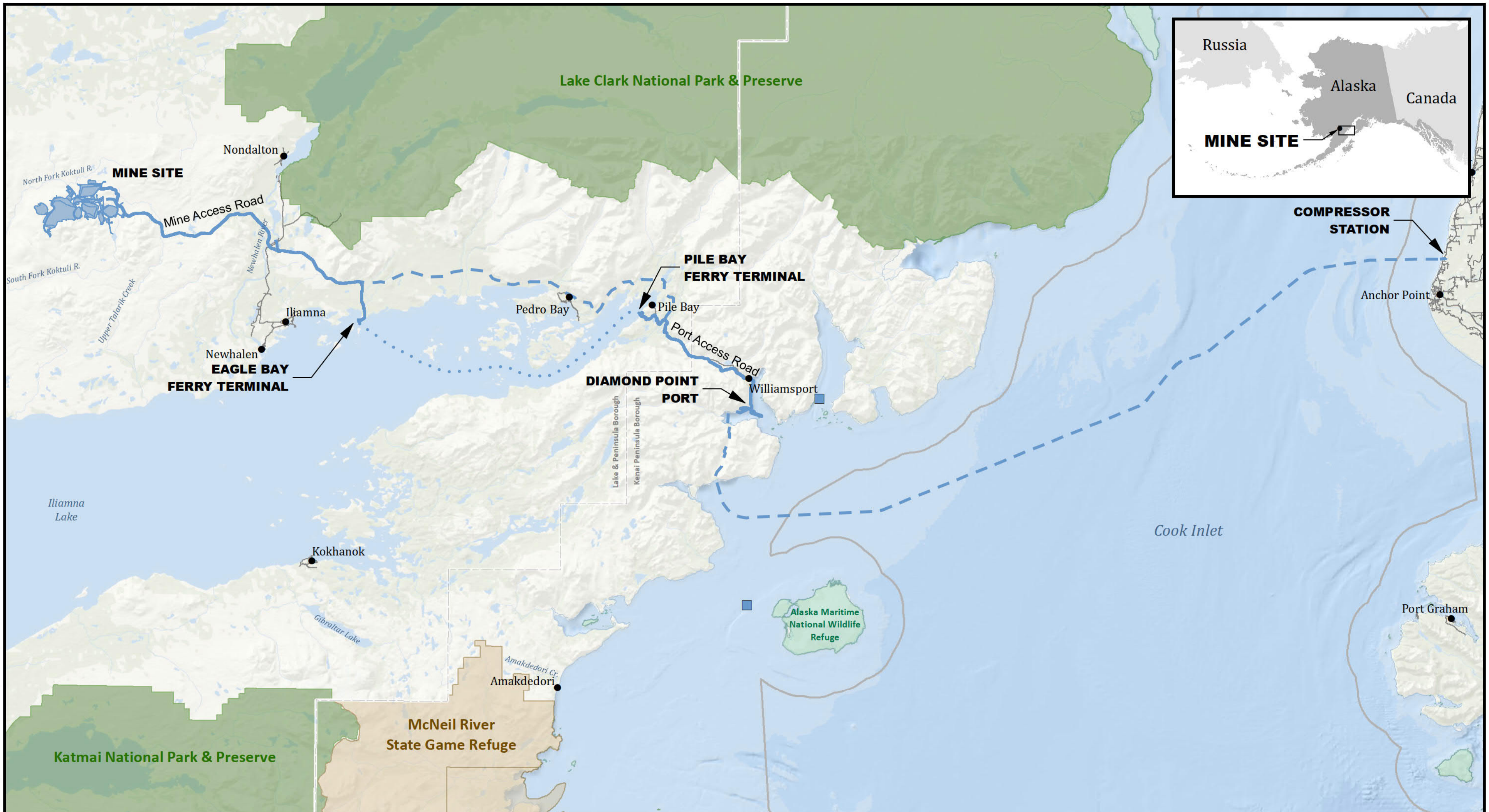
Alternative 1 Variant
- Pile-Supported Dock

Alternative 1
- Water Extraction Site
- Amakdedori Port

Alternative 1a
- Natural Gas Pipeline
- Transportation Corridor

Other Features
- High Tide Line
- Mean High Water
- Mean Low Low Water

ALTERNATIVE 1 - AMAKDEDORI PORT PILE-SUPPORTED DOCK VARIANT



Sources: PLP 2019-RFI153; ADNR

US Army Corps of Engineers

5 0 5 10

Miles

Alternative 2

- Lightering Locations
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site

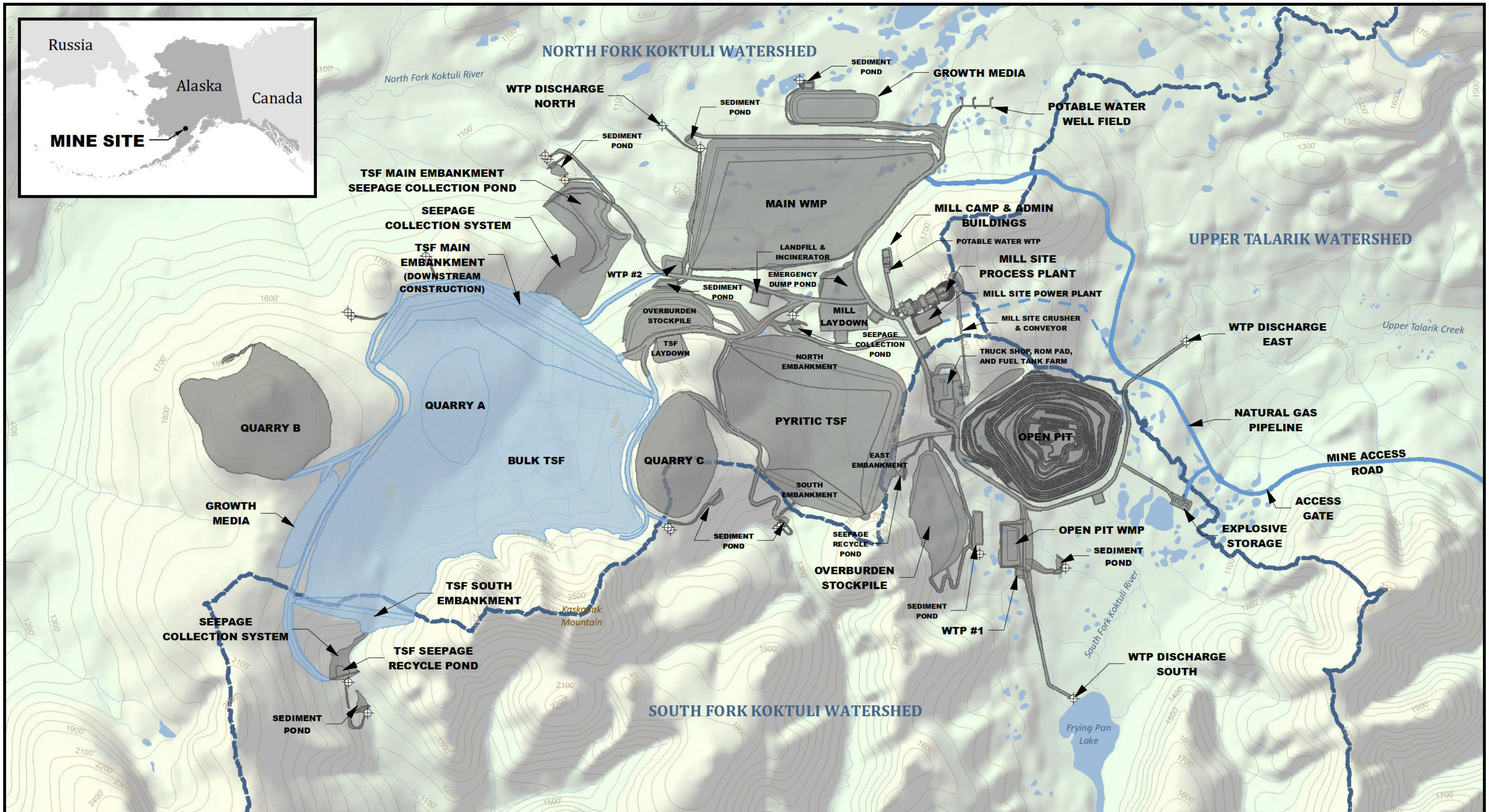
Other Features

- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 2 - GENERAL PROJECT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-64



Sources: PLP 2019-RFI153; USGS; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

0.5 0 0.5 1
Miles

Alternative 2
- Natural Gas Pipeline
- Transportation Corridor
- Bulk TSF Downstream Construction Mine Site Arrangements

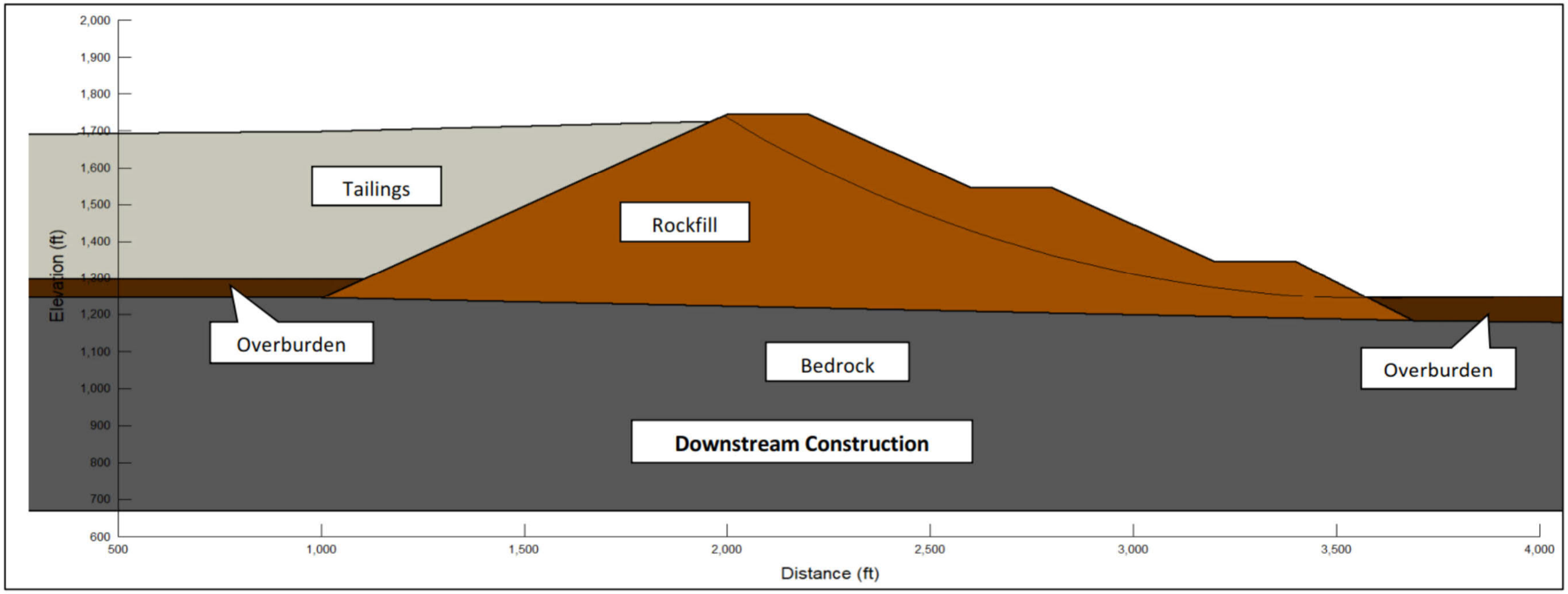
Alternative 1a
- Monitoring Wells
- Mine Site

Other Features
- River/Stream
- Lake/Pond
- Watershed
- 100' Contour (Existing)

ALTERNATIVE 2 - MINE SITE LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-65



NOTES:

1. OVERBURDEN TO BE REMOVED FROM BENEATH THE EMBANKMENT FOOTPRINT, QUARRY A, AND LOCATIONS OF UNDERDRAINS.

Sources: PLP 2018-RFI075a

US Army Corps of Engineers

ALTERNATIVE 2 - BULK TSF NORTH EMBANKMENT CROSS SECTION

There would also be minor adjustments to the sediment/seepage collection systems (1-acre increase), mine site infrastructure (1-acre decrease), and on-site access roads (4-acre decrease), compared to Alternative 1a, to accommodate the bulk TSF design. The overall mine site footprint for Alternative 2 would be 8,497 acres.

2.2.6.2 Transportation Corridor

The transportation corridor under Alternative 2 would connect the mine site to the Diamond Point port in Iliamna Bay (Figure 2-67) for the transportation of materials, equipment, and concentrate. It has three main components:

- Mine access road (353 acres): Same as Alternative 1a (Figure 2-68).
- Ferry crossing: An ice-breaking ferry to transport materials, equipment, and concentrate 29 miles across Iliamna Lake to a ferry terminal on the eastern shore at Pile Bay.
- Port access road (209 acres): A controlled access, unpaved two-lane road extending 18 miles southeast from the east ferry terminal to the Diamond Point port site in Iliamna Bay (Figure 2-69).

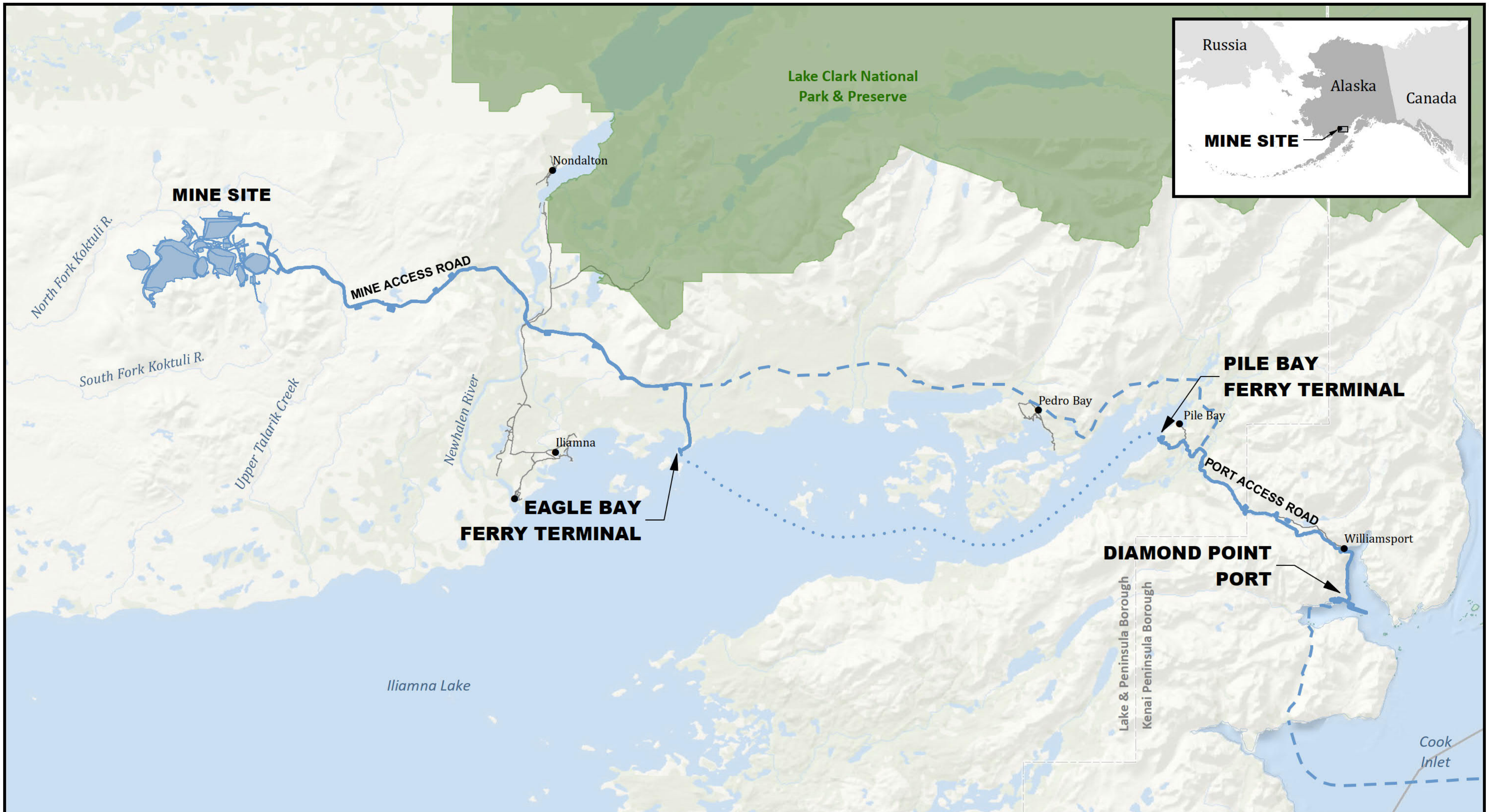
The explosives storage spur road (4 acres), previously described for Alternative 1a, is the only spur road proposed under Alternative 2.

The ferry, truck transportation, and the Diamond Point port would operate year-round. The general descriptions for temporary facilities, transportation corridor traffic, material transport, and physical reclamation and closure, would be the same as Alternative 1a, but would occur at the locations described under this alternative. The exception is that it is reasonable to assume that after closure of the proposed project, the Diamond Point marine port facilities would be maintained and operated by another entity to transfer freight and boats, instead of being removed and reclaimed as is proposed for the Amakdedori port dock under Alternative 1a. Freight and boats are currently transferred through nearby Williamsport, but the all-tide Diamond Point port would be an improvement over the existing high-tide-only Williamsport facility.

Road System

The mine access road alignment and design would be the same as Alternative 1a. The State of Alaska operates an existing road between Williamsport on Iliamna Bay and Pile Bay on Iliamna Lake (herein referred to as the Williamsport-Pile Bay Road). The proposed port access road would parallel the existing Williamsport-Pile Bay Road for approximately 5 miles from Williamsport, and would then replace the existing road for approximately 7 miles from that point until the existing road turns toward Pile Bay. Once constructed, it is assumed that project-related haul trucks would share the road with the existing road users, which are primarily privately operated trucks transporting freight and vessels being portaged.

Alternative 2 road system would include seven bridges (PLP 2020g), four of which would be single-span, two-lane bridges that range in length from approximately 50 to 90 feet. There would be one large (510 foot) multi-span, two-lane bridge at the Newhalen River (575 feet), and two other multi-span bridges at Iliamna River (200 feet) and Chinkelyes Creek (140 feet). The Newhalen River crossing would be at the southern crossing location. Typical bridge and culvert designs would be the same as described for Alternative 1a.



Sources: PLP 2019-RFI153; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

3 0 3 6
Miles

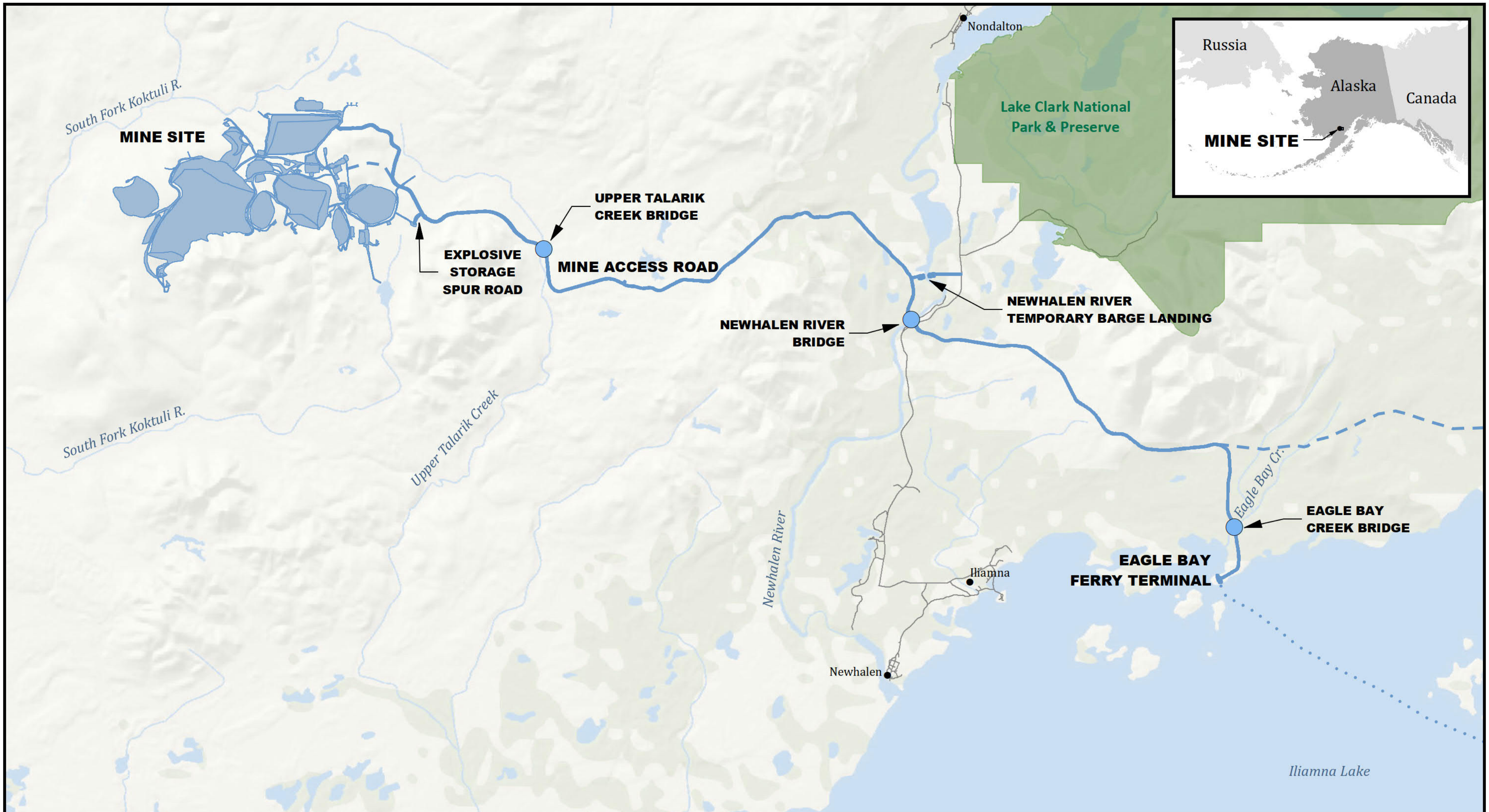
Alternative 2
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site

Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge

ALTERNATIVE 2 - TRANSPORTATION FACILITIES OVERVIEW

PEBBLE PROJECT EIS

FIGURE 2-67



Sources: PLP 2019-RFI153; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

2 0 2 4
Miles

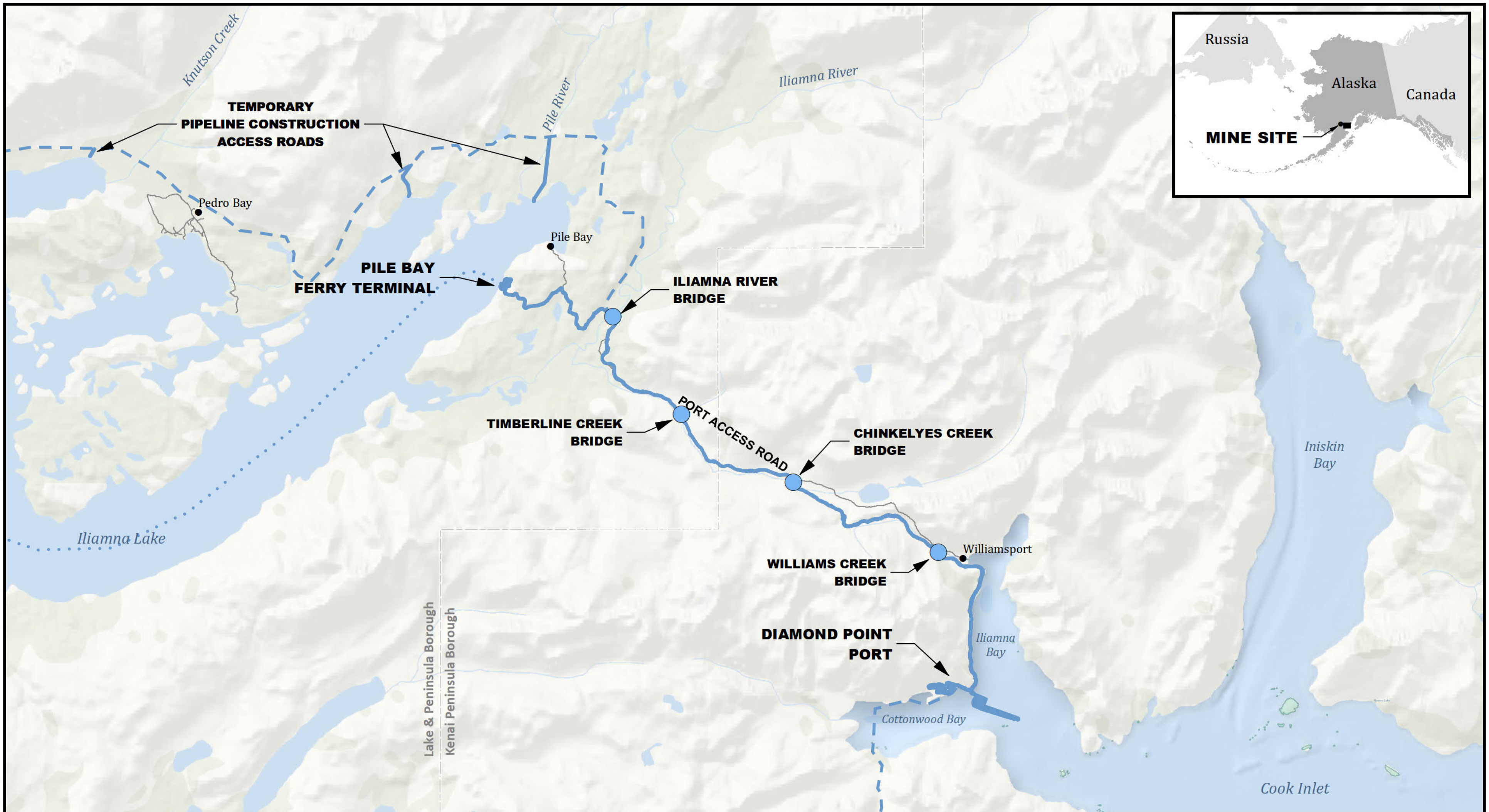
Alternative 2
- Bridge
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site

Other Features
- Local Roads
- National Park

ALTERNATIVE 2 - MINE ACCESS ROAD

PEBBLE PROJECT EIS

FIGURE 2-68



Sources: PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

1 0 1 2

Miles

Alternative 2

- Bridge
- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor

Other Features

- Local Roads
- Borough Boundary
- National Wildlife Refuge

ALTERNATIVE 2 - PORT ACCESS ROAD

PEBBLE PROJECT EIS

FIGURE 2-69

Ferry

The ferry vessel design and operations would be year-round, the same as Alternative 1a, but would have a different ferry terminal location on the southern shore of Iliamna Lake and a different ferry crossing route. The south shore ferry terminal (18 acres) would be south of the start of the Williamsport-Pile Bay Road on the eastern shore of Iliamna Lake (Pile Bay ferry terminal) (Figure 2-70).

The one-way ferry trip is about 29 miles and would take approximately 2.5 hours to complete in open water, or 5 hours in ice conditions. On average, one round trip per day across the lake would be required, the same as Alternative 1a.

Material Sites

Construction materials would be excavated from material sites along the transportation corridor. An estimate of up to 17 material sites (up to 321 acres) would be required for construction and maintenance of the co-located access road and natural gas pipeline for Alternative 2. Material sites used for construction of pipeline-only segments of the natural gas pipeline are discussed below under the natural gas pipeline component. Appendix K2 provides information for each material site, including the location, estimated quantity, size, type of material, use of material, and if blasting is required. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved. The amount of material estimated to be required for the road and pipeline is approximately 4.6 million yd^3. Final volumes of these gravel materials, and specific location of material sites and development plans for these sites, would be part of the final project design.

Water Extraction Sites

Seventeen potential water extraction sites have been identified to support project construction and operations of the co-located access road and natural gas pipeline for Alternative 2. Water extraction sites used for construction of pipeline-only segments of the natural gas pipeline are discussed below under the natural gas pipeline component. Appendix K2 provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The estimated annual volume of water that would be extracted is 64 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022). Temporary water use authorizations would be applied for by either the appropriate contractor or PLP.

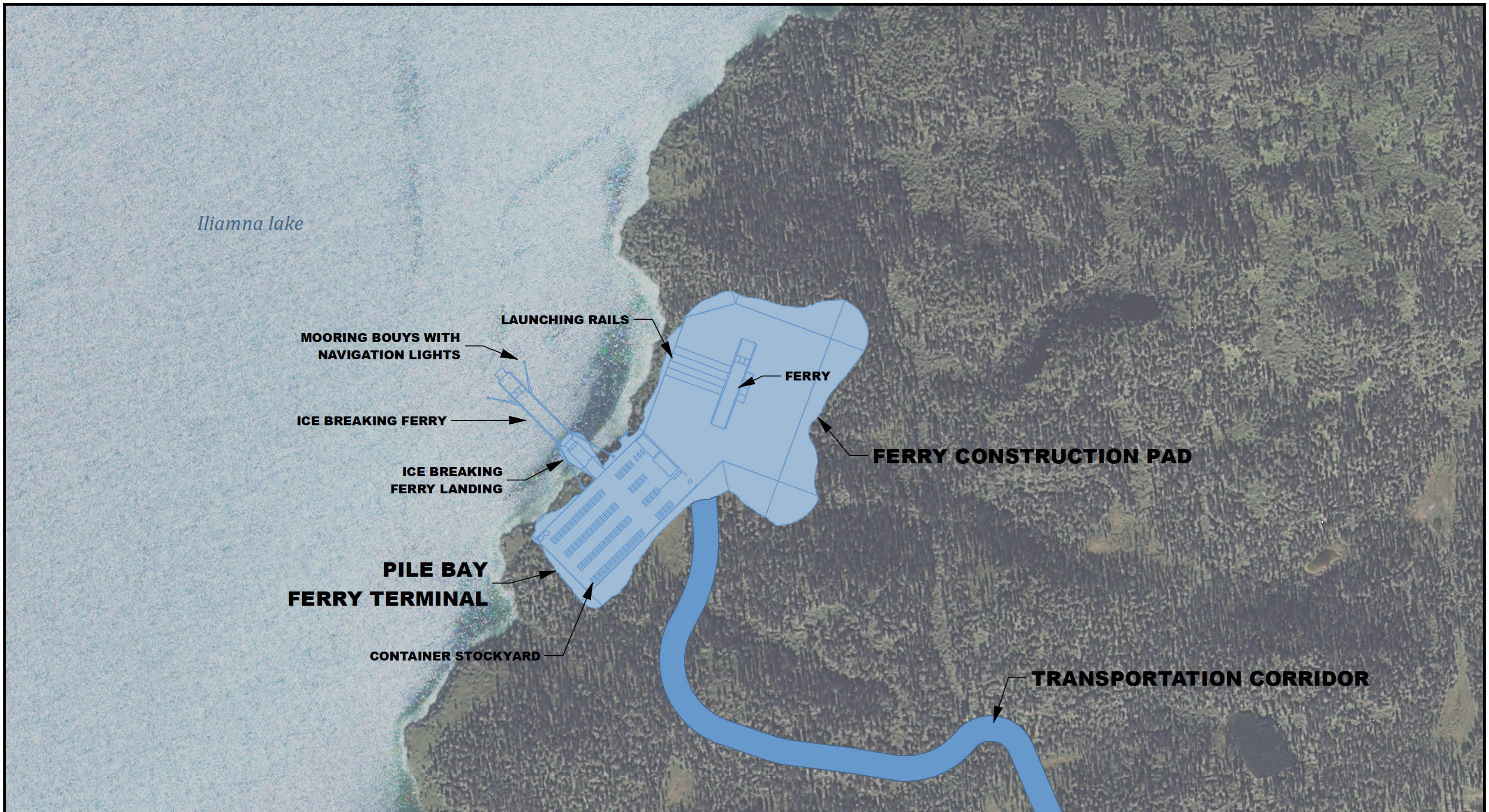
All-season gravel roads would be necessary to access some of the water extraction sites proposed for Alternative 2. Tables and figures in Appendix K2 provide details on the location and approximate length and acreage of each planned access road. Water extraction site access roads would be less than 1 mile in overall length, and would encompass less than 1 acre total.

Temporary Facilities and Initial Site Access

Temporary facilities associated with Alternative 2 are assumed to be the same as described for Alternative 1a for access roads.

Transportation Corridor Traffic and Materials/Personnel Transport

Trucks, containers, and truck traffic would be the same as Alternative 1a.



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers®

200 0 200 400
Feet

Alternative 2
- Pile Bay Ferry Terminal
- Transportation Corridor

ALTERNATIVE 2 - PILE BAY FERRY TERMINAL LAYOUT

For personnel transport under Alternative 2, PLP expects to use the airport at Pedro Bay during construction to provide commuter service for work rotation for construction crews. Some minor freight flights may be required, but the aircraft would be restricted to those capable of using the strip as it currently exists. During operations, for the alternative with road access, the Pedro Bay airport would only be used infrequently. No improvements to the airport would be expected.

2.2.6.3 Diamond Point Port and Lightering Locations

Alternative 2 port site and lightering locations are described below. The general descriptions for temporary facilities, water management, and physical reclamation and closure would be the same as Alternative 1a, but would occur at the locations described under this alternative. Under Alternative 2, an airstrip would not be constructed at the port site. However, improvements to the existing airstrip near Pile Bay may be necessary for limited use during construction (PLP 2018-RFI 099).

Port Site

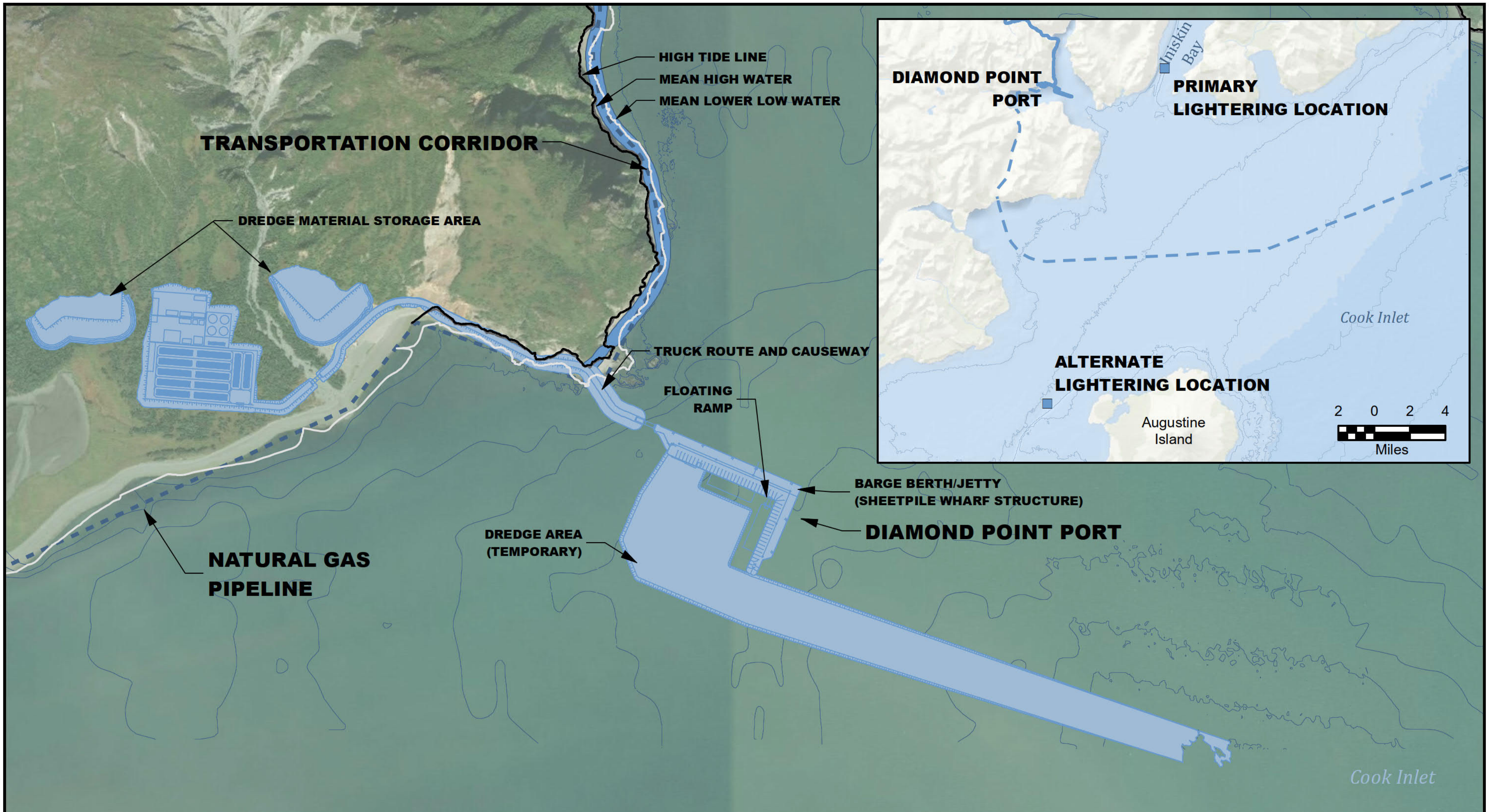
Alternative 2 includes construction of Diamond Point port (55 acres), a new year-round port at Iliamna Bay (Figure 2-71). The Amakdedori port would not be constructed under this alternative. The port site would include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project.

The shore-based facilities (41 acres) would include the port site (25 acres) with separate facilities for the receipt and storage of containers for concentrate and freight, as well as two bermed facilities (16 acres) for storage of maintenance dredging material. Other facilities at the port site would include fuel storage and transfer facilities, power generation and distribution facilities, maintenance facilities, employee accommodations, and offices. The shore-based complex would be constructed on an engineered fill pad at an elevation sufficient to address tidal surge from major storms and potential tsunamis.

The marine facilities[17] (14 acres) would be similar to the Amakdedori port design under Alternative 1; consisting of an earthen access causeway extending out to a marine jetty. The jetty is expected to be constructed as a sheet pile cell structure filled with granular material. Figure 2-72 shows a digital simulation of the Diamond Point port. Approximately 4,275 linear feet of sheet pile would be installed. A floating ramp would extend down from the side of the jetty to access the barges (100 feet long by 30 feet wide). Mobile cranes would be used on the dock for some operations. Tug moorage would be provided at the end of the jetty. Navigation buoys would not be necessary at the Diamond Point port site.

The shallow approach at this port site would require dredging to -20 feet MLLW to ensure year-round access by vessels requiring 15-foot water depth. Dredged channels are prone to sedimentation; therefore, over-dredging would reduce the frequency of maintenance dredging. The frequency of required maintenance dredging is unknown, but could be every 5 years. Dredged material would either be used in construction of the causeway and dock, or disposed of onshore. The dredge area would be approximately 58 acres. The total volume of dredged material for the 20-foot channel would be 650,000 yd^3, of which a minimum of 50 percent is estimated to be used in the barge dock construction, which would require approximately 615,000 yd^3 of fill for construction. Any rocks encountered in the channel would be moved to the side of the channel, or used in the dock construction. Any remaining dredged material and any material from maintenance dredging would be disposed of in bermed facilities on uplands east and west of the dock site (PLP 2018-RFI 032; PLP 2018-RFI 063; PLP 2018-RFI 099). Drainage from the stockpiles would likely be discharged to marine waters after treatment.

[17] Dimensions for marine facilities included in this paragraph represent the dimensions for construction below the MHW of Cook Inlet; this includes fill associated with the causeway and jetty, as well as a portion of the on-site access road out to the causeway (Figure 2-72).



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

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500 0 500 1,000
Feet

Alternative 2
- Lightering Locations
- Natural Gas Pipeline
- Diamond Point Port
- Transportation Corridor

Other Features
- High Tide Line
- Mean High Water
- Mean Lower Low Water
- Bathymetric Contour (2ft)

ALTERNATIVE 2 - DIAMOND POINT PORT AND LIGHTERING LOCATIONS

PEBBLE PROJECT EIS

FIGURE 2-71

Sources: PLP 2018

US Army Corps of Engineers®

DIGITAL SIMULATION OF DIAMOND POINT PORT

PEBBLE PROJECT EIS

FIGURE 2-72

An offtake from the natural gas pipeline (discussed below) would distribute natural gas to the port power generation facility. The pipeline would follow the access road to the port and would be buried in a trench adjacent to the road bed shoulder.

Lightering Locations

Two offshore lightering stations would be used to lighter the ore concentrate to moored bulk carriers (Figure 2-71). The primary location in Iniskin Bay would be used unless high winds, waves, ice, or other factors preclude its use. If the primary location is not suitable under given conditions, the alternate location shown on Figure 2-71 could be used if conditions there are more favorable. The lightering location in Iniskin Bay is generally protected from wave action, and heave is not expected to be a problem for loading at this location, except under extreme weather conditions.

The proposed mooring system would be the same as described for Alternative 1a.

Port Operations and Materials Transport

Port operations and material transport would be the same as described for Alternative 1a; however, the shipping routes would be to/from Diamond Point rather than Amakdedori. The likely bulk carrier shipping route for transport of concentrate to Asia, the primary supply and construction barge route from the West Coast to Diamond Point, as well as an alternative inland barge route that could be used under adverse conditions are illustrated in Appendix K3.12, Transportation and Navigation.

2.2.6.4 Natural Gas Pipeline Corridor

The Alternative 2 natural gas pipeline corridor is described below. All other components of the pipeline would be the same as described for Alternative 1a.

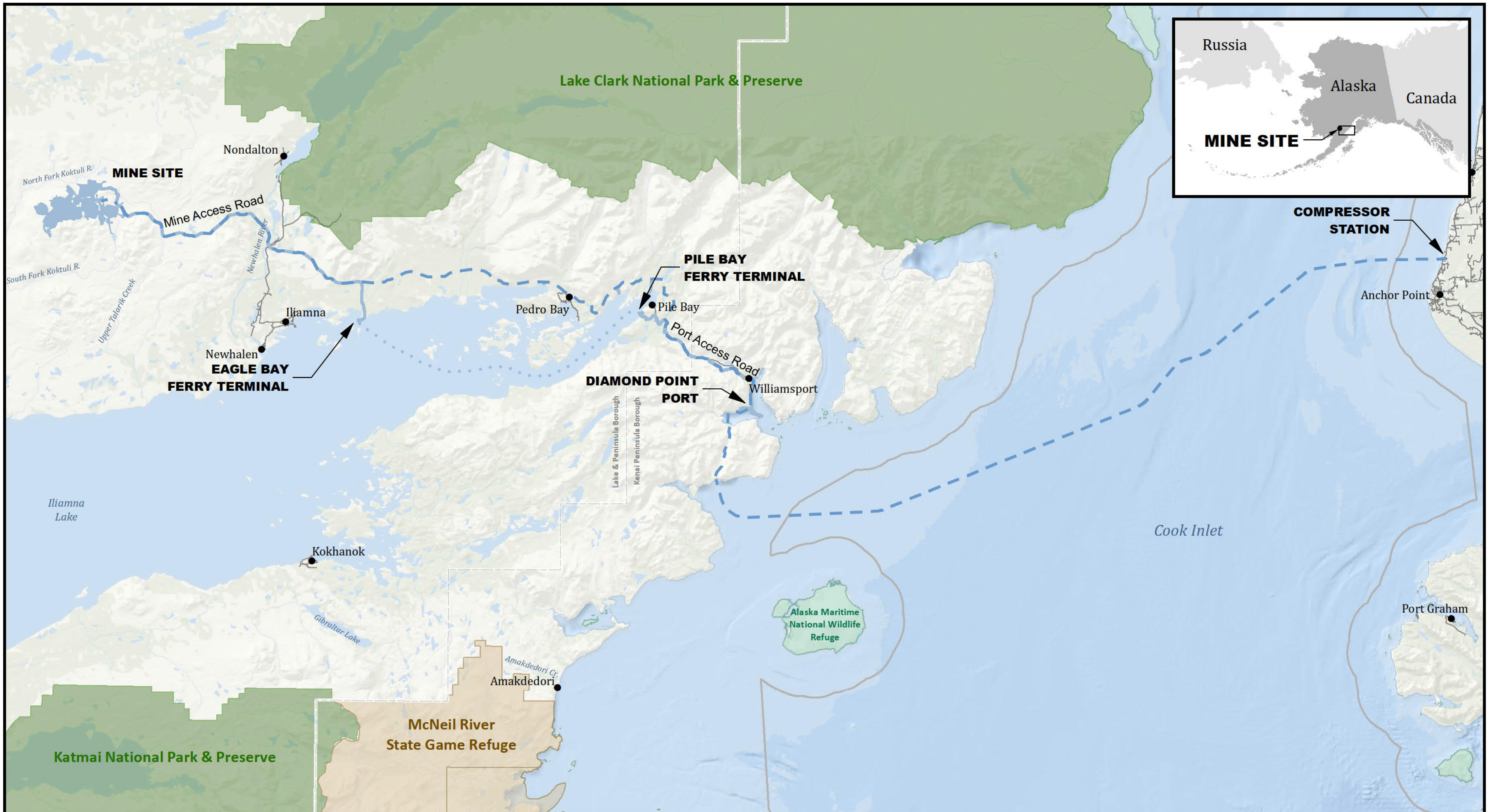
Natural Gas Pipeline Corridor and Ancillary Facilities

Natural gas would be supplied to Diamond Point port and the mine site by pipeline (Figure 2-73). The pipeline would connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula, and the pipeline design, fiber-optic cable, and the laydown area for the metering station, compressor station, and pig launching/receiving facility would be as described for the Alternative 1a.

The 164-mile natural gas pipeline from the Kenai Peninsula to the mine site would consist of three main segments, described below.

Cook Inlet Crossing to Ursus Cove—The pipeline across Cook Inlet (75 miles) would be constructed as described for Alternative 1a, but the alignment would come ashore at Ursus Cove. As with Alternative 1a, HDD would 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 heavy wall pipe would be trenched into the sea floor for the remaining Cook Inlet crossing. The pipeline burial depth and thickness would vary depending on geotechnical conditions.

The temporary construction footprint for seabed installation would vary; ranging from 57 to 101 feet across Cook Inlet (PLP 2020-RFI BSEE 1a), and a maximum 183 feet in nearshore areas. Trenching and burial would occur using the same technology described for Alternative 1a. Additional potential seabed disturbance may occur from anchor placement to hold pipe-lay barges in place. Anchor placement may extend approximately 650 feet to 4,101 feet on either side of the pipeline centerline depending on depth (Owl Ridge 2020).



Sources: PLP 2019-RFI153; ADNR

US Army Corps
of Engineers®

5 0 5 10
Miles

Alternative 2

- Ferry Route
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site

Other Features

- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 2 - NATURAL GAS PIPELINE ROUTE

PEBBLE PROJECT EIS

FIGURE 2-73

Ursus Cove to Diamond Point Port—The pipeline would come ashore in Ursus cove using trenching, follow an overland alignment across Ursus Head (west of Brown's Peak Creek for approximately 2.6 miles until the creek crossing), then continue across Cottonwood Bay to the Diamond Point port. This overland pipeline-only segment (i.e., not adjacent to an access road) would be constructed as described for Alternative 1a; with a temporary construction footprint encompassing the proposed 150-foot ROW to conservatively account for pipeline trenching, side-casting, and equipment operation/travel. Access for construction of the pipeline across Cottonwood Bay would be by barge landings from each end of the ROW. The pipeline would be installed in a trench to cross Cottonwood Bay using a barge-mounted excavator in inundated areas, or low ground pressure equipment and mats in tidal areas, to excavate the trench. The pipeline would come ashore at Diamond Point port, where natural gas would be fed to the port site power station and used for site heating. Pipeline stream crossings along this segment would use trenching or HDD to cross streams.

Diamond Point Port to Mine Site—From Diamond Point port, the pipeline would be buried in a trench that follows the general Alternative 3 north access road alignment (described below) with minor deviations. For segments that follow the Alternative 2 access road alignment, the pipeline and fiber-optic cable would be buried in a trench adjacent to the road (Figure 2-20). At bridged river crossings, the gas pipeline would either be placed beneath the rivers using HDD or trenching, or would be attached to the bridge structures. For overland segments that do not follow the road alignment, PLP would secure ROW easements from land owners. A 150-foot temporary construction ROW would be requested, as described above. Pipeline stream crossings for segments that do not follow the road alignment would use trenching or HDD to cross streams.

Three construction access points would be required (Figure 2-69) and would be reclaimed after construction. Figure 2-48 depicts typical sections showing summer construction of the pipeline along segments not adjacent to access roads.

For segments that follow access road alignment, the pipeline would be attached to bridge structures at stream crossings. Pipeline stream crossings along pipeline-only segments would use trenching or HDD to cross streams (Figure 2-44).

Temporary impact areas described above would be restored as outlined in PLP's Restoration Plan for Temporary Impacts (Owl Ridge 2019a; PLP 2019-RFI 123). See Appendix K2 for a summary of permanent and temporary construction footprints. PLP would conduct HDD in a way that minimizes the release of drilling fluids. Response to RFI 011a (PLP 2019-RFI 011a) provides examples of how this program might be executed.

Material sites used for construction of the co-located access road and pipeline are discussed under the transportation corridor component. Thirteen material sites (up to 298 acres) would be required for construction of pipeline-only segments of the pipeline for Alternative 2. Appendix K2 provides information for each material site, including the location, estimated quantity, size, type of material, use of material, and if blasting is required. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved. The amount of material estimated to be required from these material sites is approximately 2.8 million yd^3. Final volumes of these gravel materials and specific location of material sites and development plans for these sites would be part of the final project design.

Water extraction sites used for construction of the co-located access road and pipeline are discussed under the transportation corridor component. Twenty potential water extraction sites have been identified to support construction of pipeline-only segments of the pipeline for Alternative 2. Appendix K2 provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The estimated annual volume of water that would be extracted is 68 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022). Temporary water use authorizations would be applied for by either the appropriate contractor or PLP.

Leak detection systems, inspections, and maintenance would be the same as described for Alternative 1a. However, in addition to pressure monitoring and automated leak detection systems, the pipeline segment that does not follow the road corridor would be monitored by air (helicopter and/or drone) to check for any ROW issues and/or leaks. The pipeline would also be inspected by pig as part of the regular maintenance and inspection program. Any work that needs to be performed would be supported by air, or by low-pressure ground vehicle access along the ROW and/or from the lake (PLP 2018-RFI 080). Response to RFI BSEE 2 (PLP 2019-RFI BSEE 2; NanaWP and Intecsea 2019c) provides information on inspection and maintenance for the subsea portion of the natural gas pipeline crossing Cook Inlet.

2.2.6.5 Alternative 2—Summer-Only Ferry Operations Variant

An option to restrict ferry operations to the open water season was suggested during scoping due to concerns with use of an ice-breaking ferry. With this variant, concentrate shipping at the Diamond Point port using lightering and bulk freighters would continue per the year-round schedule even though the ferry operations would be restricted to the open water season. Therefore, additional storage of concentrate containers would be needed at the mine site to facilitate year-round processing operations; and along the Williamsport-Pile Bay Road due to limited available space at Diamond Point port, to accommodate the additional containers trucked when the ferry is operating. Changes to the mine site and transportation corridor with incorporation of this variant under Alternative 2 are further described below. This variant does not involve changes to the port or natural gas pipeline components.

Mine Site

Changes at the mine site with incorporation of this variant would be the same as described for the Alternative 1—Summer-Only Ferry Operations Variant (described above). Additional storage during the non-operating months of the ferry would be needed for concentrate, consumables, reagents, and diesel. The Alternative 2 mine site footprint would increase by about 33 acres as a result of the expanded and relocated container yard, relocated sewage tank pad, and reconfigured on-site access roads. Figure 2-74 shows the Alternative 2—Summer-Only Ferry Operations Variant mine site layout.

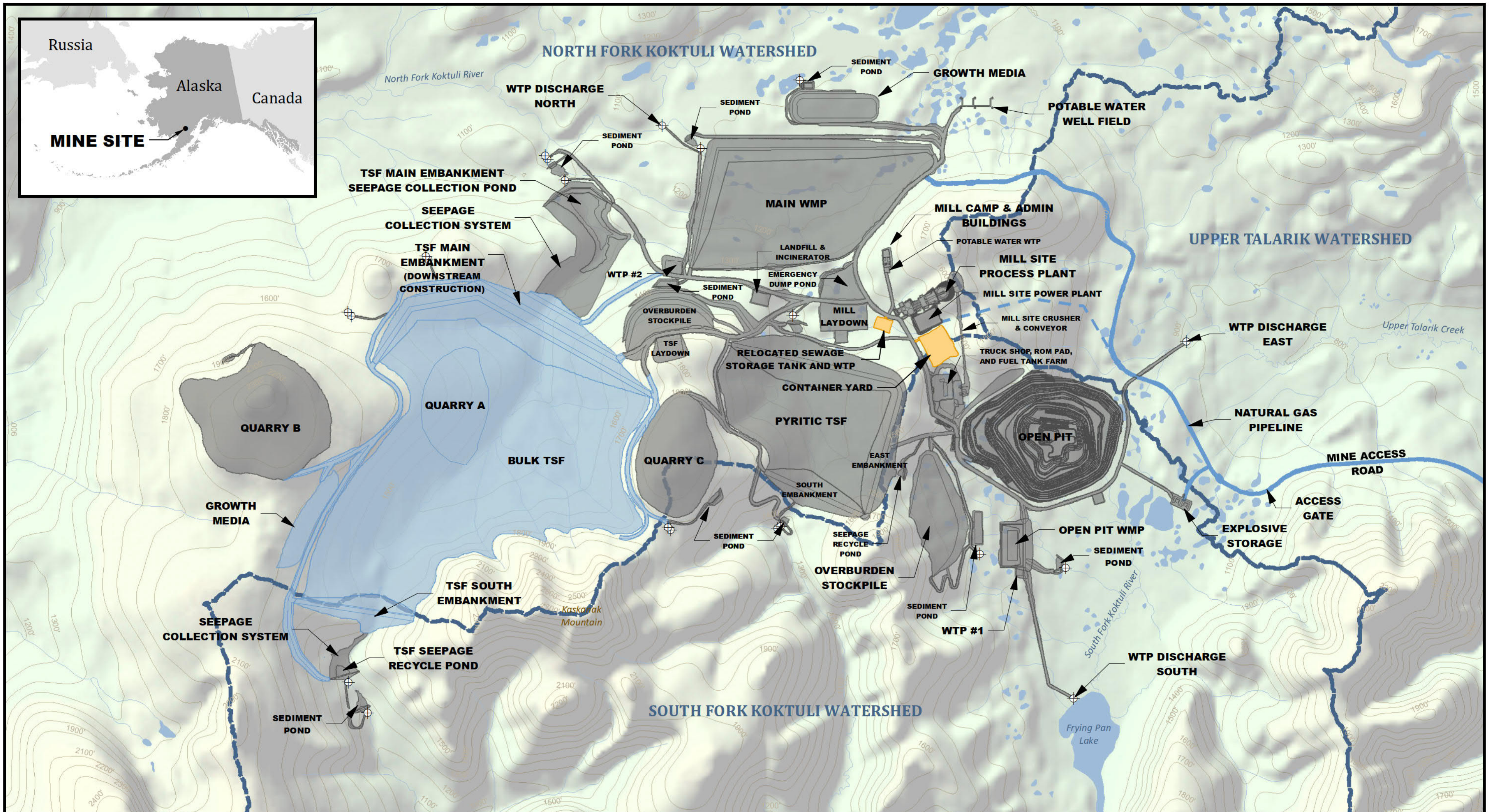
Transportation Corridor

Changes associated with the transportation corridor with incorporation of this variant would be similar to those described for the Alternative 1—Summer-Only Ferry Operations Variant (described above). The only difference is that the Alternative 2—Summer-Only Ferry Operations Variant would require an additional laydown area (container yard: 22 acres) along the Williamsport-Pile Bay Road, instead of at the port, due to limited available space at the Diamond Point port site (PLP 2018-RFI 065). Concentrate would be transported to the container yard during the ferry operating months, where it is accessible for year-round shipment to market through the Diamond Point port. Figure 2-75 shows the container yard along the Alternative 2 transportation corridor.

2.2.6.6 Alternative 2—Pile-Supported Dock Variant

This variant would construct an access trestle and pile-supported dock at Diamond Point port, instead of an earthen access causeway and jetty, to minimize in-water impacts. Figure 2-76 depicts the conceptual pile-supported dock layout. The conceptual structure would consist of 44 trestle piles and 474 dock piles, for a total of 518 piles (PLP 2018-RFI 072). All piles would be 48 inches in diameter, with a 1.5-inch wall thickness. The steel piles would be vibrated into place and then driven to refusal with an impact hammer. The marine facilities footprint[18] with this variant would be less than 4 acres, which includes the footprint of the pilings (6,500 square feet) and fill placed below the MHW mark of Cook Inlet for the port site. All other facilities and operations at the port, including the dredge area and onshore dredge material storage areas, would be the same as described for the Alternative 2 base case.

[18] Dimensions for marine facilities included in this paragraph represent the dimensions for construction below the MHW of Cook Inlet; this includes fill associated with the pilings, as well as a portion of the on-site access road out to the pile-supported dock (Figure 2-76).



Sources: PLP 2019-RFI153; USGS; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

N

0.5 0 0.5 1

Miles

Alternative 2 Variant

Summer-Only Ferry Operations Mine Site Arrangements

Alternative 2

Natural Gas Pipeline

Transportation Corridor

Bulk TSF Downstream Construction Mine Site Arrangements

Alternative 1a

Monitoring Wells

Mine Site

Other Features

River/Stream

Lake/Pond

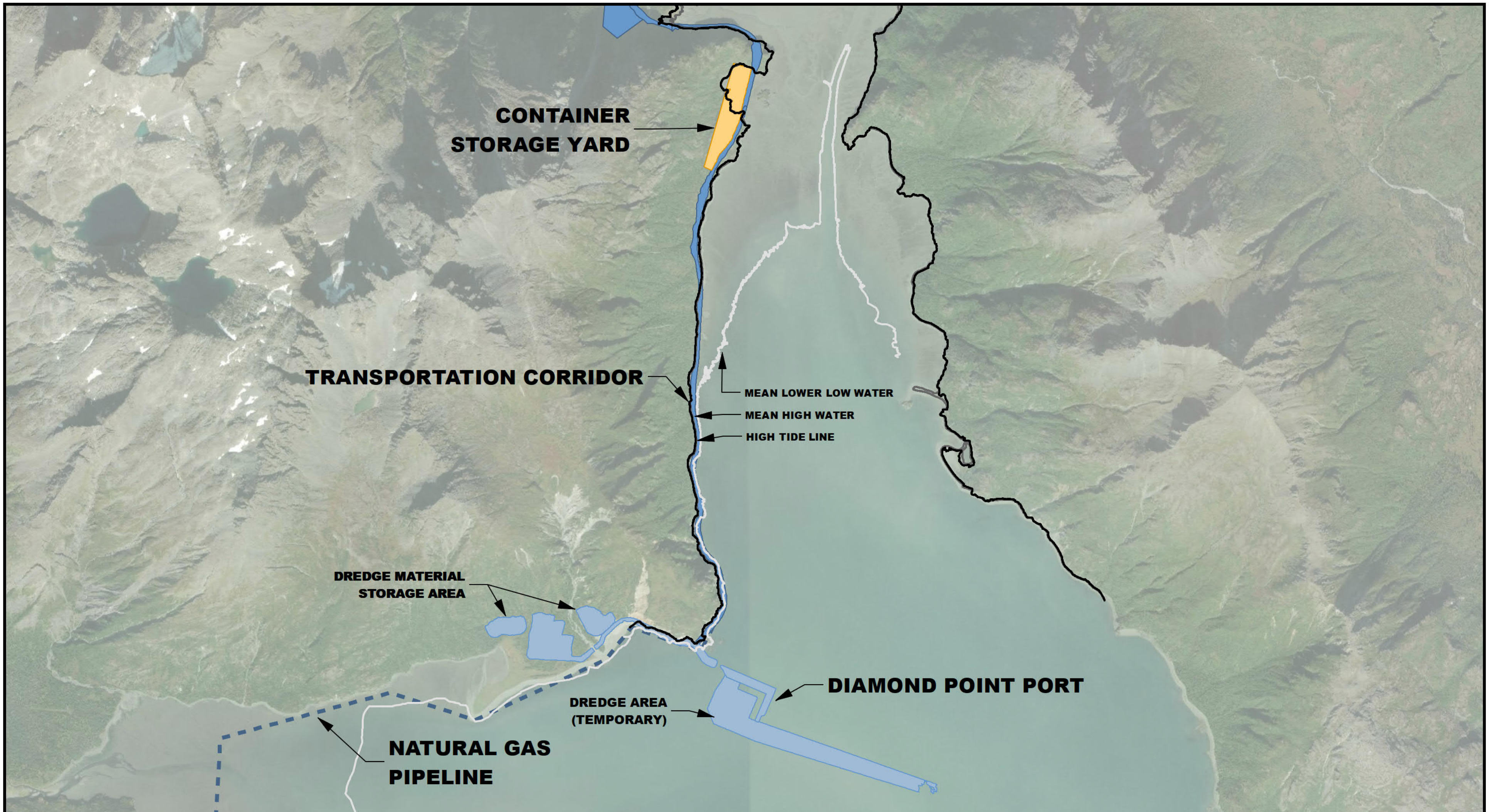
Watershed

100' Contour (Existing)

ALTERNATIVE 2 - SUMMER-ONLY FERRY OPERATIONS VARIANT - MINE SITE LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-74



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

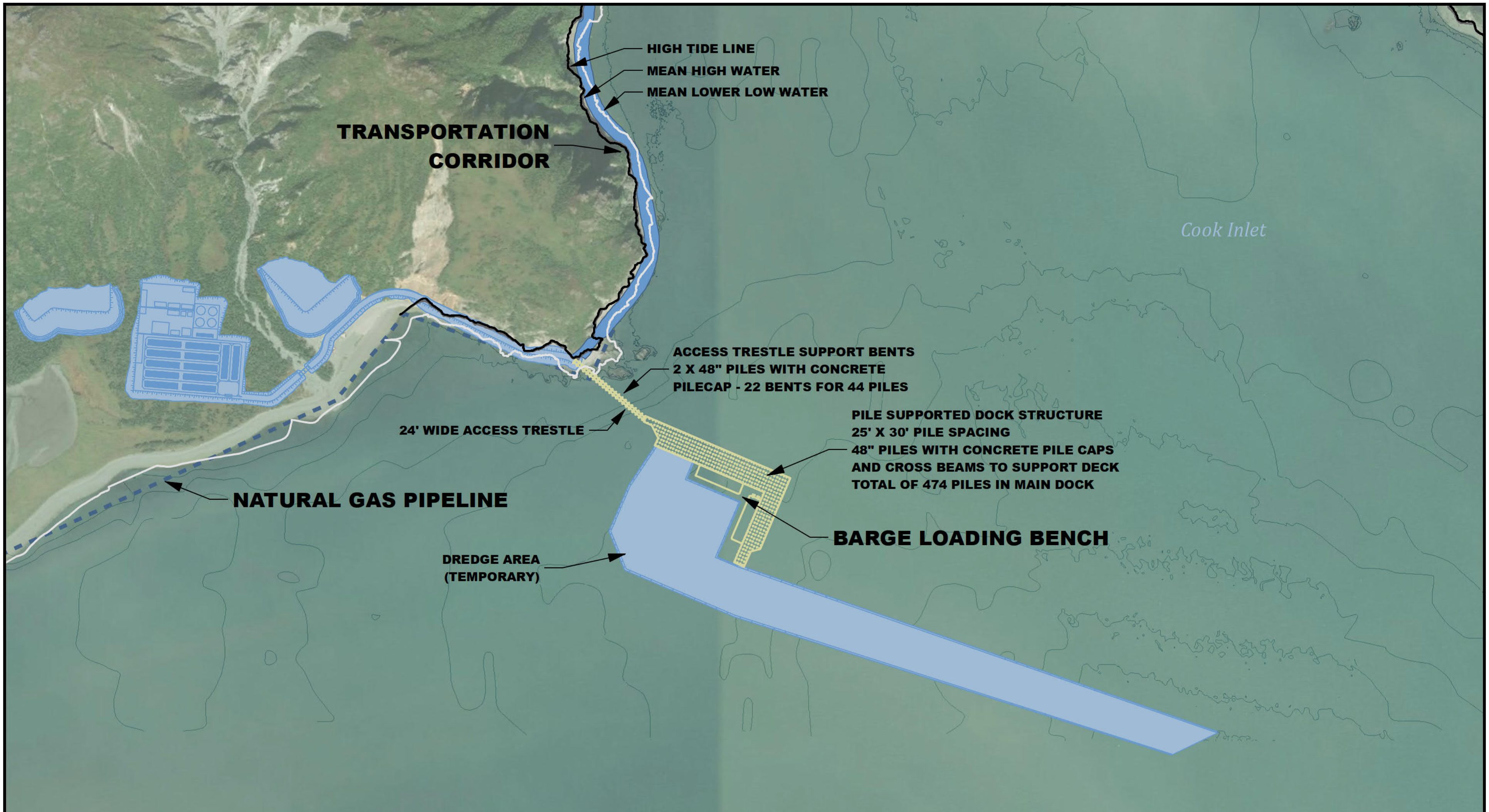
1,000 0 1,000 2,000
Feet

Alternative 2 Variant
- Summer-Only Ferry Operations Diamond Point Container Storage Yard

Alternative 2
- Natural Gas Pipeline
- Diamond Point Port
- Transportation Corridor

Other Features
- High Tide Line
- Mean High Water
- Mean Lower Low Water

ALTERNATIVE 2 - SUMMER-ONLY FERRY OPERATIONS VARIANT - TRANSPORTATION CORRIDOR CONTAINER STORAGE YARD



Sources: PLP 2019-RFI153
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

500 0 500 1,000
Feet

Alternative 2 Variant
- Pile-Supported Dock

Alternative 2
- Natural Gas Pipeline
- Diamond Point Port
- Transportation Corridor

Other Features
- High Tide Line
- Mean High Water
- Mean Lower Low Water
- Bathymetric Contour (2ft)

ALTERNATIVE 2 - DIAMOND POINT PORT PILE-SUPPORTED DOCK VARIANT

PEBBLE PROJECT EIS

FIGURE 2-76

This variant does not involve changes to the mine site, transportation corridor, or natural gas pipeline components.

2.2.6.7 Alternative 2—Newhalen River North Crossing Variant

This variant considers a north crossing location of the Newhalen River, approximately 0.8 mile north of the south crossing location that is described for Alternative 1a, and carried forward as the base case in Alternative 2 and Alternative 3. The north crossing was PLP's original proposed crossing in the DEIS that was evaluated for all action alternatives. The primary differences in the transportation corridor component are summarized below (PLP 2019-RFI 154). This variant does not involve changes to the mine site, port, or natural gas pipeline components.

Road System

The mine access road follows the same general alignment as Alternative 2, extending about 35 miles from the mine site to a ferry terminal at Eagle Bay, but follows a north crossing location of the Newhalen River (Figure 2-77). The mine access road with this variant is slightly shorter (about 0.3 mile) and the footprint is about 3 acres larger (356 acres total). The bridge design under this variant is similar to the base case Alternative 2, but the length of the bridge would increase from 510 feet to 625 feet (PLP 2020g).

Material Sites

Incorporation of this variant would result in the same total of material sites for construction and maintenance of the co-located access road and the natural gas pipeline for Alternative 2 (up to 17 material sites), but with an increased footprint (up to 338 acres). Appendix K2 provides information for each material site, including the location, estimated quantities, size, type of material, use of material, and if blasting is required. The amount of material estimated to be required for the road and pipeline would be the same (approximately 4.6 million yd^3). Final volumes of these gravel materials and specific location of material sites and development plans for these sites would be part of the final project design.

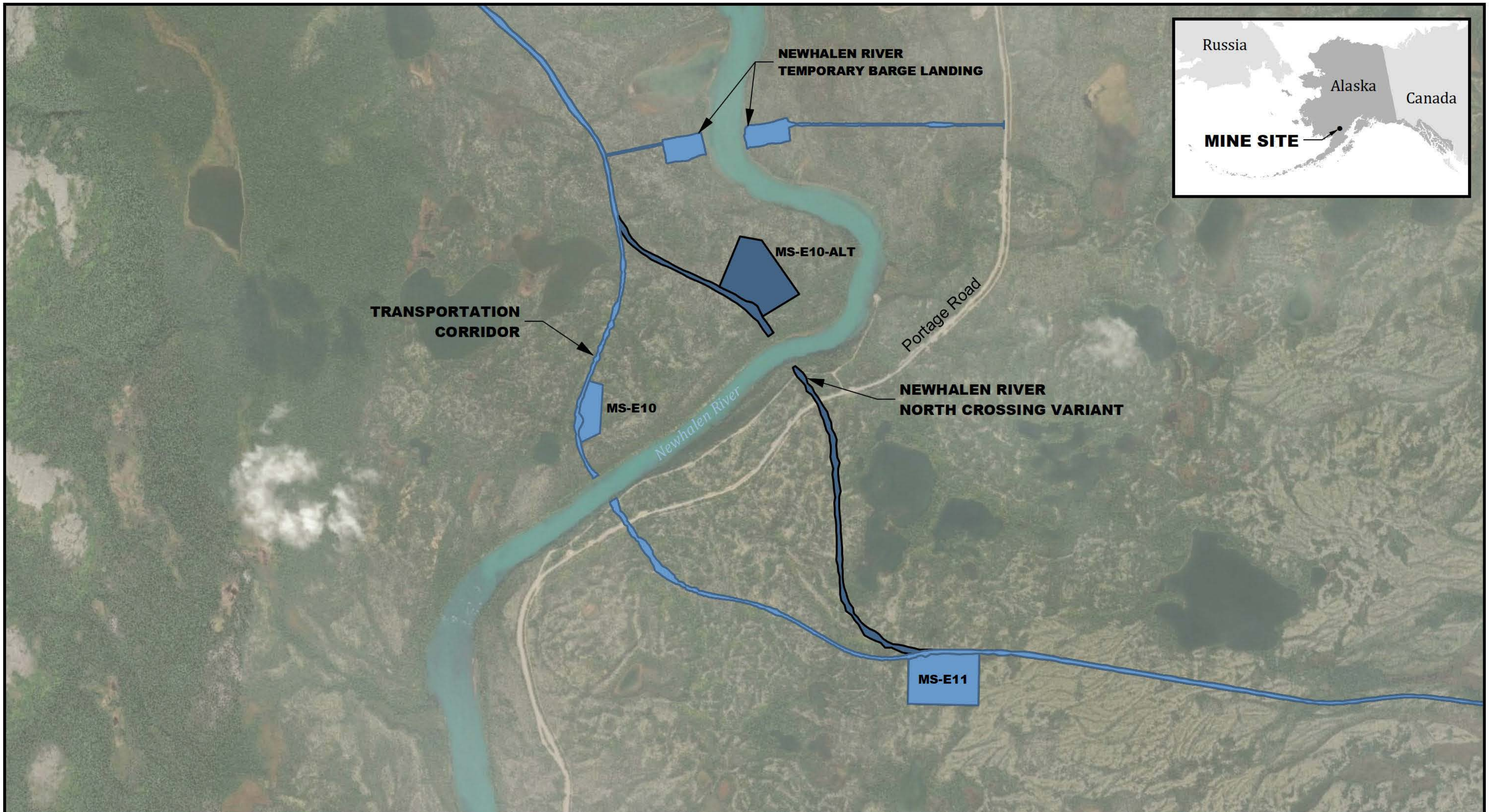
Water Extraction Sites

Incorporation of this variant would result in the same number of potential water extraction sites (17 water extraction sites), but one water extraction site along the mine site access road (WES-N30) would be in a different location. Appendix K2 provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The estimated annual volume of water would be the same (64 million gallons).

2.2.7 Alternative 3—North Road Only

This section summarizes Alternative 3—North Road Only. This alternative was developed to address scoping comments suggesting that the EIS evaluate an access road alignment north of Iliamna Lake to eliminate the need for a lake crossing.

Alternative 3 considers: 1) the same mine site layout and processes as Alternative 1a; 2) a transportation corridor route on the northern end of Iliamna Lake that does not require a ferry crossing of the lake; 3) a port site north of Diamond Point, with a caisson-supported dock design; and 4) a natural gas pipeline alignment on the northern end of Iliamna Lake that follows the north road corridor (Figure 2-1 and Figure 2-78).



Sources: PLP 2019-RFI153; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

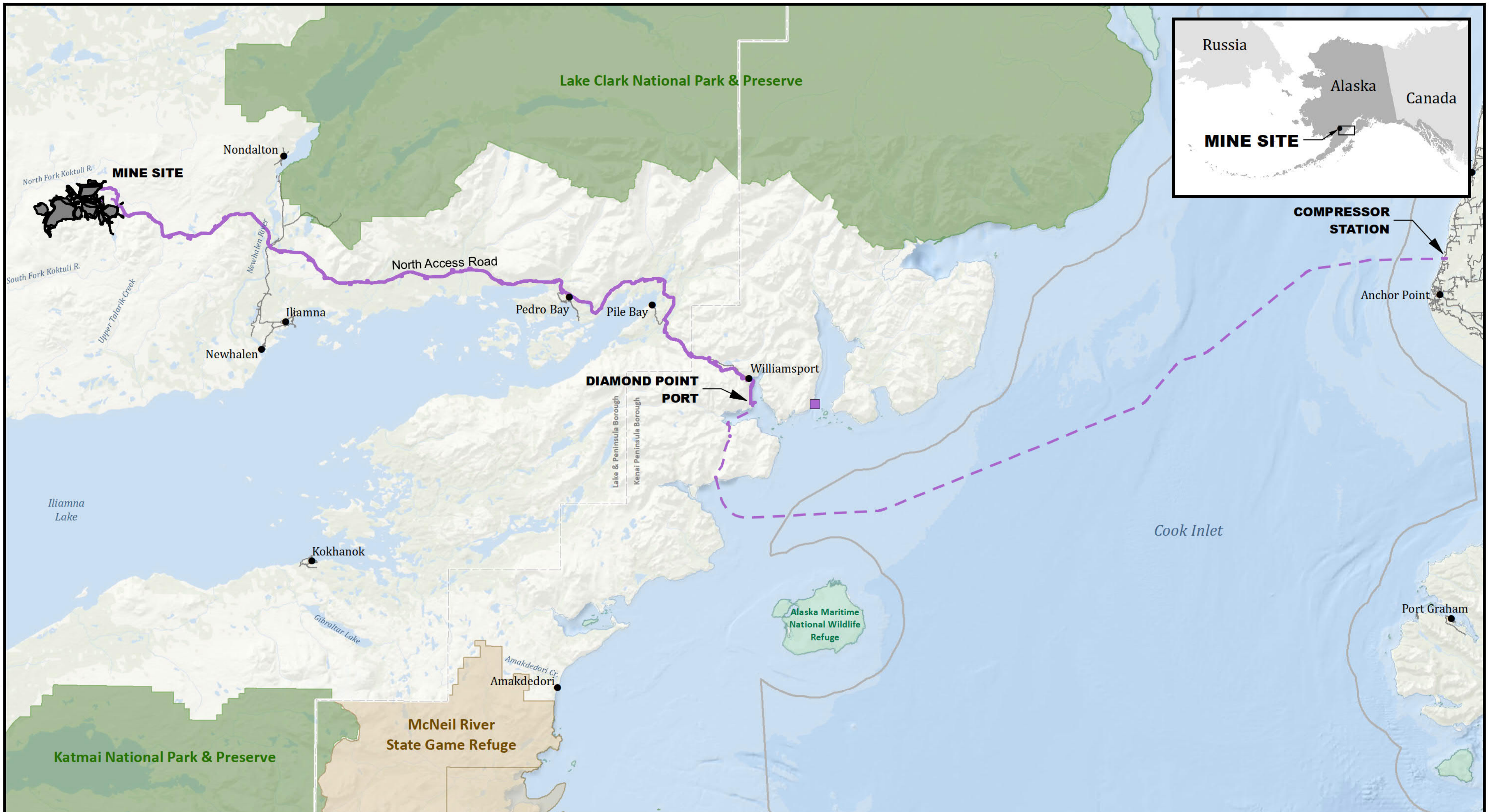
1,000 0 1,000 2,000
Feet

Alternative 2 Variant
Newhalen River North Crossing Variant
Alternative 2
Transportation Corridor

ALTERNATIVE 2 - NEWHALEN RIVER NORTH CROSSING VARIANT

PEBBLE PROJECT EIS

FIGURE 2-77



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADNR

US Army Corps of Engineers

5 0 5 10
Miles

Alternative 3
- Alt 3
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a
- Mine Site

Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

ALTERNATIVE 3 - GENERAL PROJECT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-78

PLP has identified Alternative 3 as the Applicant's Preferred Alternative, and updated their Project Description (PLP 2020d) in May 2020 to reflect this decision. PLP's updated Project Description is included as Appendix N of the EIS. Appendix K2 provides a summary of the Alternative 3 permanent footprint for each project component (mine site, transportation corridor, port, and natural gas pipeline). Additional information is provided in Appendix K2, as indicated in the discussion below.

2.2.7.1 Mine Site

The mine site layout, footprint (approximately 8,390 acres), and processes under Alternative 3 would be the same as described for Alternative 1a.

2.2.7.2 Transportation Corridor

The transportation corridor under Alternative 3 would connect the mine site to a port site located north of Diamond Point port in Iliamna Bay (Figure 2-79). The project transportation corridor would consist of a double-lane road north of Iliamna Lake, the north access road (approximately 82 miles and 1,077 acres), which would act as the main access route to and from the mine for the transportation of materials, equipment, and concentrate.

The proposed north access road would parallel the existing Williamsport-Pile Bay Road for approximately 5 miles from Williamsport, and would then replace the existing road for approximately 7 miles from that point until the existing road turns toward Pile Bay. Once constructed, it is assumed that project-related haul trucks would share the road with the existing road users, which are primarily privately operated trucks transporting freight and vessels being portaged. The proposed road to the mine site also intersects the existing road network for the villages of Iliamna and Newhalen.

There would be no ferry transportation across Iliamna Lake. The truck transportation and Diamond Point port would operate year-round.

Alternative 3 includes two spur roads: The explosives storage spur road (4 acres), previously described for Alternative 1a, and a short spur road (less than 1 mile) to the Pedro Bay Airport (6 acres).

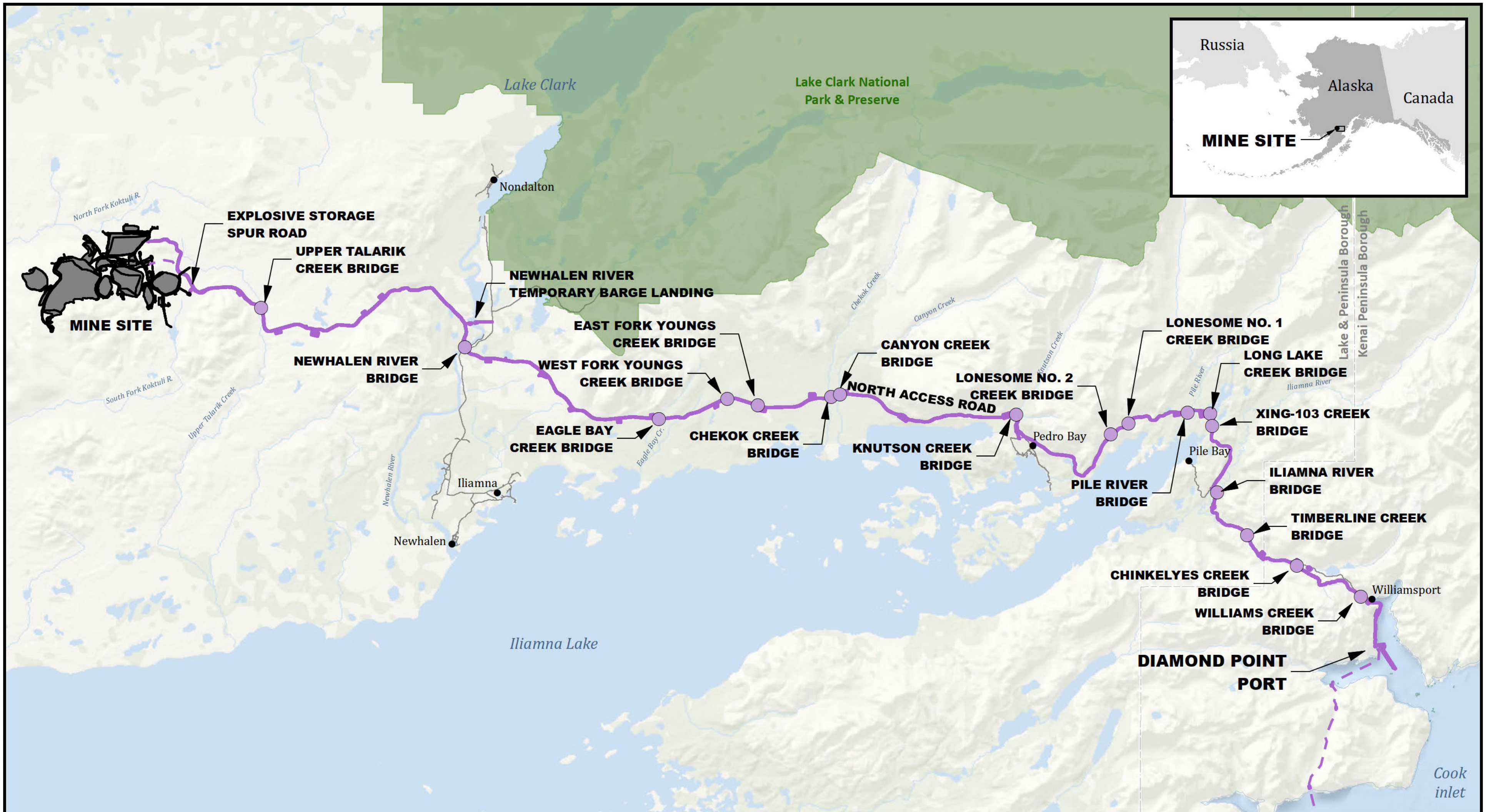
Physical reclamation and closure would be the same as described for Alternative 2.

Road System

The north access road design criteria would be the same as Alternative 1a.

The Alternative 3 road system would include 17 bridges (PLP 2020g), nine of which would be single-span bridges that range in length from approximately 50 to 90 feet. There would be one large (510-foot) multi-span two-lane bridge across the Newhalen River, and seven other multi-span, two-lane bridges that range in length from approximately 140 to 240 feet. The Newhalen River crossing would be at the southern crossing location. Typical bridge and culvert designs would be similar to those described for Alternative 1a. Plan, profile, and typical section drawings for each Alternative 3 bridge crossing as well as the various categories of culverts can be found in the Pebble Project Department of the Army Application for Permit POA-2017-271 (PLP 2020f).

The natural gas pipeline and fiber-optic cable would be buried in a corridor adjacent to the access road (described below).



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

3 0 3 6

Miles

Alternative 3

- Bridge
- Natural Gas Pipeline
- Transportation Corridor
- Port

Alternative 1a

- Mine Site

Other Features

- Local Roads
- Borough Boundary
- National Park

ALTERNATIVE 3 - TRANSPORTATION FACILITIES OVERVIEW

Material Sites

Construction materials would be excavated from material sites along the transportation corridor. An estimate of up to 27 material sites (up to 604 acres) would be required for construction and maintenance of the co-located access road and natural gas pipeline for Alternative 3. Material sites used for construction of pipeline-only segments of the natural gas pipeline are discussed below under the natural gas pipeline component. Appendix K2 provides information for each material site, including the locations, estimated quantities, size, type of material, use of material, and if blasting is required. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved. The amount of material estimated to be required for the road and pipeline is approximately 7.2 million yd^3. Final volumes of these gravel materials, and specific location of material sites and development plans for these sites, would be part of the final project design.

Water Extraction Sites

Thirty-one potential water extraction sites have been identified to support project construction and operations of the co-located access road and natural gas pipeline for Alternative 3. Water extraction sites used for pipeline construction and testing are discussed below under the natural gas pipeline component. Appendix K2 provides information for each water extraction site, including the waterbody type, use, years and season of use, and estimated extraction rate and volumes. Figures in Appendix K2 show the location of water extraction sites identified for Alternative 3. The estimated annual volume of water that would be extracted for all water extraction sites is 113 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022). Temporary water use authorizations would be applied for by either the appropriate contractor or PLP.

All-season gravel roads would be necessary to access some of the water extraction sites proposed for Alternative 3. These would be the same as described for Alternative 2. Tables and figures in Appendix K2 provide details on the location and approximate length and acreage of each planned access roads.

Temporary Facilities and Initial Site Access

Temporary facilities and initial site access would be similar to those described for Alternative 1a, but would occur at the construction locations associated with Alternative 3. For example, the initial construction effort would be at the Diamond Point port instead of Amakdedori port. Temporary facilities associated with ferry terminals would not apply to Alternative 3.

The existing Williamsport-Pile Bay Road would be used to transport equipment and supplies for initial construction of the road alignment along the north shore of Iliamna Lake while the port facilities and road along Iliamna Bay's western side are being constructed. Additional equipment would be shipped by barge from Pile Bay to Iliamna/Newhalen so that work can commence on the western portions of the access road at the same time. The existing Pedro Bay runway would be used to support initial construction of the access road. No modifications of the runway would be required. Initial access to the mine site should be complete within 1 year.

Transportation Corridor Traffic and Materials/Personnel Transport

Incoming supplies such as equipment, reagents, and fuel would be barged to the Diamond Point 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. Trucks, containers, and truck traffic would be the same as Alternative 1a. There would be no ferry traffic under Alternative 3.

Until the access road crossing the Newhalen River is complete, crews would either be bused on existing roads to their workplaces or shuttled to their workplaces by helicopter. PLP also expects to use the airport at Pedro Bay during construction to provide commuter service for work rotation for construction crews. Some freight flights may be required, but the aircraft would be restricted to those capable of using the strip as it currently exists. During operations, the Pedro Bay airport would only be used infrequently.

2.2.7.3 Diamond Point Port and Lightering Locations

Alternative 3 includes construction of a port site north of Diamond Point in Iliamna Bay (Figure 2-80). The Amakdedori port would not be constructed under this alternative. The general descriptions for temporary facilities, water management, port operations, and material transport would be the same as described for Alternative 2; physical reclamation and closure would be the same as Alternative 1a, but would occur at the locations described under this alternative. Incoming supplies such as equipment, reagents, and fuel would be barged to the Diamond Point port. To a lesser extent, some supplies, such as perishable food, may be transported by air to Iliamna Airport and trucked to the mine site. An airstrip would not be constructed at the port site under Alternative 3.

Port Site

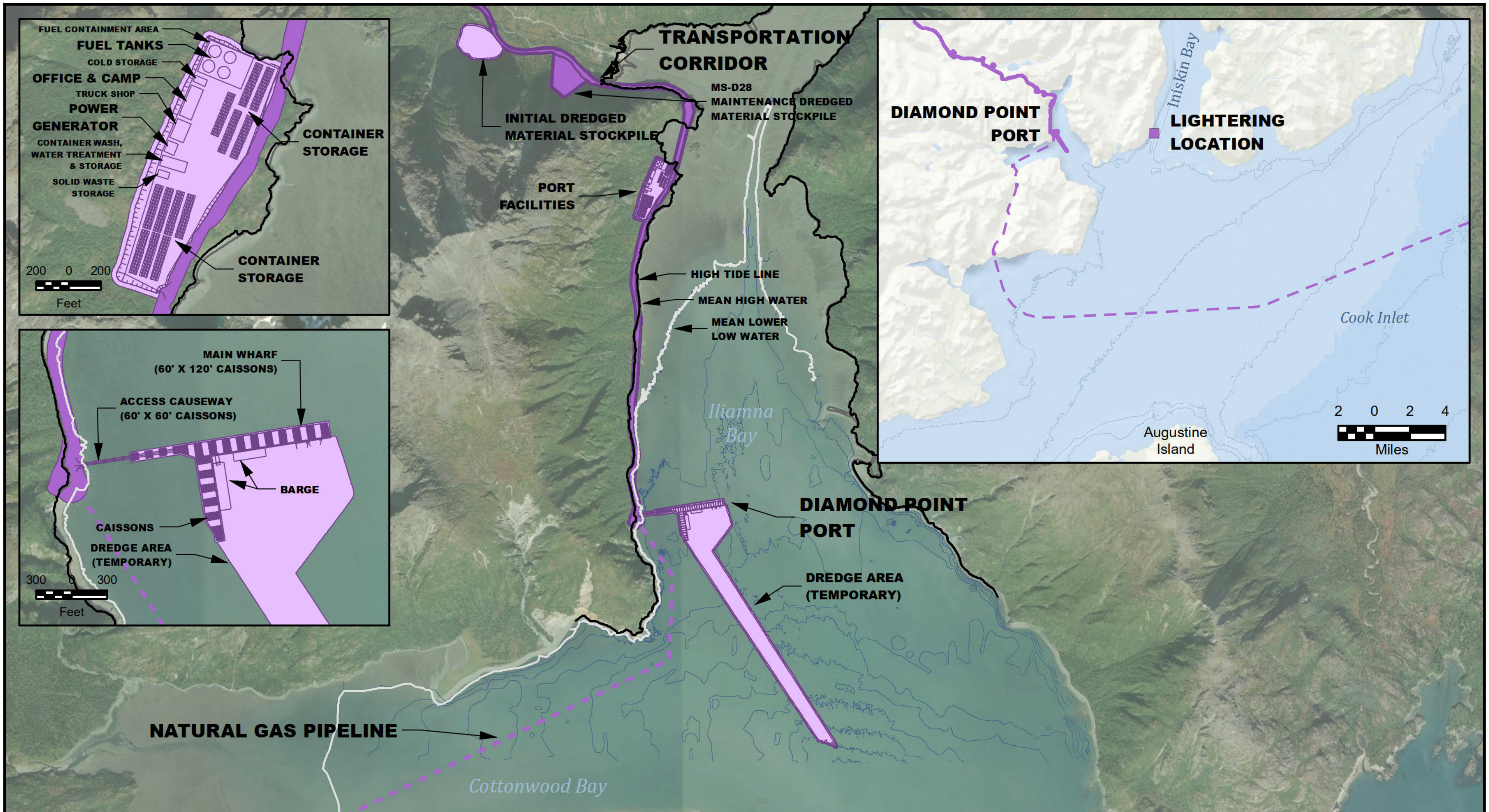
The port site (35 acres) would include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project. The shore-based facilities (16 acres) and dredge material stockpiles (16 acres) would be the similar to those described for Alternative 2, but at the location shown in Figure 2-80.

Marine facilities (3 acres) would include a causeway extending out to a marine jetty/main wharf located in an 18-foot-deep dredge basin. A dredge access channel would lead to deep water. The jetty would be constructed along the northern and western limits and consist of 160-foot by 120-foot concrete caissons up to 58 feet high that would be separated by 60 feet to allow for the free flow of sediment and water, and free passage of fish. The causeway would also be constructed using concrete caissons (60 feet by 60 feet) to support a concrete deck. Fuel and freight barges would be moored to the jetty for loading and unloading. Fuel would be pumped to the storage tanks at the shore-based facility through an 8-inch pipeline. Two ice-breaking tugboats would be used to support marine facility operations. Figure 2-81 shows a digital simulation of the Diamond Point port with the caisson-supported dock design.

The dredge area for the access channel and turning basin would be 76 acres at a depth of 18 feet below MLLW to provide access to the jetty under all tidal conditions; this would allow an additional 3 feet to accommodate for accumulated sedimentation between forecast maintenance dredging and over-depth excavation. The channel would be approximately 1.2 miles long and 300 feet wide (3 times the maximum expected barge width), while the turning basin would incorporate an area of approximately 1,100 feet by 800 feet.

Initial dredging of the facility is expected to commence in May of the second year of construction, and would take 4 to 6 months to complete The total volume of dredged material for the initial dredging is estimated at 1,100,000 cubic yards. Maintenance dredging would take place at 5-year intervals during the early summer months, and is expected to last 3 to 4 weeks. Maintenance dredging (estimated at 20 inches every 5 years) is expected to total 700,000 cubic yards over 20 years (four times).

Dredging would be accomplished using a barge-mounted cutterhead suction dredge. Dredged material would either be pumped directly to shore from the dredge barge, or placed into a small



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADNR

Note: The displayed features are the permanent footprint unless otherwise specified.

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0.25 0 0.25 0.5

Miles

Alternative 3
- Lightering Location
- Natural Gas Pipeline
- Transportation Corridor
- Diamond Point Port

Other Features
- High Tide Line
- Mean High Water
- Mean Lower Low Water
- Bathymetric Contour (2ft)

ALTERNATIVE 3 - DIAMOND POINT PORT AND LIGHTERING LOCATION

Note: This digital simulation includes some features only associated with the Concentrate Pipeline Variant. These include the concentrate conveyor, bulk transfer barges/loader, and various onshore port facilities.
Sources: PLP 2020-RFI 034g

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DIGITAL SIMULATION OF DIAMOND POINT PORT WITH CAISSON-SUPPORTED DOCK barge (200 feet by 40 feet) and hauled to shore. The dredged material would be placed into two bermed stockpiles in uplands north of the port facility and adjacent to the transportation corridor (note: one of the material stockpile sites would be in a transportation corridor material site—Figure 2-80). Consolidation and runoff water would be channeled into a sediment pond, and suspended sediments would be allowed to settle before discharge to Iliamna Bay. Boulders encountered during dredging would be removed using a grab bucket or cable net placed by divers and transported to shore for placement in the stockpiles or use in construction.

Construction of the dock and causeway would take place following completion of the dredging and would occur late in the summer/fall of the second year of construction. To prepare for caisson placement, the basin footprint under the caissons would be excavated and leveled to a depth of approximately 5 feet below the dredged basin or seabed using a barge-mounted excavator. The caissons would then be floated into place using a tug for guidance at high tide, and seated on the leveled seabed on the falling tide, or slowly lowered by pumping water into the caisson. Cranes may be used to place caissons in shallower water. Once set in place, the caissons would be filled with coarse material from the dredging and additional quarried material of a size that would achieve proper compaction when filled to avoid settlement over time. The additional fill material would be sourced from onshore material sites. Fill would be transported from shore to the caissons using a barge. Initially, only enough fill would be placed into the caisson to achieve proper seating, avoiding displacement and overflow of any water in the caisson. Fill materials would be stored temporarily on a barge moored adjacent to the construction area. Any water accumulated in the caisson would be pumped out to avoid saturation in the top fill layers; and if necessary, run through tanks on a barge for sediment settlement before discharge into the marine environment. Pre-cast bridge beams (T-sections) would be placed on the caissons to create the main service deck and the access trestle. These pre-cast beams would then be tied together with rebar and topped with a cast-in-place concrete deck for the final surface. For the shore transition, concrete pedestals would be constructed from shore to support the final bridge beams leading to the causeway. At the dock area, the caissons would be used to mount the fendering system and barge ramp equipment for the marine operations.

Lightering Locations

Bulk concentrate would be lightered by barges out to Handysize bulk carriers at a mooring point in Iniskin Bay (Figure 2-80). There would not be an alternate lighting location under Alternative 3. The proposed mooring system would be the same as described for Alternative 1a.

2.2.7.4 Natural Gas Pipeline Corridor

The pipeline would connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula, and the pipeline design, fiber-optic cable, and the laydown area for the metering station, compressor station, and pig launching/receiving facility would be as described for Alternative 1a. Leak detection systems, inspections, and maintenance would also be the same as described for Alternative 1a.

The Alternative 3 natural gas pipeline corridor would be similar to Alternative 2, but would follow the entire north road access route from Diamond Point to the mine site (Figure 2-78); and be buried in a trench adjacent to the road bed shoulder. Additionally, the three construction access points described for Alternative 2 would not apply to Alternative 3, because there would not be pipeline-only pipeline segments on the north side of Iliamna Lake that require construction access.

Material sites used for construction of the co-located access road and pipeline are discussed under the transportation corridor component. Three material sites (approximately 11 acres) would be required for construction of the pipeline-only segment of the Alternative 3 pipeline from

Ursus Cove to Diamond Point port. Appendix K2 provides information for each material site, including the locations, estimated quantities, size, type of material, use of material, and if blasting is required. Field review has not identified PAG material at any of the proposed sites. If PAG is identified at a site evaluation prior to use, the material site would be moved. The amount of material estimated to be required from these material sites is approximately 200,000 yd^3. Final volumes of these gravel materials, and specific location of material sites and development plans for these sites, would be part of the final project design.

Water extraction sites used for construction of the co-located access road and pipeline are discussed under the transportation corridor component. Four potential water extraction sites have been identified to support construction of pipeline-only segments of the pipeline for Alternative 3. Appendix K2 provides information for each water extraction site, including the locations, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The estimated annual volume of water that would be extracted is 8 million gallons. Final estimated quantities for specific uses would be determined during final design (PLP 2018-RFI 022). Temporary water use authorizations would be applied for by either the appropriate contractor or PLP.

All other aspects of the pipeline would be the same as described for Alternative 2.

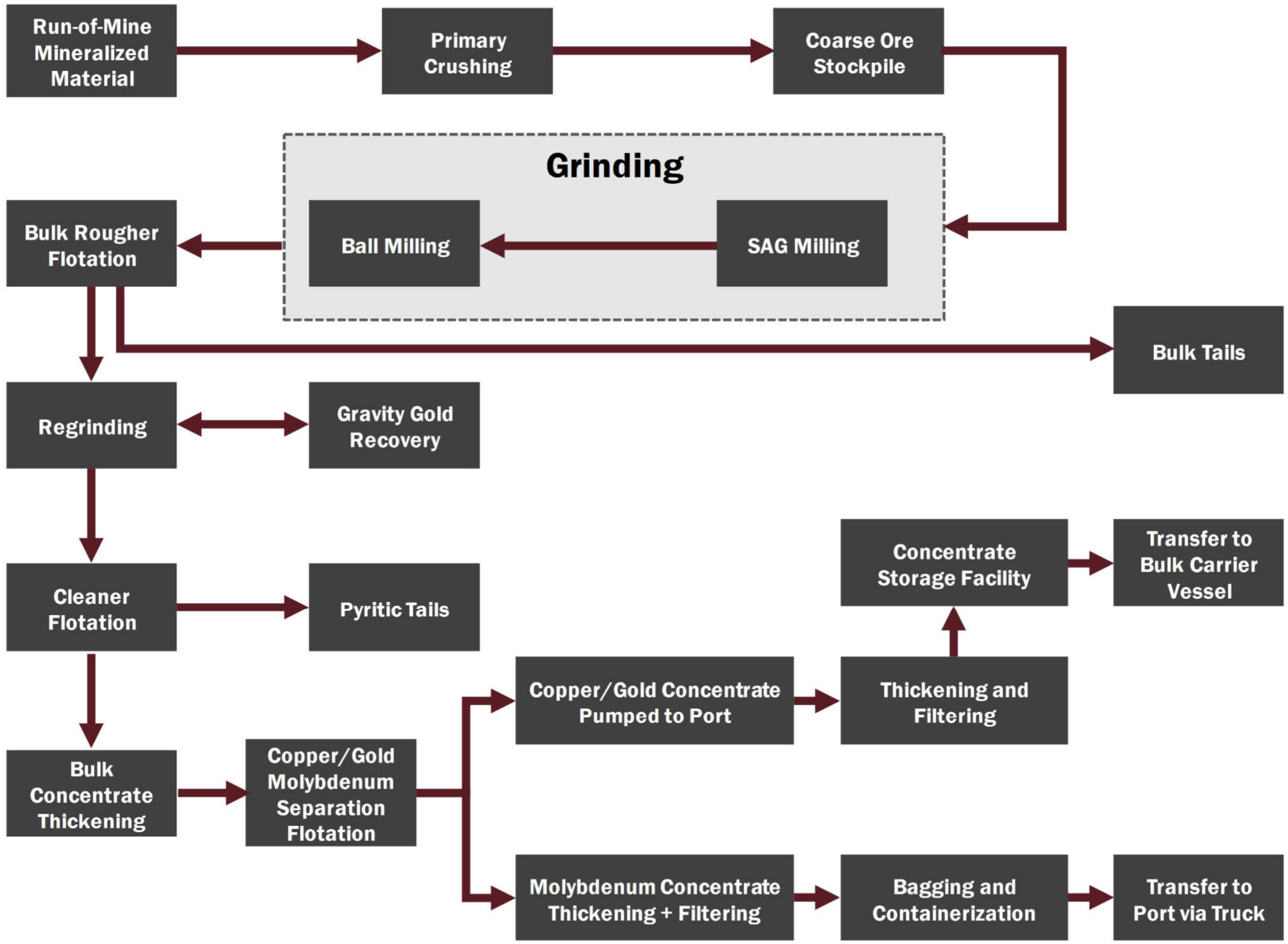
2.2.7.5 Alternative 3—Concentrate Pipeline Variant

Evaluation of an ore concentrate pipeline around Iliamna Lake was suggested during scoping. This variant considers the concept of delivering copper and gold concentrate from the mine site to Diamond Point port using a pipeline instead of trucking along the north access road. Two options are addressed under this variant: one for the concentrate pipeline only, and another for a return water pipeline with the concentrate pipeline concept. Changes to the mine site, transportation corridor, and port with incorporation of this variant under Alternative 3 are described below. This variant does not involve changes to the natural gas pipeline component or the trucking of molybdenum concentrate. This variant is being considered under Alternative 3 only, because the concentrate pipeline would need to be co-located with a road to allow inspections and response actions in the event of a pipeline leak/rupture.

Mine Site

With this variant, mineral processing would be the same as described for Alternative 1a, except the copper-gold concentrate slurry (a mixture of 55 percent concentrate and 45 percent water by mass) would be transported to the port by pipeline, where it would be filtered. The molybdenum concentrate would be filtered at the mine site. Figure 2-82 shows the process flowsheet for this variant. Two electric pump stations would be required: one at the mine site, and one at an intermediate point (described below). Both pump stations would use positive displacement pumps in the 1,000-horsepower range. This variant would increase the mine site footprint by 1 acre. Figure 2-83 shows the location of the concentrate pumphouse at the mine site.

With incorporation of a concentrate pipeline only (no return water pipeline) and the corresponding treatment and discharge of the filtrate at the port site (discussed below), the amount of water available for release to surrounding drainages at the mine site would be reduced by approximately 1 to 2 percent, on average (PLP 2018-RFI 066). With the option of the return water pipeline (described below), water extracted from the concentrate slurry and flushing water would be piped back to the mine site at a rate of approximately 1-cubic-foot-per-second (PLP 2020-RFI 066b).



Sources: PLP 2020d

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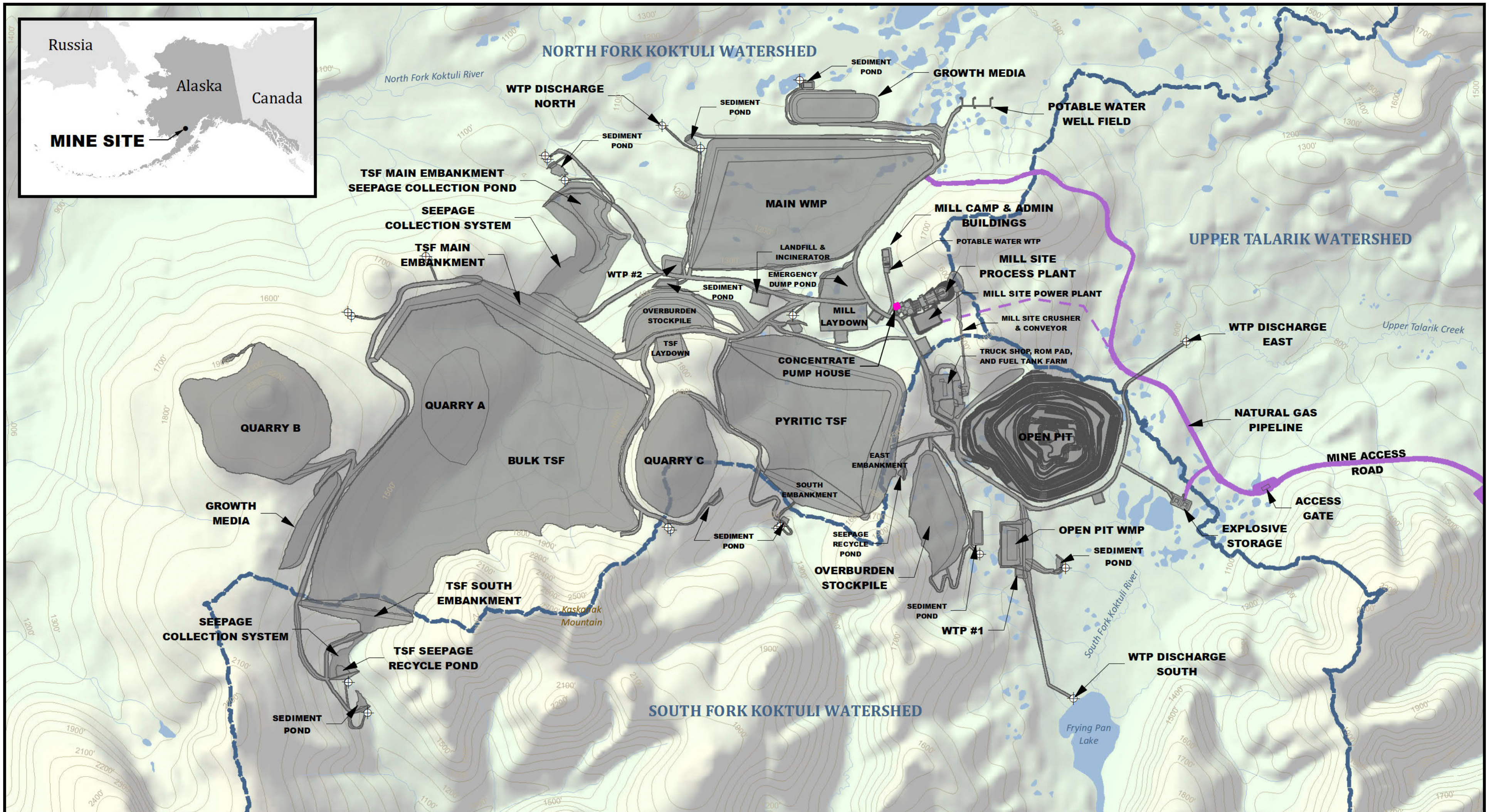
ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - PROCESS FLOW DIAGRAM



Sources: PLP 2020d; PLP 2019-RFI153; USGS; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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0.5 0 0.5 1
Miles

Alternative 3 Variant
- Concentrate Pump House

Alternative 3
- Natural Gas Pipeline
- Transportation Corridor

Alternative 1a
- Monitoring Wells
- Mine Site

Other Features
- River/Stream
- Lake/Pond
- Watershed
- 100' Contour (Existing)

ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - MINE LAYOUT

Transportation Corridor

The concentrate pipeline would follow the Alternative 3 north access road route and would be co-located in a single trench with the gas pipeline and fiber-optic cable at the toe of the road embankment (Figure 2-84 and Figure 2-85). The molybdenum concentrate, which represents approximately 2.5 percent of the total concentrate production, would still be transported in containers as described for Alternative 1a.

The concentrate pipeline would consist of a single, approximately 6.25-inch-diameter API 5L X60 grade (or similar) steel pipeline with an internal high-density polyethylene (HDPE) liner to prevent corrosion. A cathodic protection (zinc ribbon or similar) system would be included for prevention of external corrosion. A pressure-based leak detection system, with pressure transmitters along the pipeline route, would monitor the pipeline for leaks. In addition to the terminal pump station at the mine site, an intermediate booster station would be sited along the road/pipeline alignment in the footprint of a proposed material site (Figure 2-84). Rupture discs at the intermediate and terminal stations and pressure monitoring would be used to protect the pipeline from overpressure events. Manual isolation and drain valves would be spaced at intervals no greater than 20 miles apart (PLP 2018-RFI 066).

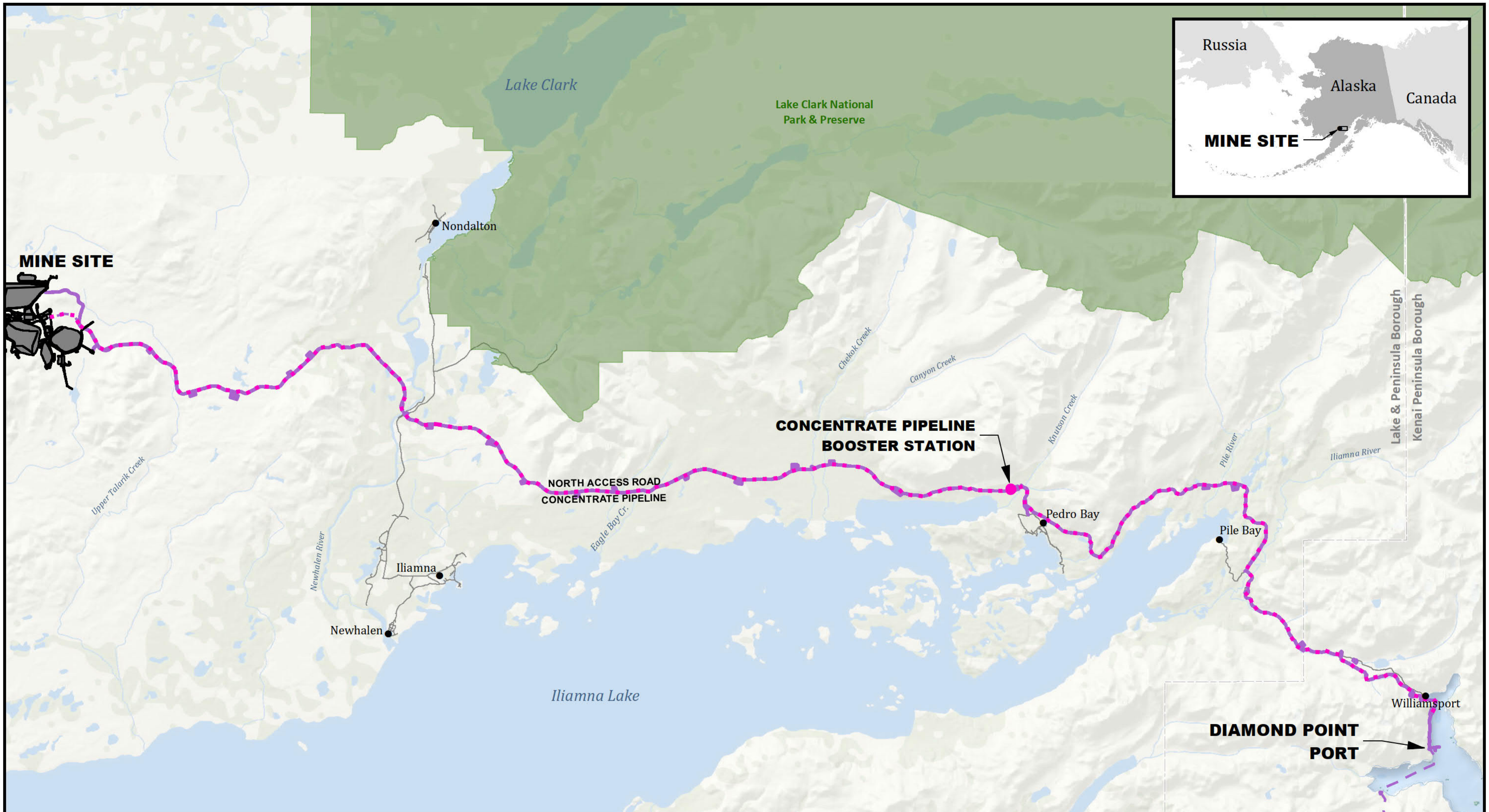
The pipeline would transport a mixture of 55 percent concentrate and 45 percent water by mass, which equates to a water consumption rate from the mine site of approximately 0.6 cfs. Additional water would be intermittently used for flushing the line during maintenance activities. Storage for water and slurry would be provided at the intermediate and terminal stations. Concentrate handling and dewatering facilities would be required at the port facility (PLP 2018-RFI 066).

During construction, steel pipe lengths would be welded together into segments, and the HDPE liner (smaller-diameter pipe) would then be pulled through each segment of steel pipe, ensuring a tight fit for the HDPE liner pipe. These lined segments are then bolted together using flange connections that connect both the inner HDPE liner pipe and the steel outer pipe. Lined concentrate pipelines cannot be built as a continuous welded segment over the entire length, because the tight-fitting HDPE liner would need to be pulled through the inside of the steel pipe. Welded segments can be up to 2,000 to 2,500 feet in length, typically allowing for river crossings that do not include flange connections.

The concentrate pipeline (and the optional return water pipeline described below) would be protected from freezing and buried in the same trench as the natural gas pipeline and fiber-optic cable, with approximately 36 inches of cover, or deeper in areas where needed to prevent freezing. The trench would be adjacent to the north access road, facilitating access for construction, inspection, and maintenance. Construction of the concentrate pipeline adjacent to the north access road corridor would increase the road corridor width, compared to base case Alternative 3, by less than 10 percent under most construction conditions. Construction of the concentrate pipeline and the optional return water pipeline would increase the average width of the road corridor by approximately 3 feet (PLP 2018-RFI 066), in comparison to the base case Alternative 3. At major stream crossings, the pipeline would be attached to the vehicle bridges and protected from freezing. Smaller crossings would use HDD, or trenching if appropriate. Decisions on the appropriate methodology for individual crossings would be made in consultation with the Alaska Department of Fish and Game. Major river crossings would have isolation valves and pressure and temperature monitoring instrumentation installed.

Transportation Corridor Traffic and Materials/Personnel Transport

With the concentrate pipeline variant, truck transport of copper-gold concentrate would be eliminated. Daily truck traffic would be reduced to 18 round trips per day for transportation of molybdenum concentrate, fuel, reagents, and consumables (PLP 2018-RFI 065). Transportation of personnel would be the same as described for Alternative 3, except the Pedro Bay airport would also be used by inspection crews, approximately once per month. No modifications to the airport are expected.



Sources: PLP 2020d; PLP 2019-RFI153; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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3 0 3 6
Miles

Alternative 3 Variant
- Concentrate Pipeline
- Concentrate Pipeline Booster Station

Alternative 3
- Natural Gas Pipeline
- Transportation Corridor
- Port

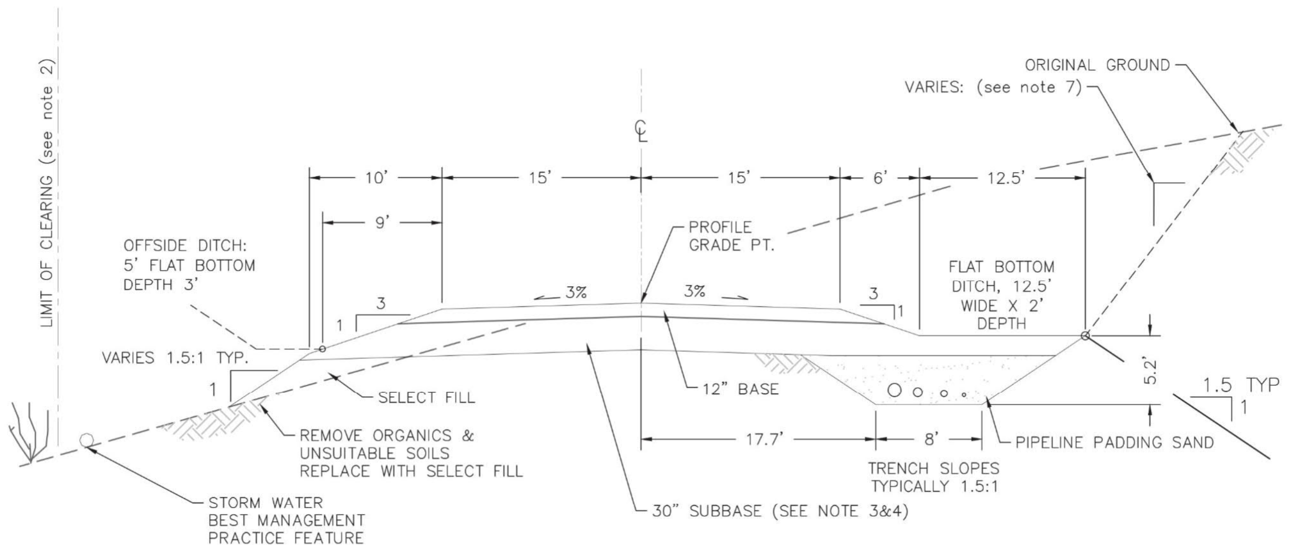
Alternative 1a
- Mine Site

Other Features
- Local Roads
- Borough Boundary
- National Park

ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - CONCENTRATE PIPELINE ROUTE

PEBBLE PROJECT EIS

FIGURE 2-84



NOTES:

1. TYPICAL SECTION APPLIES TO THE FOLLOWING INTERVALS:
   STA. 123+43 TO 133+90 (MP 2.34 TO 2.54)
   STA. 140+90 TO 2102+60 (MP 2.67 TO 39.82)
2. CLEARING LIMITS MAXIMUM OF 10 FT BEYOND TOE OF FILL OR TOP OF CUT.
3. BASE TO CONSIST OF 2 in MINUS, DURABLE, WELL GRADED, CRUSHED ROCK WITH 6 TO 10% PASSING THE 200 SIEVE. MATERIAL TO BE DURABLE. 12" MIN DEPTH.
4. SUBBASE TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL. NON–FROST–SUSCEPTIBLE. 30" MIN DEPTH
5. SELECT FILL MATERIAL: TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL, AS APPROVED BY ENGINEER.
6. DEPTH OF FILL WILL VARY DEPENDING ON SOIL TYPE AND CONDITION. 3.5 ft TOTAL EMBANKMENT DEPTH WILL TYPICALLY BE THE MINIMUM.
7. BACKSLOPES WILL VARY DEPENDENT UPON SOIL OR ROCK TYPE AND CHARACTER
   TYPICAL: 2:1 FOR GLACIAL MORAINE SOILS
   1.5:1 FOR COARSE ROCK SIDE SLOPES
   0.25:1 TO 1:1 FOR ROCK
8. FORESLOPE TO EXTEND AT 3:1 FOR MIN. 10 FT BEYOND SHOULDER, THEN BREAK TO SLOPE THAT WILL VARY. DEPENDING ON SOIL TYPE AND EXTENT OF FILL
9. ACCOMMODATE EXCESS EXCAVATION AND WASTE DISPOSAL BY FLATTENING AND/OR EXTENDING INSLOPE WITHIN THE R.OW.
10. INSTALL GUARDRAIL WHERE WARRANTED. EXTEND ROAD SURFACE WIDTH 3 FT & INCREASE FORESLOPE TO 1.5:1 WHERE GUARDRAIL UTILIZED.
11. STORMWATER BEST MANAGEMENT PRACTICE FEATURES TO BE APPLIED AS APPROPRIATE FOR SITE CONDITIONS. FEATURES MAY INCLUDE: SILT FENCE, STRAW WATTLES, EROSION CONTROL MATS, OR SURFACE ARMORING WITH ROCK.

Sources: PLP 2020f

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ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - TYPICAL ROAD SECTION

Diamond Point Port

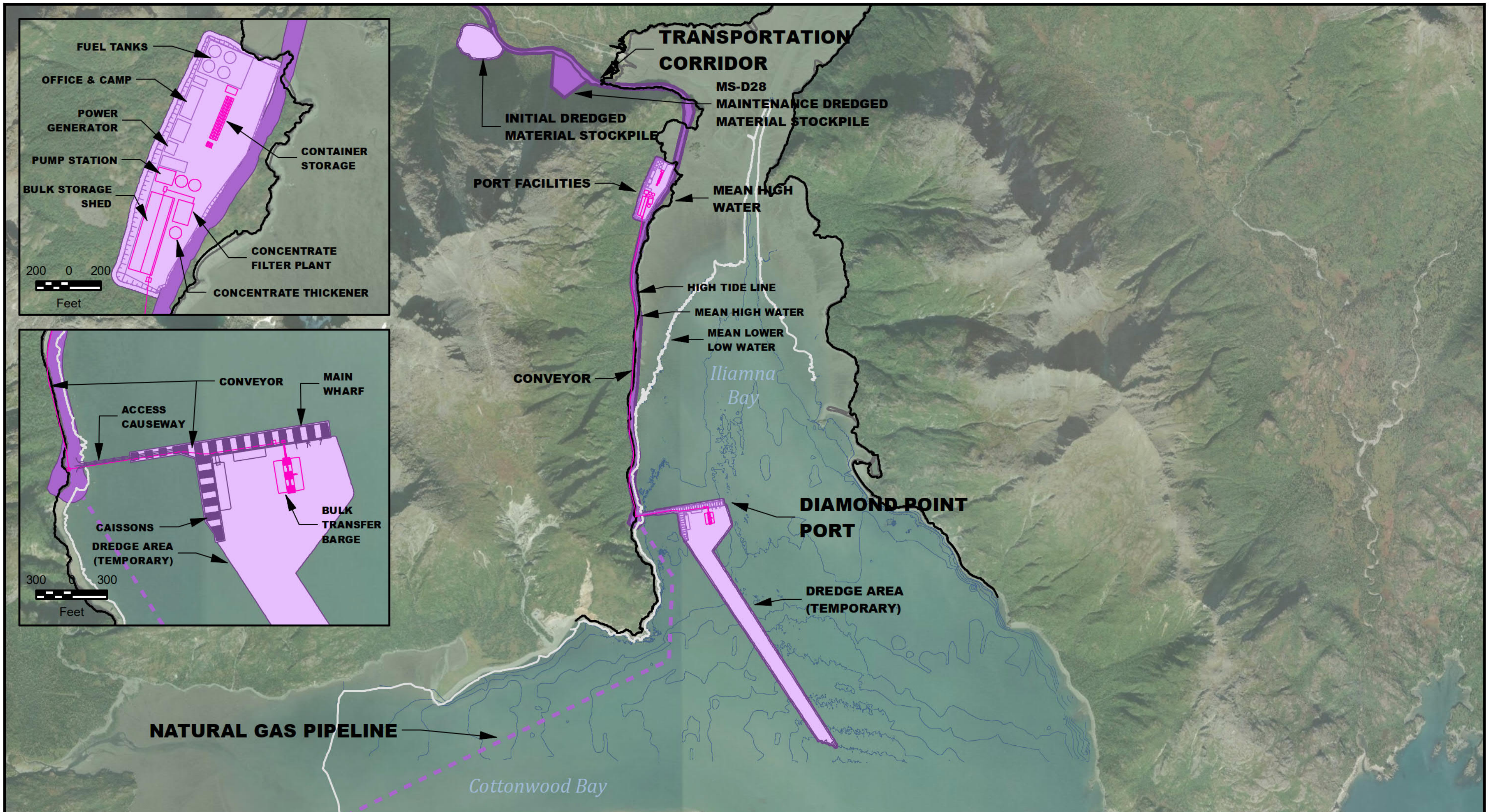
Copper-gold concentrate would be transferred from the mine site to the Diamond Point port by concentrate pipeline, then dewatered at the port site, and stored between vessel sailings in a dedicated concentrate storage building. Use of a concentrate pipeline would require concentrate handling, dewatering, and treatment facilities at Diamond Point port (Figure 2-86). Port operations would change due to the requirements of dewatering the concentrate, storing water and concentrate, and treating and discharging the filtrate water; however, the overall footprint of the port terminal would not increase.

In addition to the jetty described for Alternative 3, the marine facility would include a series of three caissons (60 feet by 60 feet) placed in the dredge basin to provide mooring and loading for concentrate lightering barges; expanding the marine facility footprint by less than 1 acre (approximately 0.2 acre) (Figure 2-86). A gantry would support an enclosed conveyor from the jetty to a barge loader mounted on the caissons.

Copper-gold concentrate would be loaded onto lightering barges using the enclosed conveyor system and then transported to the lightering location in Iniskin Bay for bulk transfer. The lightering barges would have dust covers to control dust emissions. Once loaded, the barges would be transported to and secured against Handysize vessels at the mooring location in Iniskin Bay. Wheel loaders would reclaim the concentrate from the barge deck and transfer it to a ship loader, which would load the ships. The barge location would be adjusted along the ship during the loading process. The loading trunk would extend down into the hold of the ship to minimize dusting, and mist sprays would be used to further control dust generation. Due to the high density of the concentrate, the holds would not be loaded to the top, further reducing any potential for concentrate dust to escape the hold. About five to six trips by the lightering barges would be required to load a bulk carrier, which would be anchored for 3 to 4 days at the lightering location.

The moisture content of the concentrate after dewatering would be 8 percent, resulting in an average of approximately 220 gallons of filtrate water per minute that would need to be treated. Water produced from sources such as pipeline flushing, or process-contacted stormwater, would also require treatment. The port water treatment facility would therefore be designed for a treatment capacity of up to 350 gpm (approximately 0.8 cfs). The water quality characteristics of the slurry filtrate water and port area stormwater streams are expected to exceed discharge criteria for pH and metals concentrations to marine waters. The treatment of this stream would consist of chemical addition for pH adjustment and metals precipitation, followed by clarifiers for bulk suspended solids removal. Following clarification, additional metals precipitation would be accomplished by addition of sodium hydrogen sulfide, and either multimedia filtration or ultrafiltration. The filtered water would be discharged through an outfall pipeline and diffuser into surrounding marine waters (PLP 2019-RFI 066a). The ADEC regulates discharges of process wastewater under the APDES program and EPA has oversight authority for the program. EPA commented that CWA regulations at 40 CFR 440, Subparts J and L apply to the proposed port site discharges of process water and that the concentrate filtrate discharge would not be an allowable discharge.[19] ADEC's position on the discharge of this process water at the port is outlined in response to RFI 158 (ADEC 2020-RFI 158); based on information provided in response to RFI 066 (PLP 2018-RFI 066) they do not dispute EPA's comments. RFI 066 (PLP 2018-RFI 066) presents PLP's position that EPA's CWA New Source Performance Standards Effluent Limitation Guidelines do not prohibit the discharge of the concentrate filtrate at the port site. Solids and/or brine captured in the clarification process and the filtration backwash would be trucked to the mine site, or barged to an off-site disposal facility as appropriate. If, during State permitting, it was confirmed to not be an allowable discharge, a water return pipeline to transport water removed from the concentrate slurry to the mine site for treatment would be proposed (see below).

[19] 40 CFR Part 440.104(b)(1) specifies "there shall be no discharge of process water to navigable waters from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores or any combination of these ores."



Sources: PLP 2020d

Note: The displayed features are the permanent footprint unless otherwise specified.

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0.25 0 0.25 0.5

Miles

Alternative 3 Variant

Concentrate Design Features

Alternative 3

Natural Gas Pipeline

Transportation Corridor

Diamond Point Port

Other Features

High Tide Line

Mean High Water

Mean Lower Low Water

Bathymetric Contour (2ft)

ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - DIAMOND POINT PORT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-86

Concentrate Pipeline Operations Variant Option with Return Water Pipeline

Changes from the concentrate pipeline variant described above, with incorporation of a return water pipeline, are as follows:

- The return water pipeline would be placed in the same trench as the slurry and natural gas lines, adjacent to the road, so the trench would be widened by a few feet (Figure 2-85). This pipeline would need to be sized to accommodate water from flushing operations, resulting in a return water size of approximately 8 inches. This would also be an HDPE-lined steel pipeline with corrosion protection and safety controls similar to the concentrate pipeline. No intermediate pump station would be required for the water return pipeline.
- The Diamond Point port footprint would not change substantially. The WTP would be removed, but other process and storage infrastructure would remain, and a return water pump station and associated generation capacity would be required at the port site.

2.2.8 Summary of Differences Between Action Alternatives

Table 2-2 summarizes the primary differences between the action alternatives. The table depicts differences between Alternative 1a and the other three action alternatives, rather than summarizing all the components of each alternative. Table 2-1 describes the variants analyzed for each action alternative, and Figure 2-1 illustrates the primary differences between the action alternatives.

2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

As described above under “Alternatives Development Process,” USACE considered a reasonable range of alternatives for various project components. Appendix B further details the alternatives development process, including a detailed explanation of the screening criteria applied, and an explanation for why each of the many project options that were evaluated were either included as a component of one of the action alternatives or eliminated from detailed analysis in the EIS.

Over 100 project options were evaluated during the alternatives development process, including alternatives for mine location and layout, mining methods, processing, throughput, gold recovery methods, power, access, concentrate transport, reclamation and closure access, tailings management, PAG waste rock storage, main WMP locations, water treatment, and air emissions. Of these, many options were eliminated from further consideration in the EIS because they did not meet the overall project purpose, were assessed as not reasonable, not practicable, or would not have less environmental damage than the relevant component(s) of the Applicant’s proposal.

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
Mine Site Component				
Mine Site	***Alternative 1a*** • Total Footprint: 8,390 acres • Bulk TSF Main Embankment: Unlined; Centerline Construction ○ Bulk TSF Footprint[1]: 2,797 acres	***Alternative 1*** Same as Alternative 1a ***Alternative 1 – Kokhanok East Variant*** This variant does not involve changes at the mine site (same as Alternative 1 base case) ***Alternative 1 – Summer-Only Ferry Operations Variant*** • Total Footprint: 8,424 acres (increase of 33 acres detailed below) ○ Container Yard: relocated and increased by 32 acres ○ Sewage Storage Tank and WTP: relocated and increased by 0.5 acre ○ On-site access roads: increase by less than 1 acre ***Alternative 1 – Pile-Supported Dock Variant*** This variant does not involve changes at the mine site	***Alternative 2*** • Total Footprint: 8,497 acres (increase of 107 acres compared to Alternative 1a; detailed below) • Bulk TSF Main Embankment: Unlined; Downstream Construction ○ Bulk TSF Footprint[1]: 2,907 acres (110-acre increase) ○ Sediment/Seepage Collection Systems: 1-acre increase ○ On-site access roads: 4-acre decrease ***Alternative 2 – Newhalen River North Crossing Variant*** This variant does not involve changes at the mine site. ***Alternative 2 – Summer-Only Ferry Operations Variant*** • Total Footprint: 8,530 acres (increase of 33 acres detailed below) ○ Container Yard: relocated and increased by 32 acres ○ Sewage Storage Tank and WTP: relocated and increased by 0.5 acre ○ On-site access roads: increased by less than 1 acre ***Alternative 2 – Pile-Supported Dock Variant*** This variant does not involve changes at the mine site	***Alternative 3*** Same as Alternative 1a ***Alternative 3 – Concentrate Pipeline Variant*** • Total Footprint: 8,392 acres (increase of 1 acre detailed below) ○ Concentrate Pump House: 1 acre

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
Transportation Component				
Transportation Corridor Traffic	***Alternative 1a*** • Trucks: Up to 35 truck trips (round trip) per day • Ferry: One round trip per day on average	***Alternative 1*** Same as Alternative 1a ***Alternative 1 – Kokhanok East Variant*** This variant would not change truck or ferry trips ***Alternative 1 – Summer-Only Ferry Operations Variant*** • Trucks: Up to 70 round-trip truck moves per day on each side of the ferry. • Ferry: Larger ferry or two ferries making one round trip each per day. ***Alternative 1 – Pile-Supported Dock Variant*** This variant would not change truck or ferry trips	***Alternative 2*** Same as Alternative 1a ***Alternative 2 – Summer-Only Ferry Operations Variant*** • Trucks: Up to 70 round-trip truck moves per day on each side of the ferry. • Ferry: Larger ferry or two ferries making one round trip each per day. ***Alternative 2 – Pile-Supported Dock Variant*** This variant would not change truck or ferry trips	***Alternative 3*** Same as Alternative 1a ***Alternative 3 – Concentrate Pipeline Variant*** Reduced to 18 round trips per day

Access Roads	***Alternative 1a***
	• Total Road Length/Footprint: 74 miles/783 acres
	  ○ Mine Access Road[2]: 35 miles, 353 acres
	  ○ Port Access Road: 37 miles, 411 acres
	  ○ Kokhanok Spur Road: 1 mile, 15 acres
	  ○ Explosives storage spur road: <1 mile, 4 acres
	  ○ Water extraction site access roads: <1 mile, <1 acre
	• Bridges: 10
		Alternative 1
		• Total Road Length/Footprint: 77 miles/893 acres
		  ○ Mine Access Road[2]: 28 miles, 341 acres
		  ○ Port Access Road: 37 miles, 411 acres
		  ○ Kokhanok Spur Road: 1 mile, 15 acres
		  ○ Iliamna Spur Road: 9 miles, 119 acres
		  ○ Explosives storage spur road: <1 mile, 4 acres
			Alternative 2
			• Total Road Length/Footprint: 54 miles/566 acres
			  ○ Mine Access Road: 35 miles; 353 acres
			  ○ Port Access Road: 18 miles; 209 acres
			  ○ Explosives storage spur road: <1 mile, 4 acres
			  ○ Water extraction site access roads: <1 mile, <1 acre
			• Bridges: 7
			• Newhalen River Crossing Alignment: South location
				Alternative 3
				• Total Road Length/Footprint: 82 miles; 1,087 acres
				  ○ North Access Road: 82 miles; 1,077 acres
				  ○ Pedro Bay Airport spur road: <1 mile, 6 acres
				  ○ Explosives storage spur road: <1 mile, 4 acres
				  ○ Water extraction site access roads: <1 mile, <1 acre (temporary impact)
				• Bridges: 17

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
	• Newhalen River Crossing Alignment: South location	○ Water extraction site access roads: 1 mile, 2 acres • Bridges: 10 • Newhalen River Crossing Alignment: NA ***Alternative 1 – Kokhanok East Variant*** • Total Road Length/Footprint: 70 miles/828 acres ○ Mine Access Road: 28 miles, 341 acres ○ Port Access Road: 27 miles, 297 acres ○ Kokhanok Spur Road: 5 miles, 65 acres ○ Iliamna Spur Road: 9 miles, 119 acres ○ Explosives storage spur road: <1 mile, 4 acres ○ Water extraction site access roads: 1 mile, 2 acres • Bridges: 8 ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change road lengths ***Alternative 1 – Pile-Supported Dock Variant*** This variant would not change road lengths	***Alternative 2 – Newhalen River North Crossing Variant*** • Total Road Length/Footprint: 54 miles/569 acres (differences from Alternative 2 base case detailed below) ○ Mine Access Road: 35 miles (0.3 mile longer than Alternative 2 base case), 356 acres (3-acre increase from Alternative 2 base case) • Newhalen River Crossing Alignment: North location ***Alternative 2 – Summer-Only Ferry Operations Variant*** • Same length as Alternative 2 • Total Footprint: 588 acres (differences from Alternative 2 base case detailed below) ○ Container Yard along the Williamsport-Pile Bay Road: 22 acres ***Alternative 2 – Pile-Supported Dock Variant*** This variant would not change road lengths	• Newhalen River Crossing Alignment: South location ***Alternative 3 – Concentrate Pipeline Variant*** • Same overall length as Alternative 3 • Total road footprint would increase (differences from Alternative 3 base case detailed below) ○ The concentrate pipeline and the optional return water pipeline would be co-located in a single trench with the gas pipeline at the toe of the north road corridor embankment, increasing the average width of the road corridor by 3 feet. Note: the increase would be less for the concentrate pipeline without a return pipeline (increase in width would be less than 10 percent compared to Alternative 3 under typical construction conditions). (PLP 2018-RFI 066) ○ Intermediate booster station along the road alignment: 0.7 acre (Note: this is within the footprint of a material site so would not increase the overall footprint of this variant).

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
Ferry Crossings	***Alternative 1a*** • 28 miles	***Alternative 1*** • 18 miles ***Alternative 1 – Kokhanok East Variant*** • 27 miles ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change the ferry crossing length ***Alternative 1 – Pile-Supported Dock Variant*** This variant would not change the ferry crossing length	***Alternative 2*** • 29 miles ***Alternative 2 – Newhalen River North Crossing Variant*** This variant would not change the ferry crossing length ***Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change the ferry crossing length ***Alternative 2 – Pile-Supported Dock Variant*** This variant would not change the ferry crossing length	***Alternative 3*** Not applicable – No ferry ***Alternative 3 – Concentrate Pipeline Variant*** This variant would not be changed by absence of a ferry
Material Sites	***Alternative 1a*** • Total Material Sites: 19 • Material Sites Footprint: 380 acres	***Alternative 1*** • Total Material Sites: 19 • Material Sites Footprint: 251 acres ***Alternative 1 – Kokhanok East Variant*** • Total Material Sites: 19 sites • Material Sites Footprint: 358 acres ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change material sites ***Alternative 1 – Pile-Supported Dock Variant*** This variant would not change material sites	***Alternative 2*** • Total Material Sites: 17 • Material Sites Footprint: 321 acres ***Alternative 2 – Newhalen River North Crossing Variant*** • Total Material Sites: 17 • Material Sites Footprint: 338 acres (17-acre increase from Alternative 2 base case) ***Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change material sites ***Alternative 2 – Pile-Supported Dock Variant*** This variant would not change material sites	***Alternative 3*** • Total Material Sites: 27 • Material Sites Footprint: 604 acres ***Alternative 3 – Concentrate Pipeline Variant*** This variant would not change material sites

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
North Ferry Terminal	***Alternative 1a*** • Location: Eagle Bay • Total Footprint: 7 acres	***Alternative 1*** • Location: Southwest of Newhalen • Total Footprint: 4 acres ***Alternative 1 – Kokhanok East Variant*** This variant would not change the north ferry terminal ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Alternative 1 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Alternative 2*** Same as Alternative 1a ***Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Alternative 2 – Newhalen River North Crossing Variant*** This variant would not change ferry terminals ***Alternative 2 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Alternative 3*** Not applicable – No ferry ***Alternative 3 – Concentrate Pipeline Variant*** This variant would not be changed by absence of a ferry or ferry terminals
South Ferry Terminal	***Alternative 1a*** • Location: West of Kokhanok • Total Footprint: 23 acres	***Alternative 1*** Same as Alternative 1a ***Alternative 1 – Kokhanok East Variant*** • Location: East of Kokhanok • Total Footprint: 15 acres ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Alternative 1 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Alternative 2*** • Location: Pile Bay • Total Footprint: 18 acres ***Alternative 2 – Newhalen River North Crossing Variant*** This variant would not change ferry terminals ***Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Alternative 2 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Alternative 3*** Not applicable – No ferry ***Alternative 3 – Concentrate Pipeline Variant*** This variant would not be changed by absence of a ferry or ferry terminals

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
Port Component				

Port Facilities	***Alternative 1a***
	• Location: Amakdedori
	• Dock Design: Caisson-supported
	• Dredging: None
	• Airstrip: 6 acres
	• Water Extraction Pad/Road: 1 acre; <1 mile
	• Port Footprint: 17 acres
	  ○ Shore-based facilities: 15 acres
	  ○ Marine facilities: 2 acres
		Alternative 1
		• Location: Amakdedori
		• Dock Design: Earthen causeway and sheet pile jetty
		• Dredging: None
		• Airstrip: Same as Alternative 1a
		• Water Extraction Pad/Road: 1 acre; < 1 mile
		• Port Footprint: 26 acres
		  ○ Shore-based facilities: 15 acres
		  ○ Marine facilities: 11 acres
		Alternative 1 – Kokhanok East Variant
		This variant does not involve changes at the port site
		Alternative 1 – Summer-Only Ferry Operations Variant
		• Port Footprint: 54 acres (differences from Alternative 1 base case detailed below)
		  ○ Container Yard: 27 acres
		  ○ Water Extraction Pad/Road: <1 acre; <1 mile
		Alternative 1 – Pile-Supported Dock Variant
		• Dock Design: Pile-supported dock
		• Port Footprint: 15 acres (differences from Alternative 1 base case detailed below)
		  ○ Marine Facilities: <0.1 acre (footprint decreases from Alternative 1 base case by approximately 11 acres)
			Alternative 2
			• Location: Diamond Point
			• Dock Design: Earthen causeway and sheet pile jetty
			• Dredging: Yes (58-acre temporary impact area)
			• Airstrip: None
			• Water Extraction Pad/Road: None
			• Port Footprint: 55 acres
			  ○ Shore-based facilities: 25 acres
			  ○ Marine facilities: 14 acres
			  ○ Onshore dredge material storage areas: 16 acres
			Alternative 2 – Newhalen River North Crossing Variant
			This variant does not involve changes at the port site
			Alternative 2 – Summer-Only Ferry Operations Variant
			This variant does not involve changes at the port site
			Alternative 2 – Pile-Supported Dock Variant
			• Dock Design: Pile-supported dock
			• Port Footprint: 44 acres (differences from Alternative 2 base case detailed below)
			  ○ Marine Facilities: 4 acres (footprint decreases from Alternative 2 base case by approximately 11 acres)
				Alternative 3
				• Location: Diamond Point
				• Dock Design: Caisson-supported
				• Dredging: Yes (76-acre temporary impact area)
				• Airstrip: None
				• Water Extraction Pad/Road: None
				• Port Footprint: 35 acres
				  ○ Shore-based facilities: 16 acres
				  ○ Marine facilities: 3 acres
				  ○ Onshore dredge material storage areas: 16 acres
				Alternative 3 – Concentrate Pipeline Variant
				Port Footprint: 36 acres (differences from Alternative 3 base case detailed below):
				  ○ Marine facilities: 3 acres (<1 acre larger due to additional caisson supports for the bulk transfer barge)
				Water Treatment Plant: The water treatment plant would not be needed with the return water pipeline option.

Table 2-2: Summary of Primary Differences Between Action Alternatives

<table>
<tr><th>Project Component/ Facilities</th><th>Alternative 1a</th><th>Alternative 1 (Includes 4 Variants)</th><th>Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)</th><th>Alternative 3—North Road Only (Includes 1 Variant)</th></tr>
<tr><td>Lightering Location and Navigational Buoys</td><td>Alternative 1a
• Primary Lightering Location: 12 miles offshore east of Amakdedori port
• Alternate Lightering Location: ~18 miles east-northeast of Amakdedori port between Augustine Island and the mainland
• Navigational Buoys: Two lighted buoys on the reefs framing the entrance to Amakdedori port (~1.5 miles east)
• Sea Floor Footprint: <1 acre</td><td>Alternative 1
Same as Alternative 1a
Alternative 1 – Kokhanok East Variant
This variant would not change lightering locations
Alternative 1 – Summer-Only Ferry Operations Variant
This variant would not change lightering locations
Alternative 1 – Pile-Supported Dock Variant
This variant would not change lightering locations</td><td>Alternative 2
• Primary Lightering Location: Iniskin Bay
• Alternate Lightering Location: Same as Alternative 1a.
• Navigational Buoys: None
• Sea Floor Footprint: <1 acre
Alternative 2 – Newhalen River North Crossing Variant
This variant would not change lightering locations
Alternative 2 – Summer-Only Ferry Operations Variant
This variant would not change lightering locations
Alternative 2 – Pile-Supported Dock Variant
This variant would not change lightering locations</td><td>Alternative 3
• Primary Lightering Location: Iniskin Bay
• Alternate Lightering Location: None
• Navigational Buoys: None
• Sea Floor Footprint: <1 acre
Alternative 3 – Concentrate Pipeline Variant
This variant would not change lightering locations</td></tr>
<tr><td colspan="5">Natural Gas Pipeline Component</td></tr>
<tr><td>Pipeline Facilities</td><td>Alternative 1a
• Total Footprint[3]: 3 acres
○ Compressor station[4]: 2 acres
○ Iliamna Lake Crossing: 1 acre
• Total Length: 193 miles
○ Tie-in to Compressor Station: <1 mile
○ Compressor Station to Cook Inlet: 1 mile
○ Cook Inlet Crossing: 104 miles</td><td>Alternative 1
• Total Footprint[3]: 7 acres
○ Compressor station[4]: Same as Alternative 1a
○ Iliamna Lake Crossing: 4 acres
• Total Length: 187 miles
○ Tie-in to Compressor Station: < 1 mile
○ Compressor Station to Cook Inlet: 1 mile</td><td>Alternative 2
• Total Footprint[3]: 300 acres
○ Compressor station[4]: Same as Alternative 1a
○ Material Sites (13 total): 298 acres
• Total Length: 164 miles
○ Tie-in to Compressor Station: <1 mile
○ Compressor Station to Cook Inlet: 1 mile
○ Cook Inlet Crossing: 75 miles</td><td>Alternative 3
• Total Footprint[3]: 13 acres
○ Compressor station[4]: Same as Alternative 1a
○ Material Sites (3 total): 11 acres
• Total Length: 164 miles
○ Tie-in to Compressor Station: < 1 mile
○ Compressor Station to Cook Inlet: 1 mile
○ Cook Inlet Crossing: 75 miles</td></tr>
</table>

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
	○ Cook Inlet to Port Access Road: 1 mile ○ Port Access Road (co-located): 35 miles ○ Port Access Road to Iliamna Lake: <1 mile ○ Iliamna Lake Crossing: 21 miles ○ Iliamna Lake to Mine Access Road: 10 miles ○ Mine Access Road (co-located): 19 miles ○ Mine Access Road to Mine Site: 2 miles	○ Cook Inlet Crossing: 104 miles ○ Cook Inlet to Port Access Road: 1 mile ○ Port Access Road (co-located): 35 miles ○ Port Access Road to Iliamna Lake: <1 mile ○ Iliamna Lake Crossing: 19 miles ○ Iliamna Lake to Mine Access Road: 1 mile ○ Mine Access Road (co-located): 26 miles ○ Mine Access Road to Mine Site: 2 miles	○ Ursus Cove to Cottonwood Bay: 6 miles ○ Cottonwood Bay Crossing: 3 miles ○ Port Access Road (co-located): 14 miles ○ Overland between Port and Mine Access Roads: 36 miles ○ Mine Access Road (co-located): 29 miles ○ Mine Access Road to Mine Site: 2 miles	○ Ursus Cove to Cottonwood Bay: 6 miles ○ Cottonwood Bay Crossing: 3 miles ○ North Access Road (co-located): 79 miles ○ North Access Road to Mine Site: 2 miles
Pipeline Facilities (continued)		***Alternative 1 – Kokhanok East Variant*** • Total Footprint: 7 acres • Total Length: 185 miles (differences from Alternative 1 base case detailed below) ○ Amakdedori port to Iliamna Lake: This segment follows the port access road and the spur road into Kokhanok (co-located; 30 miles); from there it follows an existing road alignment to the point where it departs the shoreline to tie into the proposed route from Kokhanok West (2 miles). ○ Iliamna Lake Crossing: 20 miles	***Alternative 2 – Summer-Only Ferry Operations Variant*** This variant does not involve changes to the natural gas pipeline ***Alternative 2 – Newhalen River North Crossing Variant*** The pipeline would be attached to the bridge over the Newhalen River at the north crossing alignment; no change to the footprint or overall length from the Alternative 2 base case. ***Alternative 1 – Pile-Supported Dock Variant*** This variant does not involve changes to the natural gas pipeline	***Alternative 3 – Concentrate Pipeline Variant*** The concentrate pipeline (and the optional return water pipeline) would be co-located in a single trench with the gas pipeline at the toe of the north road corridor embankment. See summary under transportation component above.

Table 2-2: Summary of Primary Differences Between Action Alternatives

Project Component/ Facilities	Alternative 1a	Alternative 1 (Includes 4 Variants)	Alternative 2—North Road and Ferry with Downstream Dams (Includes 2 Variants)	Alternative 3—North Road Only (Includes 1 Variant)
		○ All other segments are the same as Alternative 1 base case ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant does not involve changes to the natural gas pipeline ***Alternative 1 – Pile-Supported Dock Variant*** This variant does not involve changes to the natural gas pipeline		
Total Permanent Footprint				
Total Permanent Footprint	***Alternative 1a*** • 9,611 acres	***Alternative 1*** • 9,600 acres ***Alternative 1 – Kokhanok East Variant*** • 9,635 acres ***Alternative 1 – Summer-Only Ferry Operations Variant*** • 9,661 acres ***Alternative 1 – Pile-Supported Dock Variant*** • 9,589 acres	***Alternative 2*** • 9,763 acres ***Alternative 2 – Newhalen River North Crossing Variant*** • 9,783 acres ***Alternative 2 – Summer-Only Operations Variant*** • 9,819 acres ***Alternative 2 – Pile-Supported Dock Variant*** • 9,753 acres	***Alternative 3*** • 10,130 acres ***Alternative 3 – Concentrate Pipeline Variant*** • 10,132 acres[5]

Notes: Dimensions are based on project GIS database and represent permanent impacts. Numbers are rounded to the nearest whole number; therefore, the sum of individual segments/ features may not match the totals listed for the overall component.
[1] Includes the bulk tailings storage cell and TSF embankments
[2] Includes Upper Talarik spur (0.4 acre)
[3] Represents permanent footprint for the natural gas pipeline only; temporary footprint outlined in Appendix K2
[4] Includes access road to compressor station
[5] The concentrate pipeline (and the optional return water pipeline) would be co-located in a single trench with the gas pipeline at the toe of the north road corridor embankment. See summary under transportation component above. The Alternative 3 base-case road width was conceptually engineered larger to accommodate the concentrate pipeline variant.
TSF = tailings storage facility
WTP = water treatment plant