Volume 1:
Chapters 1 and 2

US Army Corps of Engineers

Pebble Project EIS

Draft Environmental Impact Statement

February 2019

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1.0 PURPOSE AND NEED

1.1 INTRODUCTION

The US Army Corps of Engineers (USACE), Alaska District (District), Regulatory Division is examining the potential environmental impacts associated with Pebble Limited Partnership's (PLP) submittal of a Department of the Army (DA) Permit application (POA-2017-271). In its application, PLP has asked for authorization to discharge fill material into waters of the US (WOUS) and for work in and the placement of structures in navigable waters of the US (NWUS) for the purpose of developing a copper-gold-molybdenum porphyry deposit (Pebble deposit). PLP's proposed discharges and activities are located in the Lake and Peninsula Borough (LPB) and Kenai Peninsula Borough of Alaska.

1.2 APPLICATION DESCRIPTION

PLP has applied for authorization to discharge dredged and fill material into WOUS as part of its proposed development of the Pebble deposit. DA authorization for the discharge of dredged and fill material into WOUS is required by Section 404 of the Clean Water Act (CWA) (33 US Code [USC] 1344). PLP has also applied for authorization to work in and place structures in NWUS. DA authorization for work and placement of structures in NWUS is required by Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403).

PLP proposes discharges into WOUS and work in and placement of structures in NWUS in order to develop and operate an open-pit mine and associated ore processing facilities for the purpose of producing copper, gold, and molybdenum, and other commodities for sale. Additional elements necessary for this purpose, identified in the application include: the construction of a 29-mile road from the mine site to Iliamna Lake; a 37-mile road from Iliamna Lake to the Cook Inlet at Amakdedori Creek; spur roads to the villages of Iliamna, Newhalen, and Kokhanok; ferry terminals to support an 18-mile ice-breaking ferry crossing; a port facility and lightering locations in Cook Inlet; an 187-mile gas pipeline originating on the Kenai Peninsula and extending across the Cook Inlet to Amakdedori port, terminating at the mine site; and power generation facilities located at the mine and the port site. PLP states that the operating life of the resultant surface mine would be an approximate 20-year period, and that mine closure and monitoring activities would extend for many years thereafter. A more detailed summary of PLP's proposed project is provided in Chapter 2, and the complete project description submitted, including updates to applicant's proposed alternative, is provided in Appendix N.

1.3 FEDERAL DECISIONS TO BE MADE

DA authorization is required for the proposed permanent discharges of dredged or fill material into 3,560 acres and temporary discharge of fill into 510 acres of WOUS associated with the construction of the mine and associated roads, port, and natural gas pipeline in wetlands and other WOUS under Section 404 of the CWA. DA authorization is also required for the work and structures associated with construction of the port facilities, ferry terminals, lightering locations and the natural gas pipeline in NWUS. The USACE has set forth implementing regulations in 33 Code of Federal Regulations (CFR) Parts 320-332.

Through review of the application, the USACE identified two additional federal decision-makers which would use the Environmental Impact Statement (EIS) to inform their decisions; the US Coast Guard (USCG), and the Department of the Interior's Bureau of Safety and Environmental

Enforcement (BSEE). USCG has authority over locations and clearances of bridges and causeways in or over NWUS. USCG authorization is required for a proposed bridge over the Newhalen River. The USCG has set forth implementing regulations in 33 CFR Parts 114-118. The BSEE oversees safety, environmental protection, and conservation of resources related to the exploration for and development of offshore resources on the Outer Continental Shelf. BSEE authorization is required for the right-of-way (ROW) encompassing the natural gas pipeline between the Kenai Peninsula and the proposed port facility, but only that portion of the ROW that would lie on the Outer Continental Shelf of Cook Inlet. This authority derives from the Outer Continental Shelf Lands Act, as implemented by BSEE regulations at 30 CFR Part 250, Subpart J.

The decisions to be made by the three federal agencies, if those decisions are to grant applicable permits, would not fully authorize mining of the Pebble deposit. The State of Alaska would need to approve many mining activities to include: approval to construct the dams required for the tailings storage facilities and other impoundments, air and water discharges, Plan of Operations, Reclamation and Closure Plan, and the Waste Management Plan. The State of Alaska would also need to issue ROW leases for the proposed roads and natural gas pipeline. PLP must apply for and receive a number of additional federal, state, and local permits and approvals. A list of permits, approvals, and consultations required for development and operation of the proposed project are provided in Appendix E.

1.4 ENVIRONMENTAL ANALYSIS

The USACE has determined that the proposed discharge of fill material into WOUS and/or work in and placement of structures in NWUS associated with PLP's application is a major federal action that could significantly affect the quality of the human and natural environment. Based on this determination, this EIS has been prepared under Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969 (42 USC 4321 et seq.) and its implementing regulations promulgated by the Council on Environmental Quality (CEQ) (40 CFR Part 1500–1508), and USACE regulations found at 33 CFR 325 Appendix B, NEPA Implementation Procedures for the Regulatory Program. NEPA procedures are designed to ensure that federal agencies identify and assess the reasonable alternatives to proposed actions, along with the environmental consequences of a proposed action and reasonable range of alternatives, in order to avoid or minimize the adverse effects of those actions upon the quality of the human environment.

Information gathered as part of the NEPA process will be used to inform USACE's public interest review determination, required by 33 CFR Part 320.4. Information will also be used by the USACE to make a determination of the least environmentally damaging practicable alternative under the CWA's Section 404(b)(1) Guidelines (see Appendix F) and any appropriate required compensatory mitigation for unavoidable impacts to WOUS. No discharges of dredged or fill materials are permitted to be authorized by the USACE under the CWA if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem, as long as the alternative does not have other significant adverse environmental consequences.

An EIS is used to inform the public and agency decision-makers, but it is not a decision document. A joint Record of Decision (ROD) by the USACE, BSEE, and USCG, issued at the conclusion of the NEPA process, will record each appropriate federal agency's decision(s), identify the alternatives considered in reaching those decision(s), and identify practicable means to avoid or minimize environmental harm (if required).

As the lead federal agency under NEPA, USACE issued a Notice of Intent (NOI) to prepare an EIS and a Notice of Scoping for the Pebble Project was published in the Federal Register (FR) on March 29, 2018 (83 FR 13483; pages 13,483-13,484). The scoping comment period was extended by 60 days to continue through June 29, 2018. Nine public meetings were held during the scoping period. A total of 174,889 submissions were received through June 29, 2018. Further details on the scoping process are found in the Scoping Report (Appendix A).

The USACE invited USCG, BSEE, and other federal and state agencies, local governments, and federally recognized tribes to become cooperating agencies based on their special expertise and/or jurisdiction by law. The Advisory Council on Historic Preservation, the US Fish and Wildlife Service (USFWS), the US Environmental Protection Agency (EPA), the US Department of Interior (USDOI) National Park Service (NPS), the Pipeline and Hazardous Materials Safety Administration, the State of Alaska, the LPB, the Curyung Tribal Council, and the Nondalton Tribal Council accepted invitations to become cooperating agencies. The USACE is coordinating this EIS with multiple cooperating agencies, which are defined as those agencies with jurisdiction by law or special expertise with respect to any environmental impact involved in a proposed project or its reasonable alternatives. Cooperating agencies may include state or local agencies and Tribal governments. A summary of consultation and coordination with agencies can be found in Chapter 6, Consultation and Coordination.

1.5 PURPOSE AND NEED

A permit applicant's stated purpose and need is used as part of the NEPA process to inform the reasonable alternatives to a proposed action, and the stated need is used by the USACE to determine the overall purpose (and thus, practicable alternatives for the CWA 404(b)(1) evaluation) and to evaluate a proposed project from the public's perspective (under the public interest review criteria). PLP's (the applicant) stated need for the proposed project is, "to meet the increasing global demand for commodities such as copper, gold, and molybdenum."

From the broad, macroeconomic scale, the project need is reflected in the worldwide demand for copper. In 2018, the International Copper Study Group projected a small surplus of projected available copper; however, worldwide demand for copper is projected to exceed the available supply in 2019 (ICSG 2018).

Gold is used for the production of jewelry, electronics, and electrical components, official coins, and other uses. In the first 9 months of 2017, domestic consumption of gold used in the production of coins and bars decreased by more than 50 percent; however, gold consumption for jewelry increased slightly, and demand for gold coins and bars increased by 13 percent in comparison to the first 9 months of 2016 (USGS 2018d).

Molybdenum is used for the production of ferromolybdenum, metal powder, and various chemical products. Metallurgical application accounted for 87 percent of the total molybdenum consumed. In 2017, US imports for consumption of molybdenum increased by 68 percent from 2016; US exports increased by 37 percent from 2016, mainly owing to an increase in export of molybdenum ores and concentrates and molybdates. Apparent consumption increased by 26 percent in comparison to 2016 (USGS 2018d).

The applicant has stated that the proposed project's purpose is to produce commodities, including copper, gold, and molybdenum, from the Pebble deposit in a manner that is commercially viable, using proven technologies that are suitable for the project's remote location. According to the applicant, because the area the applicant has leased for mineral development is not served by existing infrastructure, achieving the project purpose requires the construction of facilities for the mining and processing of mineral-bearing rock, as well as construction of support and access infrastructure. The purpose of the natural gas pipeline from the Kenai Peninsula is to provide a long-term stable supply of natural gas to meet the energy needs of the project by connecting to the existing regional gas supply network.

Although the USACE generally focuses on an applicant's stated purpose and need for a proposed project, in all cases the USACE exercises independent judgment in defining the purpose and need from both the applicant's and the public's perspective. The USACE has determined that the applicant's stated purpose is made too narrow by limiting the proposed development to the Pebble deposit. The public's interest in commodities such as copper, gold, and molybdenum does not dictate a particular source of these commodities. However, the public also has an interest in improving the economy of the state, in the creation of jobs in the state, and in the extraction of natural resources for the benefit of the state. This is demonstrated by scoping comments which indicated a desire to bring economic opportunity and jobs to the region, as well as by policy language in the Alaska State Constitution and Alaska Statutes encouraging development of the state's mineral resources consistent with the public interest.

In addition, USACE has determined that the construction of facilities and other infrastructure to support the proposed project is more appropriately evaluated as part of the alternatives, and therefore requires no inclusion in the overall purpose. No specific piece of the proposed infrastructure is required to meet the stated need. An overall project purpose is determined solely by the USACE, while considering the applicant's and the public's perspective, and is used to help identify practicable alternatives (i.e., those that are available and capable of being done after taking into consideration cost, existing technology, and logistics) to be evaluated under CWA 404(b)(1) guidelines. Any overall purpose must seem feasible as well as take into account the need for the type of proposed development.

The USACE has determined that the overall project purpose is to develop and operate a copper, gold, and molybdenum mine in Alaska in order to meet current and future demand.

2.0 ALTERNATIVES INCLUDING APPLICANT'S PROPOSED ALTERNATIVE

The Council on Environmental Quality's (CEQ's) regulations describe the alternatives section as the "heart of the Environmental Impact Statement," and 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 one that is "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)).

According to US Army Corps of Engineers (USACE's) National Environmental Policy Act (NEPA) 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 the 404(b)(1) guidelines analysis.

In addition to evaluating the Applicant's proposed project under NEPA, USACE will be evaluating the Applicant's permit application pursuant to Section 10 of the Rivers and Harbors Act (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 in addition to the requirements under NEPA, it will 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.

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 Alternatives

Appendix B details each step of the 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 action alternatives.
- 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 action alternatives.

  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 action alternatives.
- Environmental Impacts: Options that have a high potential to increase the overall adverse environmental impacts or that add no environmental benefit compared to the proposed project were eliminated from further consideration as action alternatives. 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 one of the screening criteria, it was eliminated from further consideration, and did not proceed to the subsequent screening tests.

2.2 ALTERNATIVES CARRIED FORWARD FOR DETAILED ANALYSIS

Options that met screening criteria were packaged into action alternatives (i.e., an alternative must be a functioning project and include power, a port, transportation, and mine facilities). The alternatives screening process resulted in the identification of three major action alternatives (listed below). Variations to components of the project that do not comprise a complete functioning alternative are analyzed as variants under action alternatives. Each action alternative analyzes one to three variant 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.

- Action Alternative 1 – The base case for Action Alternative 1 is Pebble Limited Partnership's (PLP's) proposed Pebble Project. In addition, three variants, with modification to key project components have been analyzed. Action Alternative 1 includes the proposed mine site at Pebble; a transportation corridor with a mine access road, a port access road, and a ferry crossing of Iliamna Lake; a port at Amakdedori; and a natural gas pipeline from the Kenai Peninsula that crosses Cook Inlet to the port, then follows the transportation corridor to the mine site. Action Alternative 1 and its variants are presented below.

- Action Alternative 2 – This alternative, termed the North Road and Ferry Alternative with Downstream Dams, is being considered as an alternative that would reduce the overall length of access roads and use alternate methods for construction of the bulk tailings storage facility (TSF). The Action Alternative 2 access route includes a road alignment from the mine site along the northern shore of Iliamna Lake to Eagle Bay; a ferry from Eagle Bay to Pile Bay; and a road alignment to a port at Diamond Point. In addition, Action Alternative 2 has been analyzed subject to two of the same variants identified for Action Alternative 1. Action Alternative 2 and its variants are presented blow.
- Action Alternative 3 – This alternative, termed the North Road Only 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. The Action Alternative 3 access route includes a north road alignment from the mine site to a port at Diamond Point on Cook Inlet. Action Alternative 3 and its variant are presented below.

Table 2-1 describes the variants being considered for each alternative. Figure 2-1 illustrates the primary differences between the action alternatives. For each of the variants being considered in the EIS, 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.

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

Variant Description/ Project Component	Action Alternative 1 – Applicant's Proposed Alternative	Action Alternative 2 – North Road and Ferry with Downstream Dams	Action Alternative 3 – North Road Only
Summer-Only Ferry Operations Variant 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 Action Alternatives 1 and 2.			
Mine Site	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 Action Alternative 3 because there is no ferry with this alternative.

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

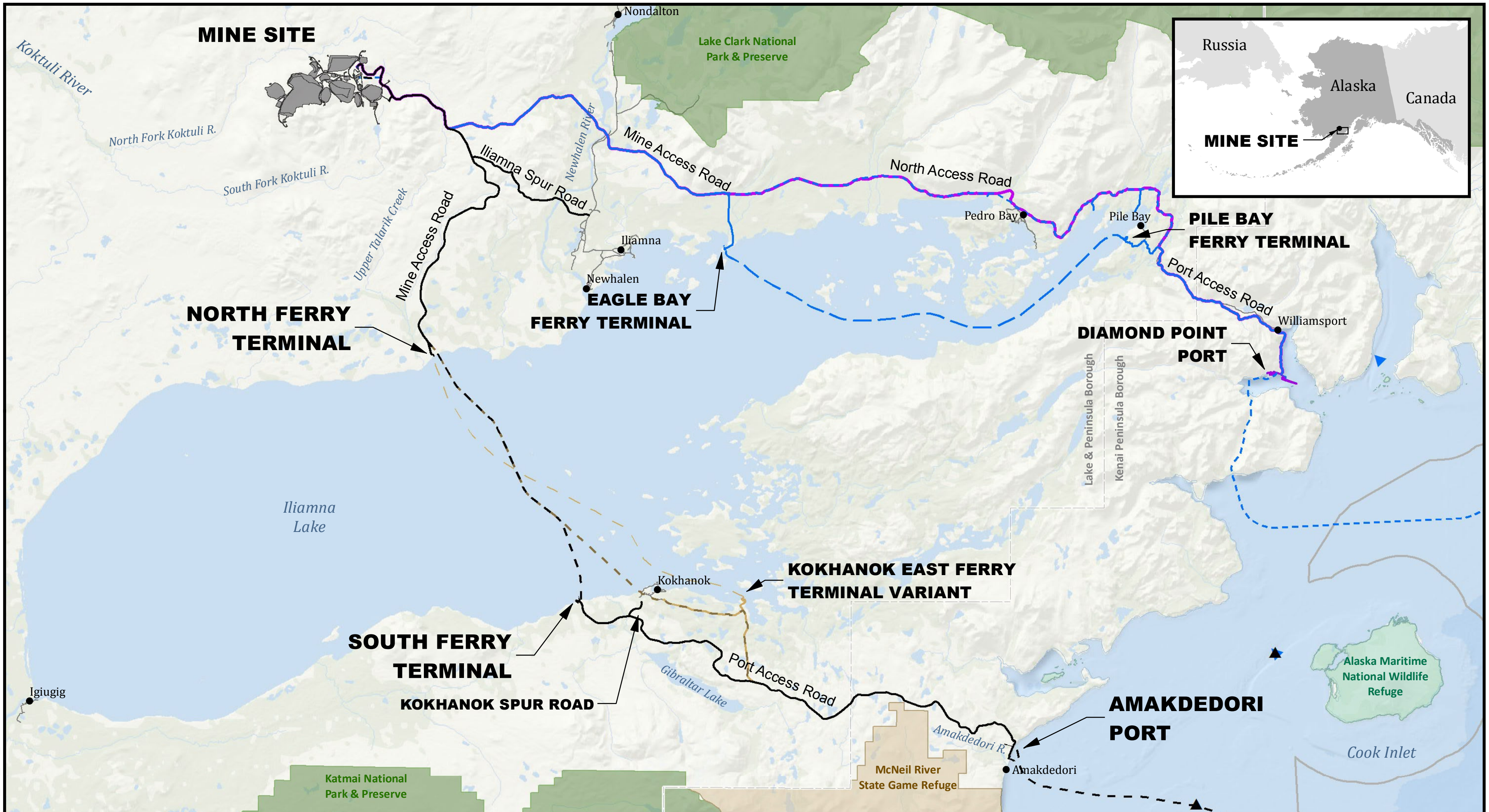
Variant Description/ Project Component	Action Alternative 1 – Applicant's Proposed Alternative	Action Alternative 2 – North Road and Ferry with Downstream Dams	Action Alternative 3 – North Road Only
Transportation Corridor	With ferry operations limited to the open water season only, there would be increased 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 Action Alternative 2 base case).	
Natural Gas Pipeline	This variant would not change this component (same as Action Alternative 1 base case).	This variant would not change this component (same as Action 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 alternate south shore ferry terminal location east of Kokhanok (Kokhanok east ferry terminal site) and is evaluated as a variant to Action Alternative 1.			
Mine Site	This variant would not change this component (same as Action Alternative 1 base case).	This variant is not evaluated for Action 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 Action 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).		

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

Variant Description/ Project Component	Action Alternative 1 – Applicant's Proposed Alternative	Action Alternative 2 – North Road and Ferry with Downstream Dams	Action Alternative 3 – North Road Only
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.		
Pile-Supported Dock Variant PLP proposes 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 Action Alternatives 1 and 2.			
Mine Site	This variant would not change this component (same as Action Alternative 1 base case).	This variant would not change this component (same as Action Alternative 2 base case).	This variant is not evaluated for Action Alternative 3 because it has the same port component as Action Alternative 2 (Diamond Point port).
Transportation Corridor	This variant would not change this component (same as Action Alternative 1 base case).	This variant would not change this component (same as Action Alternative 2 base case).	
Port	Alternate pile-supported dock design at Amakdedori port.	Alternate pile-supported dock design at Diamond Point port.	
Natural Gas Pipeline	This variant would not change this component (same as Action Alternative 1 base case).	This variant would not change this component (same as Action 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 Action 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	This variant is not evaluated for Action 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 Action 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, an electric pump station would be sited at the mine site. Water mixed with the concentrate would result in a small reduction (<1 cubic foot per second) in water available for discharge at the mine site.

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

Variant Description/ Project Component	Action Alternative 1 – Applicant's Proposed Alternative	Action Alternative 2 – North Road and Ferry with Downstream Dams	Action 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 Action Alternative 3 base case).



Sources: PLP 2018; ADNR

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

US Army Corps of Engineers

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Action Alternative 1
- Lightering Locations
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Ferry Route
- Natural Gas Pipeline
- Ferry Terminal

Kokhanok East Ferry Terminal Variant
- Transportation Corridor

Action Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

Action Alternatives 2/3
- Lightering Location
- Natural Gas Pipeline
- Port Site

Action Alternative 3
- Transportation Corridor

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

ACTION ALTERNATIVES COMPARISON

PEBBLE PROJECT EIS

FIGURE 2-1

2.2.1 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. Impacts from the proposed project (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 USACE would not issue a permit for development of proposed project components that require the discharge of dredged and fill material in waters of the US (WOUS), or work and structures in navigable waters of the US (NWUS). The US Coast Guard (USCG) Bridge Administration Program would not issue approval for proposed bridges over waters that the USCG considers navigable. The Department of the Interior's Bureau of Safety and Environmental Enforcement (BSEE) would not issue a right-of-way (ROW) for the proposed natural gas pipeline on the outer continental shelf. Federal regulatory authorities are described in Chapter 1, Purpose and Need.

Under the No Action Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State of Alaska's authorization process, as well as conduct any activity that would not require federal authorization. Although no resource development would occur, permitted resource exploration activities currently associated with the project may continue (ADNR 2018-RFI 073). 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. PLP would be required to reclaim any remaining sites at the conclusion of their state-authorized exploration program. If reclamation approval is not granted immediately after the cessation of reclamation activities, the state may require continued authorization for ongoing monitoring and reclamation work as deemed necessary by the State of Alaska.

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 Final EIS (FEIS).

2.2.2 Action Alternative 1 – Applicant's Proposed Alternative

This section summarizes the Applicant's proposed alternative. Detailed information about engineered facilities and operations for the project from initial construction through closure and reclamation is included in Appendix N. Appendix K2 provides the proposed construction schedule and a summary of the Action Alternative 1 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. Proposed mitigation measures, project elements, and environmental protections, including best management practices (BMPs), that PLP is proposing to implement to avoid and minimize impacts are described in Chapter 5, Mitigation. A technical glossary of mining-related and physical science terms applied throughout project documents can be accessed online at https://pebbleprojecteis.com/overview/glossary.

PLP's December 2018 Project Description (PLP 2018d) (included as Appendix N), the Pebble Project Department of the Army Application for Permit POA-2017-271 and supporting documents (PLP 2019a), various responses to Request for Information (RFIs) as cited herein and associated Geographic Information System (GIS) data provided by PLP form the basis for the description of Action Alternative 1. Figures presented in Chapter 2 represent permanent installations, unless otherwise noted on the figures. It is important to note that the USACE regulatory process is iterative. 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 during the process. Updates to the proposed project since PLP's initial application was submitted to USACE in December 2017 (PLP 2017) include:

1. The milling rate increased to 180,000 tons per day from 160,000 tons per day. 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 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.
3. The pyritic tailings (and PAG waste rock) would now be placed into the pit lake (i.e., the water that would accumulate in the open pit as a lake at closure).
4. The main water management pond was made larger and moved to a new location.
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 as a result of fieldwork.
    - D. The Amakdedori port compressor station has been removed.
6. Dredging is no longer proposed for the Amakdedori port and concentrate would be lightered into deep water using barges for loading onto anchored bulk carriers.

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 (see Figure 2-2).

The project is comprised 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. See Figure 2-3, which shows the general project layout of Alternative 1.

Sources: PLP; ADNR

US Army Corps of Engineers

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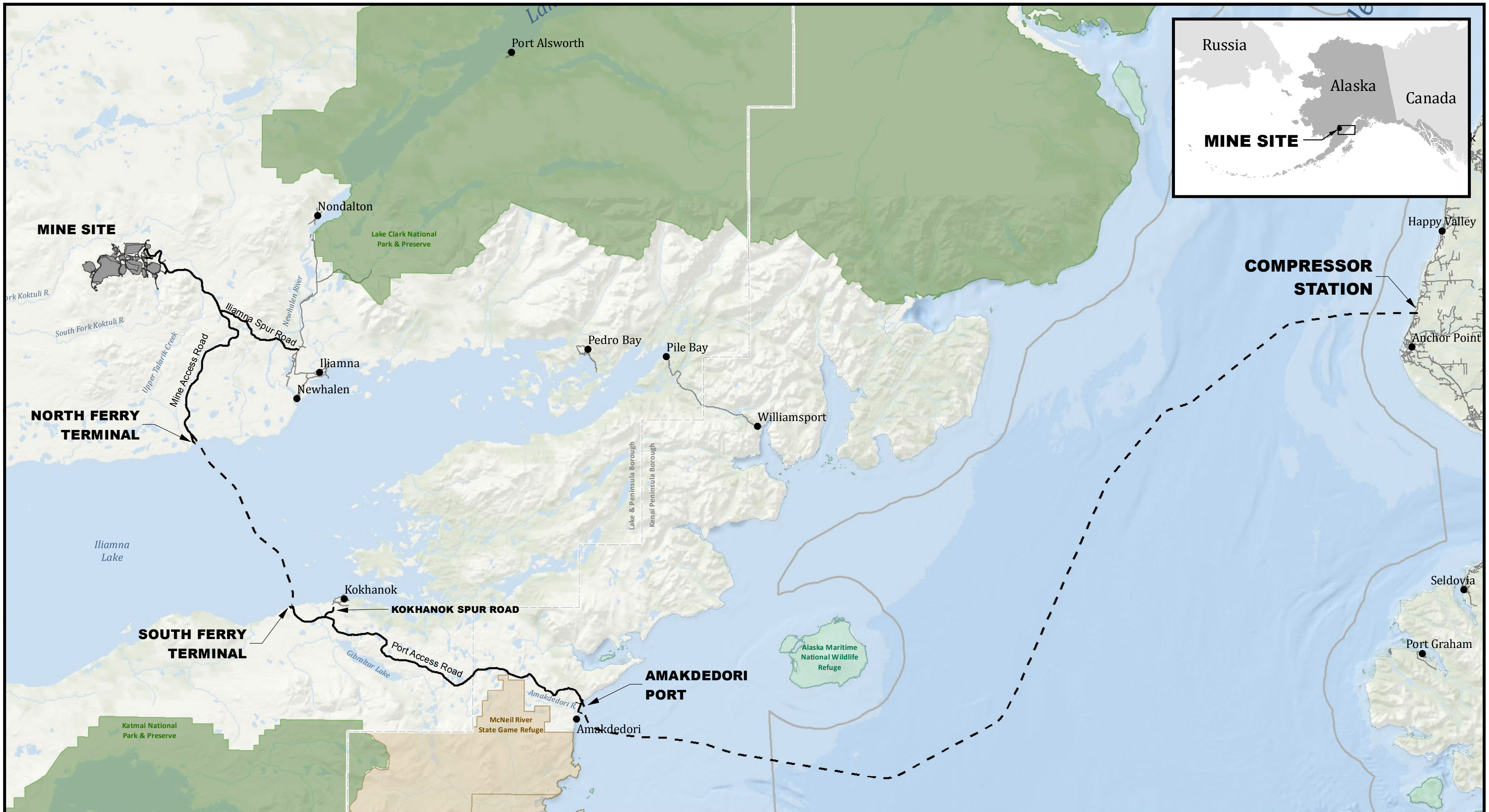
Miles

- Pebble Deposit
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- Alaska State Park
- Wild and Scenic River
- State Game Refuge/Sanctuary

REGIONAL MAP

PEBBLE PROJECT EIS

FIGURE 2-2



Sources: PLP 2018; ADNR

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

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Miles

Action Alternative 1

- Mine Site
- Transportation Corridor
- Natural Gas Pipeline

Other Features

- Local Roads
- Borough Boundary
- Three Nautical Mile Line

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

ACTION ALTERNATIVE 1 - GENERAL PROJECT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-3

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 used to describe the project and assess impacts throughout the EIS.

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 and would last for 20 years. 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 over the long-term, as needed.

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 (Appendix N).

- 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 1,970 feet in depth.
- Mining rate up to 73 million tons per year, average rate of 70 million tons per year.
- Milling rate[1] up to 66 million tons per year.
- 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 50 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.
- Power plant generating capacity of 270 megawatts (MW).

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

- An 84-mile[2] transportation corridor from the mine site to a year-round port site on Cook Inlet near the mouth of Amakdedori Creek consisting of:
  - A 29-mile private two-lane unpaved road from the mine site to a ferry terminal on the north shore of Iliamna Lake (referred to herein as the mine site access road).
  - An 18-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).
- Separate unpaved spur roads, approximately 11 miles in total length, connecting the transportation corridor to the communities of Iliamna, Newhalen, and Kokhanok.
- A port facility and jetty with docking for lightering and supply barges.
  - Annual vessel traffic of up to 27 concentrate vessels and 33 supply barges.
  - Lightering[3] of concentrate between Amakdedori port and offshore lightering locations for loading onto bulk carriers.
- A 187-mile gas pipeline from the Kenai Peninsula across Cook Inlet to the project site with a compressor station on the Kenai Peninsula.

2.2.2.1 Mine Site

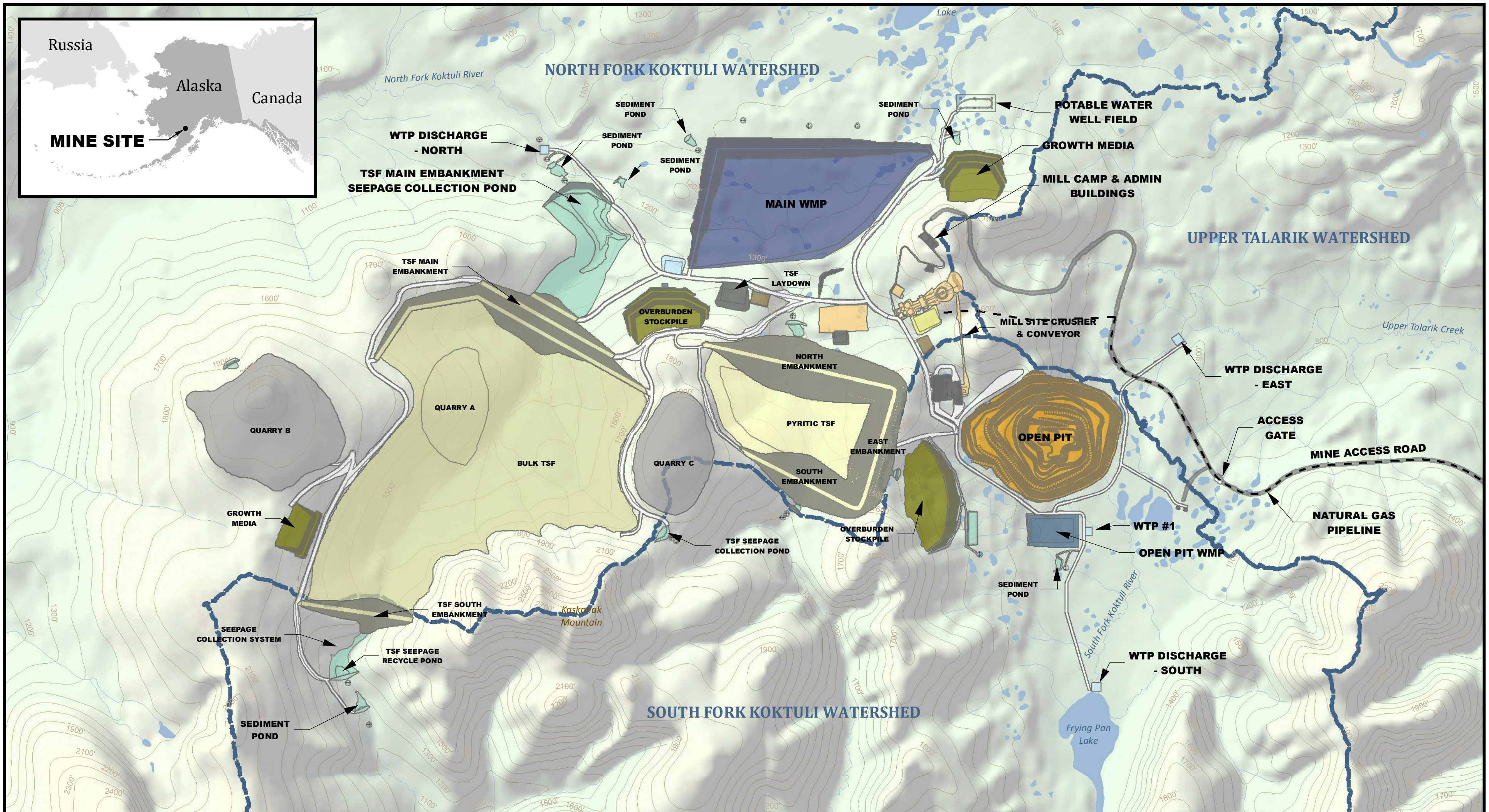
The fully developed mine site (approximately 8,086 acres) would include the open pit, bulk TSF, pyritic TSF, overburden stockpiles, material sites (quarries), water management ponds (WMPs), seepage collection ponds (SCPs), sediment ponds, milling and processing facilities, and supporting infrastructure such as the 270-MW power plant, water treatment plants (WTPs), camp facilities, and storage facilities. See Figure 2-4, which shows the proposed layout of the fully developed mine site. The site is currently undeveloped and not served by any 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).

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 tons per year, 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.

[2] Source: PLP 2018h. Minor differences in the road lengths used in the EIS compared to what is presented in PLP's project description are a result of rounding.
[3] 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 2018; USGS; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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0.5 0 0.5 1
Miles

Action Alternative 1
- Monitoring Wells
- Natural Gas Pipeline

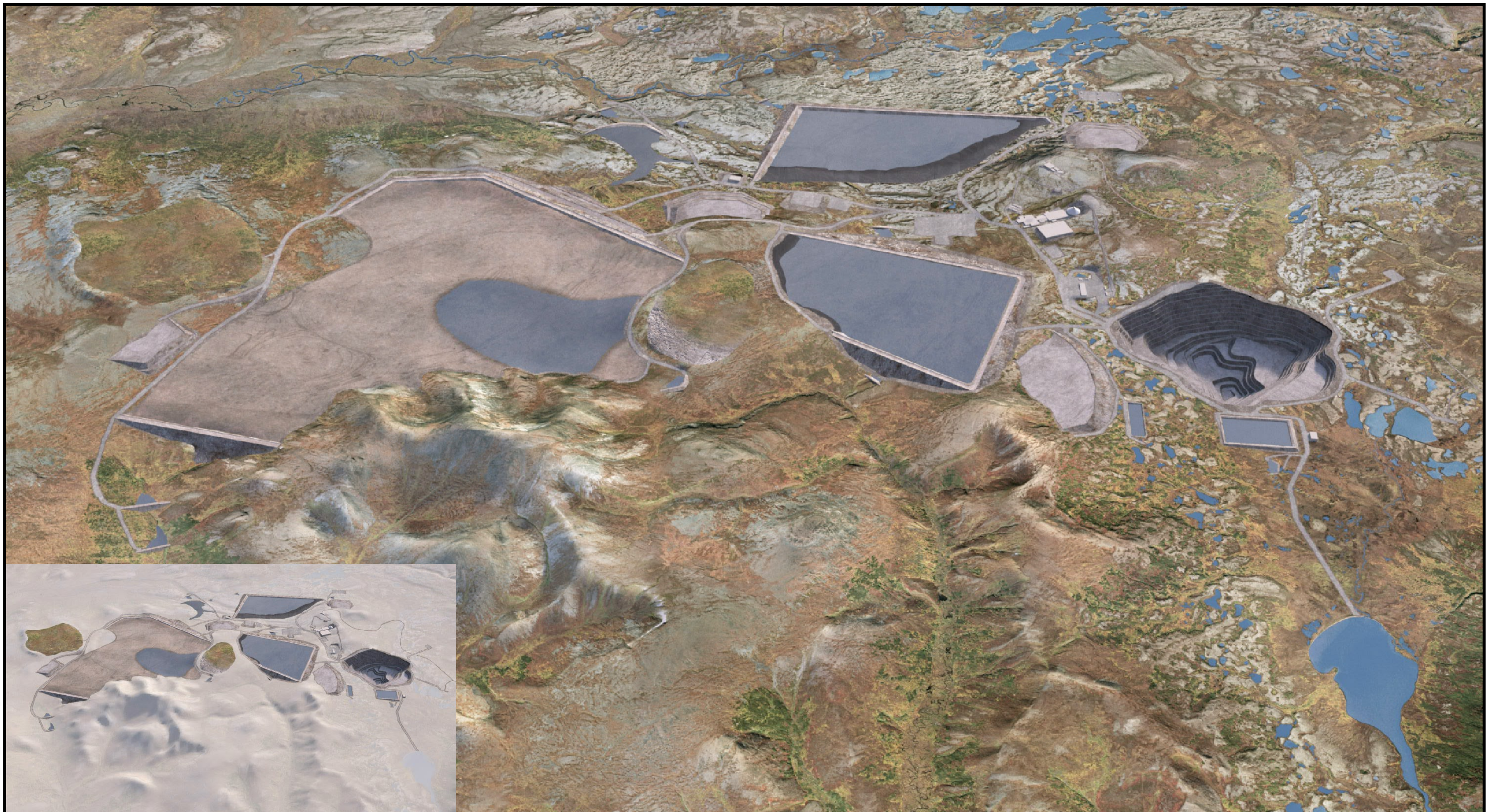
Mine Site Infrastructure
- Bulk Tailing Storage Facility
- Main Water Management Pond
- Mill Site Power Plant
- Mine Site Infrastructure
- Mineral Processing Facilities
- Onsite Access Roads
- Open Pit
- Pyritic Tailings Storage Facility
- Quarries
- Sediment/Seepage Collection Systems
- Stockpiles
-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

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

ACTION ALTERNATIVE 1 - MINE SITE LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-4



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

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ACTION ALTERNATIVE 1 - DIGITAL SIMULATION OF MINE SITE

PEBBLE PROJECT EIS

FIGURE 2-5

Mine pre-production would commence with dewatering of the open pit, approximately 1 year before the start of pre-production mining. This water would be primarily collected from perimeter wells, and either stored for mill start-up or treated and discharged into the South Fork Koktuli (SFK) drainage south of the open pit. 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 tons/day. The open pit would be mined in a sequence of increasingly larger and deeper stages. See Figure 2-6, which 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 608 acres.

Blasting

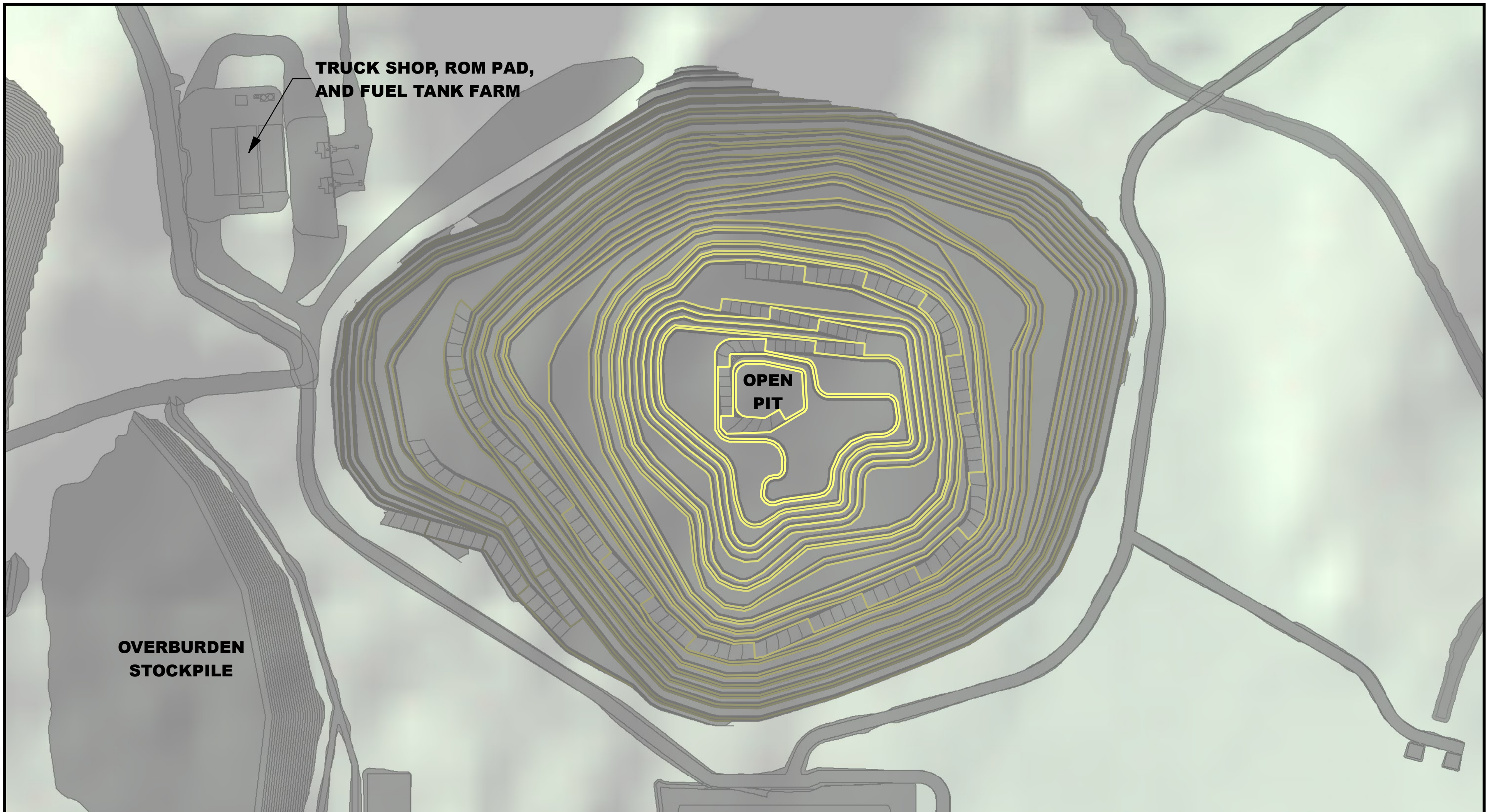
Most of the material to be removed from the open pit consists of intact rock, which must be blasted to enable it to be excavated. Most open pit blasting would be conducted using emulsion blasting agents manufactured on site. Pre-packed emulsion blasting agents or a mobile bulk emulsion manufacturing 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. Waste rock would be segregated by its potential to generate acid. Controls would be used to distinguish PAG and ML waste from non-potentially acid generating (NPAG) and non-metal leaching (non-ML) waste. Examples of these controls are visual inspection, blast hole sampling, and bench mapping. The selection of such control would be made during detailed mine planning and design. PAG and ML waste rock would be stored in the pyritic TSF until mine closure, when it would be back-hauled into the open pit. NPAG and non-ML waste rock could be used for embankment construction.

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.



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

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N

500 0 500 1,000
Feet

Action Alternative 1

Open Pit Contours (End of Operation)

Mine Site Footprint

ACTION ALTERNATIVE 1 - OPEN PIT DESIGN

PEBBLE PROJECT EIS

FIGURE 2-6

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 (see 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 (see 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[4] (Quarry A [243 acres], Quarry B [571 acres], and Quarry C [301 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 during 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 2018). As the material is quarried, its suitability would be confirmed by visual inspection, bench mapping, and blast hole testing. Further detail would need to be developed in support of state permitting and the Reclamation Plan Approval requirements, and Closure Cost Estimate and bonding requirements.

Quarry A would need to be closed soon after mine operations start and before it becomes inundated with bulk tailings. Measures might be needed to protect the environment before filling the quarry with 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 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

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

particles settle supernatant pond). Quarry B and Quarry C runoff would be collected and treated within 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 (see 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 floatation steps would be used to produce the copper-gold and molybdenum concentrates. The concentrates would then be filtered for shipment for off-site refining.

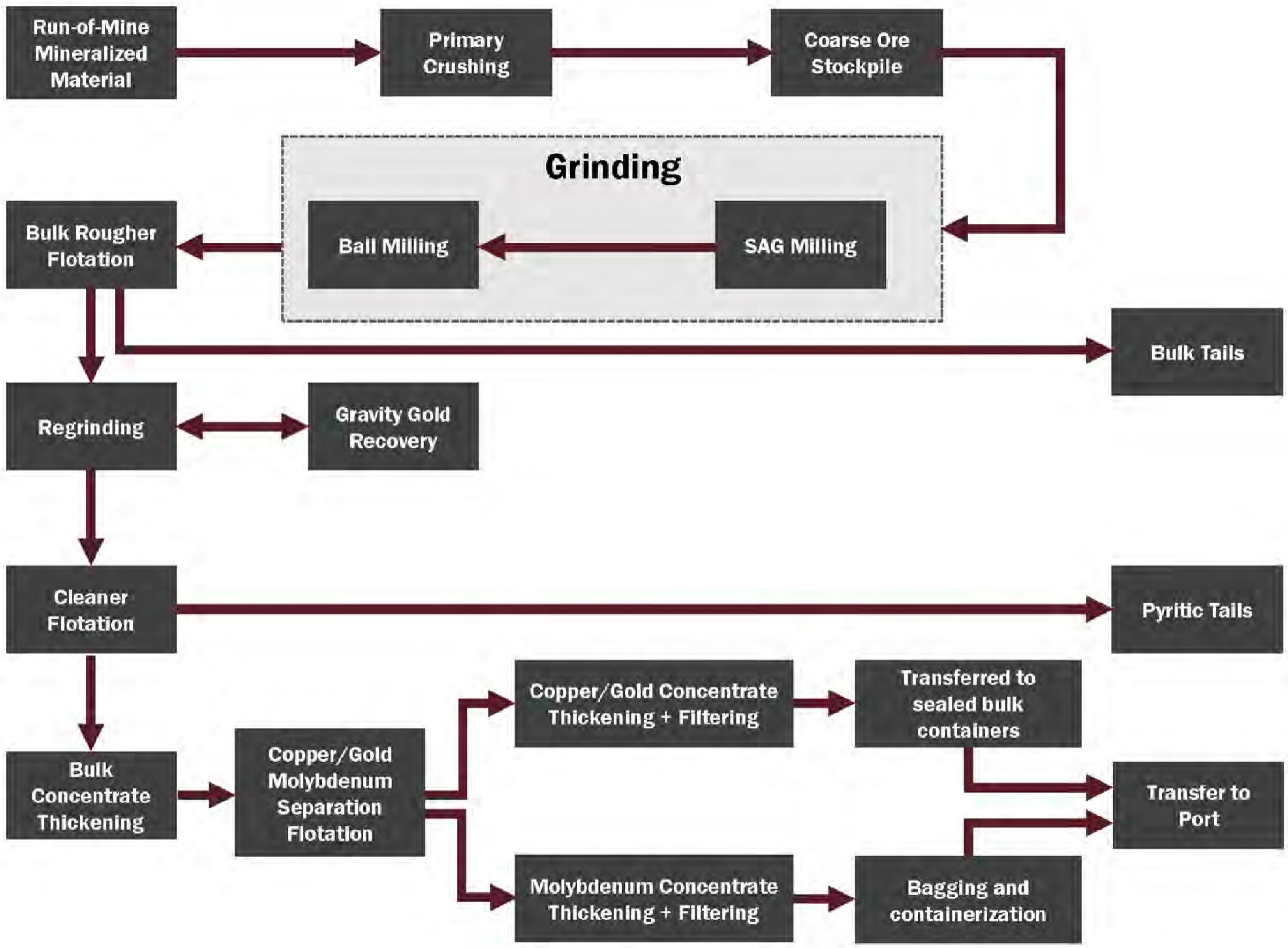
Gravity concentrators would be placed at various locations throughout the grinding and flotation circuits in the process plant, with the intent of recovering a portion of the free gold and silver in the plant feed. The concentrates from these facilities would consist primarily of higher-density particles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

Processing mineralized material to recover concentrates would result in two types of tailings: bulk tailings and pyritic tailings; see Figure 2-7 showing 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—such as 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 and shipped offsite by air.

Tailing Storage Facilities and Main Water Management Pond

Separate TSFs for the bulk tailings (approximately 2,796 acres) and pyritic tailings (approximately 1,071 acres) would be located primarily in the NFK watershed but would also have some footprint in the SFK watershed. The main WMP (approximately 955 acres) would be in the NFK. Both TSFs and the main WMP would have associated SCP facilities. See Figure 2-4 for the Alternative 1 Mine Site Layout. The TSF, SCPs, and WMP embankments would be jurisdictional dam structures regulated by the Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water, 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) and would meet or exceed all of ADNR's guidelines from its updated 2017 Guidelines for Cooperation with the Alaska Dam Safety Program (ADSP). The guidelines lay out the process, qualifications, level of detail for study, modeling, and design, and expectations for permitting dams versus being a list of standards. Permitting for large mine projects in Alaska is further discussed in Chapter 5, Mitigation, and Appendix E, Laws, Permits, Approvals, and Consultation Required, of this EIS.



Sources: PLP 2018

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ACTION ALTERNATIVE 1 - PROCESS FLOW DIAGRAM

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.[5]

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 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 in accordance with the ADSP guidelines and would be installed following manufacturer specifications and quality control and assurance guidelines (PLP 2018-RFI 019c).

[5] 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 comprised 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.

Bulk TSF

The bulk TSF would have two embankments: the main and south embankments. 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 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). See Figure 2-8, which shows the bulk TSF embankment cross sections.

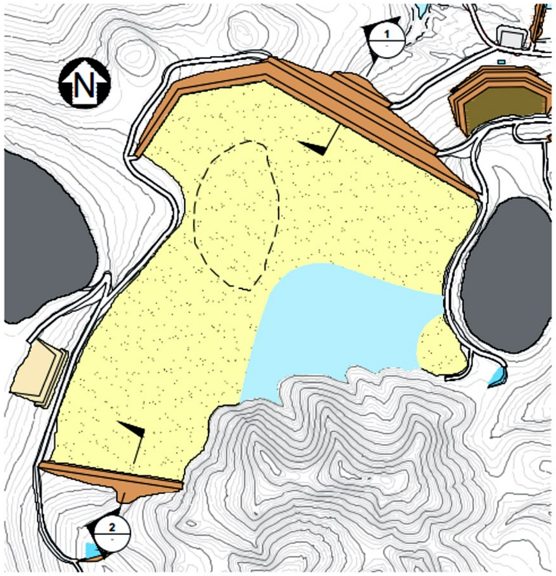
The bulk tailings cell would have a relatively small pond of water (supernatant pond), located away from the embankments. This would be achieved by depositing the tailings from spigot points along the embankment crests. The spigots would discharge the tailings alongside the upstream slopes of the embankments. 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 out from the embankments and would slope gradually 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 also 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.

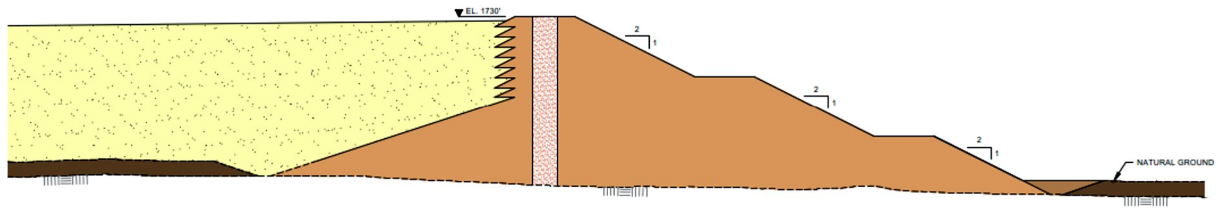
The bulk TSF main embankment would be constructed using the centerline construction method with local borrow materials, including appropriate open pit materials and rock from the three quarries. The embankment foundation would be prepared by removing overburden materials to competent bedrock prior to 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 (see Figure 2-8).

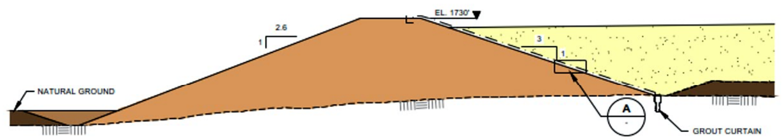
Locations, alignments, configurations, sizes, capacities, and other details of the underdrains would be developed following more detailed site-specific geotechnical and geological investigations and observations made during the preliminary and detailed designs, in accordance with the ADSP guidelines.



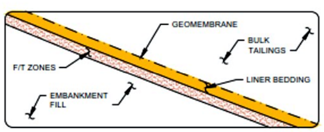
PLAN
BULK TAILINGS STORAGE FACILITY
SCALE A



SECTION 1
BULK TSF MAIN EMBANKMENT
SCALE B



SECTION 2
BULK TSF SOUTH EMBANKMENT
SCALE B



DETAIL A
LINER
NTS

LEGEND:

- BULK TAILINGS
- EMBANKMENT FILL
- FILTER / TRANSITION ZONES
- LINER BEDDING
- OVERBURDEN
- SUPERNATANT WATER POND
- TOE FILL
- GEOMEMBRANE
- BEDROCK

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.

SCALE B: 200 0 200 400 600 800 1000 ft

SCALE A: 2000 0 2000 4000 6000 8000 10000 ft

Sources: PLP 2018 RFI-008f

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ACTION ALTERNATIVE 1 - BULK TAILINGS STORAGE FACILITY EMBANKMENT CROSS SECTIONS

The flow-through structure, filter/transition zones, downstream buttresses, underdrains, and tailings beach placement, and pumping of surplus TSF pond water to the main WMP during operations would all serve to minimize seepage pressure and maintain permeability and stability of the embankment (Section 4.15, Geohazards). 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 offsite, and return it to the main WMP (Section 4.18, Water and Sediment Quality).

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 a SCP below the south embankment to capture any seepage that might flow out of the TSF through, under, or around the south embankment.

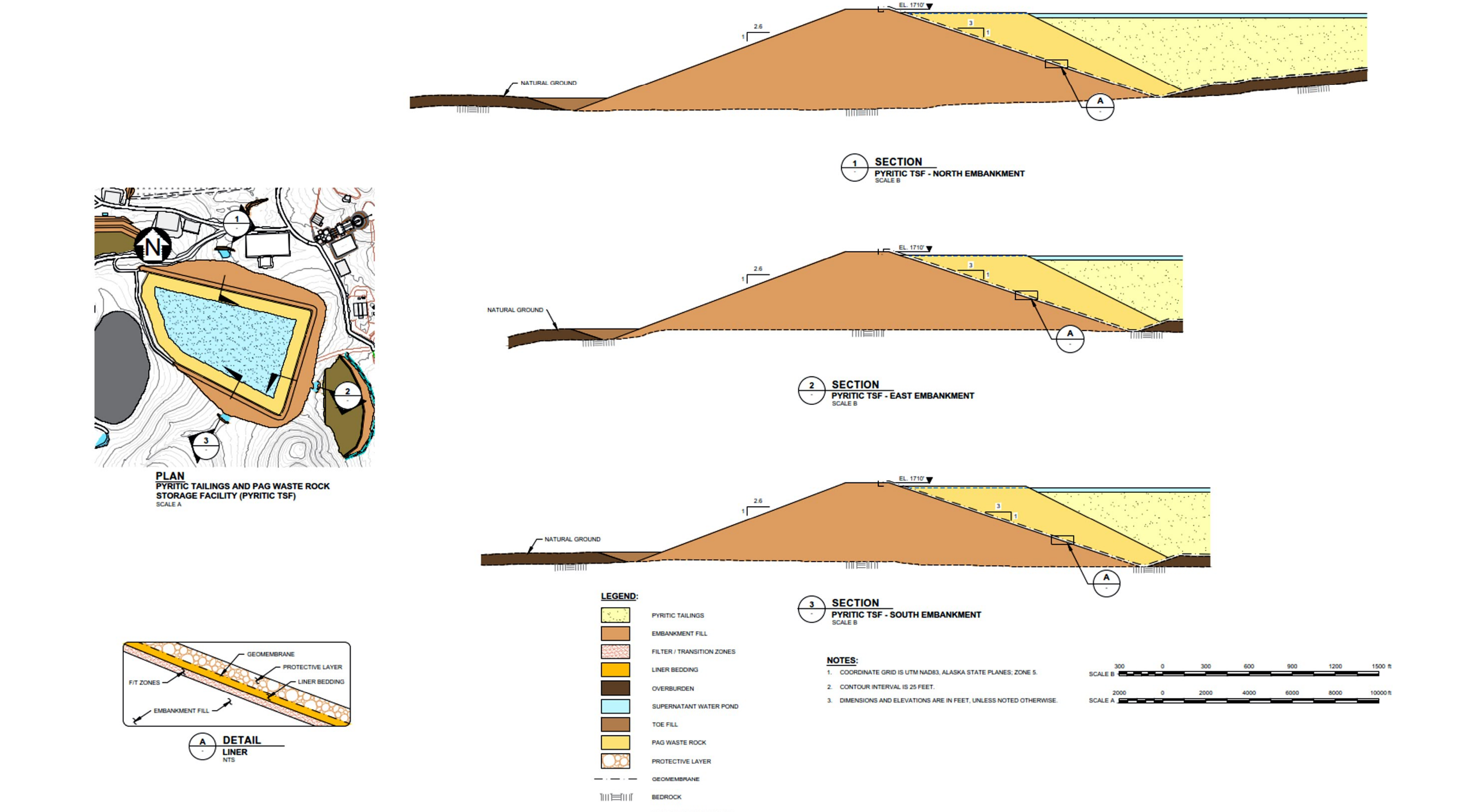
The bulk TSF south embankment would be constructed using the downstream construction method to facilitate lining of the upstream face, which would be constructed with a 3H:1V slope.[6] The downstream slope would be at 2.6H:1V. Overburden materials would be removed to competent bedrock below the embankment. The earthfill/rockfill embankment would include engineered filter zones and a grout curtain tied to the liner to reduce seepage below the embankment (see Figure 2-8).

Pyritic TSF

The pyritic TSF would be fully lined and 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 1,710 feet above sea level. The north embankment height would be 425 feet, the south embankment height would be 305 feet, and the east embankment height would be 315 feet. See Figure 2-9, which shows the pyritic TSF embankment cross section.

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. Basin underdrains would collect and convey all of the seepage they might collect to the downstream SCPs.

[6] 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 2018 RFI-055a

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ACTION ALTERNATIVE 1 - 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, and the PAG waste would be covered by the pyritic tailings. The entire pyritic TSF would be continually inundated with water to prevent the tailings and PAG waste 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 (CQA/QC) manual, and Operations and Maintenance (O&M) manual per the ADSP guidelines.

A current generic 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 to place it did 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.

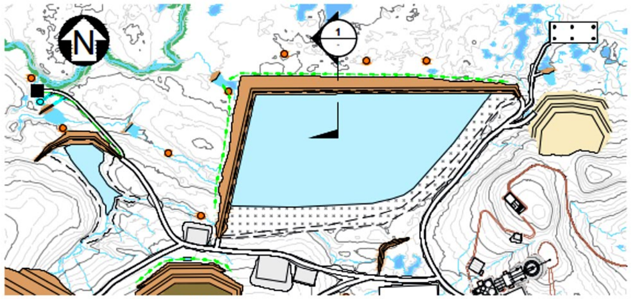
Water Management Ponds

Water management ponds at the mine site 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).

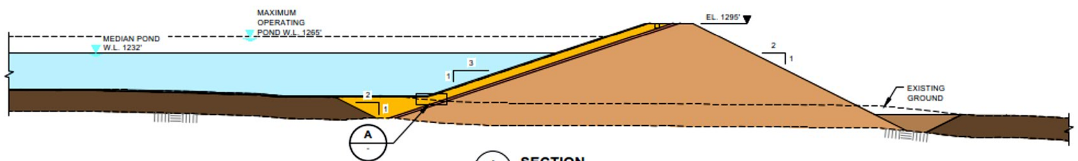
The main WMP is the primary water management structure at the mine site. It would be a fully lined facility and the enclosing embankment would be constructed using quarried earthfill and rockfill materials founded on competent bedrock. The embankment would be approximately 190 feet high, with an overall 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. In addition to the geomembrane liner, the embankment would include a filter/transition zone. The basin and upstream embankment face would include a layer of materials above the geomembrane to provide ice protection during freezing conditions. See Figure 2-10, which shows the main WMP section.

Tailings Deposition

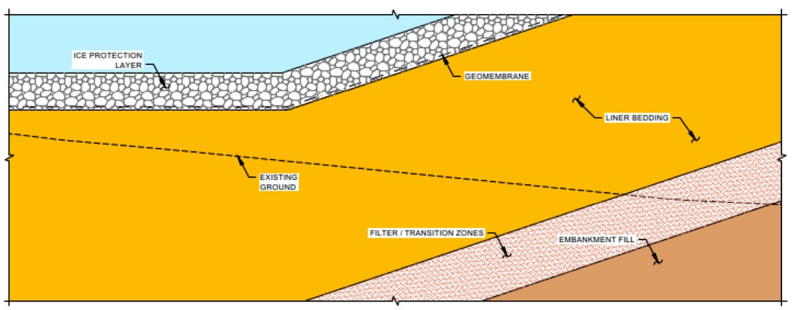
Each tailings type would be delivered to its respective TSF embankments and parts of the TSF perimeters using two pump stations: one in the process plant, and one booster station positioned approximately mid-way along the pipeline route. The bulk tailings would be discharged via spigots spaced at regular 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.



PLAN
MAIN WATER MANAGEMENT POND (MAIN WMP)
NTS



SECTION
MAIN EMBANKMENT
NTS



DETAIL
LINER
NTS

LEGEND:

- EMBANKMENT FILL
- FILTER / TRANSITION ZONES
- LINER BEDDING
- OVERBURDEN
- SUPERNATANT WATER POND
- TOE FILL
- ICE PROTECTION LAYER
- GEOMEMBRANE
- BEDROCK
- GROUNDWATER QUALITY MONITORING AND POTENTIAL PUMP BACK AREA
- COLLECTION DITCH

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.
4. MATERIAL ZONE WIDTHS TO BE DETERMINED.

Sources: PLP 2018 RFI-055a

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ACTION ALTERNATIVE 1 - MAIN WATER MANAGEMENT POND SECTION

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 always be buffered from the embankments by the PAG waste rock. The pyritic tailings would be kept submerged to prevent oxidation and potential acid generation.

Embankments would be constructed of NPAG and non-ML earthfill and rockfill materials. Therefore, any embankment runoff that would not be captured by the SCPs would be managed as stormwater.

Tailings would be discharged from spigot points along the upstream edge of the embankments and around parts of the TSF perimeters. Discharge points would be progressively moved from one spigot to the next to maintain a wetted surface and reduce the potential for dust generation.

The O&M manual 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. This is all required by the ADSP guidelines and would be enforced by ADNR.

Monitoring requirements and procedures would be specified in the O&M manual. Emergency action plans would be described in an Emergency Action Plan (EAP). The O&M manual and EAP would be submitted to ADNR for issuance of TSF operations permits. A construction completion report and revised O&M manual and EAP would be provided to ADNR after each starter dam and raise is built for issuance of TSF operations permits. The O&M manual would be approved by ADNR as part of issuance of a permit to operate each embankment, including each raise of each TSF embankment.

Embankment monitoring would be conducted by continual instrumentation along with data reduction, and by visual observation along with documentation and comparison with the instrumentation data. Instrumentation requirements would be developed during preliminary and detailed designs in accordance with ADSP guidelines and would include continual surveillance for abnormal data and trends, provision of warnings of embankment mitigation action needs, and the ultimate objective of maintaining safe and stable embankments. Visual observation requirements would include relatively frequent scheduled drive-by reconnaissance and foot inspections by trained staff, and less frequent but more stringent third-party inspections, including the ADNR-required Periodic Safety Inspection.

Seepage would be monitored using piezometers in the embankments and between the embankment and SCPs, and by monitoring wells below the SCPs. The piezometers would be used to monitor that the water levels in the embankments are below the levels needed to maintain embankment safety and integrity.

If a process water signature is detected in the monitoring wells, the pump-back wells below the SCP would be activated, and the seepage would be directed back to the SCP or main WMP.

Stability monitoring would be performed using instrumentation placed in the embankments, standard survey control points, three-dimensional Light Detection and Ranging (LIDAR) mapping, and similar techniques. Any slumping that may be detected would be mitigated by placing buttress material as needed.

EAPs would be prepared for all site embankments in accordance with ADSP guidelines and would:

- Protect lives, property, and environment if an emergency condition develops at an embankment.
- Prepare owners, operators, and emergency management personnel for the emergency event, in advance.
- Detail the actions and measures to be taken by all parties responsible for responding to an emergency.
- Facilitate the coordination and cooperation of the various emergency responders.

Notification would use techniques such as:

- Sirens to warn site personnel and any recreational users in the immediate area.
- Telephone communications to appropriate authorities in potentially affected communities identified in the EAP.
- Public service bulletins via radio or other means for more distal communities.
- Helicopters to fly over and along the downstream reaches of the rivers.

Further details would be developed through the preliminary and detailed design and state permit process; specifically, the ADSP guidelines and ADNR Dam Safety permit process and Alaska Department of Environmental Conservation (ADEC) Integrated Waste Management Plan approval.

Mine Site Infrastructure

Due to the remote location and the 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.
- Shops: a truck shop complex housing a light-vehicle maintenance garage, a heavy-duty shop, a truck wash building, a tire shop, and a 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.
- Onsite 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.
- 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. Chemical wastes would be disposed of in accordance with all applicable laws and regulations.
- 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 would be located at the mine site. 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 at the mine to provide accommodations for initial construction. The temporary camp would be situated near the mill laydown area (see Figure 2-4). Construction crews would use the temporary construction camp and the 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.

Material Management and Supply

Fuel, lubricants, tires, and blasting agents would be the primary materials used in mining. Reagents[7] would be used in low concentrations throughout the mineral processing plant and are primarily consumed in the process. Appendix K2 provides a table that shows 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 designed to meet regulatory requirements. Sump and truck pump-out facilities would be installed to handle any 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. Fuel would be dispensed to a pump house in a fuel storage area for fueling light vehicles. It would also be dispensed 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.

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

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

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. All facilities would be constructed and operated to meet mine safety and health regulations as set forth in 30 CFR Part 77.1301.

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. Any hazardous reagents imported for testing would be transported, handled, stored, reported, and disposed of as required by law, 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.

Water Management

A mine site water management plan is essential to understanding fresh water and mine process water requirements in relation to natural runoff timing and open pit dewatering requirements; to design water management and treatment systems; and to minimize 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) to support the NEPA analysis. Additional detail would be developed and included in updates to these plans as the project proceeds through the state permitting process.

The main objective of water management at the mine site would be to manage water that flows through the project area, while providing an adequate water supply for operations. The goal of the water management would be to manage discharges to minimize impacts to water flow and quality, as well as to minimize and mitigate impacts to fish habitat. PLP's primary design consideration would be to ensure that all contact water that requires treatment prior to release to the environment would be effectively managed. PLP proposes to capture all runoff water contacting the facilities at the mine site and water pumped from the open pit to protect the overall 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 ditches. 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 Model

PLP developed operations and closure site-wide water balance models using Goldsim® as part of the water management plans for purposes of design, construction, operations, and closure of the open pit, TSFs, SCPs, WMPs, WTPs, sediment ponds, quarries, and other mine-site facilities (Knight Piésold 2018a, 2018b) in an interactive and progressive manner, with a focus on planning ahead for projected mine site operations and development.

Key elements of implementing the water balance models would be to plan for the construction of TSF embankment raises ahead of when they are needed in terms of tailings storage projections and water freeboard forecasts, and to monitor the performance of the SCPs, WMPs, WTPs, and sediment ponds with respect to their adequacy in terms of storage capacity, freeboard, and connectivity with each other and with the TSF and open pit operations.

The Pebble water balance model is comprised of three primary modules: watershed module; groundwater module; and mine plan module. They collectively provide the means of quantifying the numerous water flows in the streams, in the ground, and in the various pipes, ponds, and mine structures associated with the mine development. The watershed module focuses on water flows throughout the NFK, SFK, and Upper Talarik Creek (UTC) drainages. The groundwater module focuses on the detailed simulation and understanding of groundwater flows in those drainages, and serves to inform the watershed module, and vice versa. The mine plan module focuses on mine site water inflows and uses.

Complementing the water balance 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 three modules, which are all numerical water balance models, are very different, yet complementary. These models are further described in Appendix N.

Pre-production Water Management Plan

The water management and sediment control plan during mining pre-production would consist of multiple aspects focusing on minimizing contact water[8] 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.

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. The 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. If required, 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 required. 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.

[8] 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.

- 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.
- Prior to the operations WTPs being brought on-line, modular WTPs would be used to treat contact water that does not meet discharge requirements. The modular construction WTPs would be operational on site prior to the start of earthworks and would remain until the operations WTPs are commissioned. It is anticipated that treatment would need to address pH and elevated levels of dissolved metals. Treatment would use an HDS process with additional polishing steps, as determined through preliminary and detailed design in per the state water quality requirements. Treated water from the construction WTP would be discharged to the NFK drainage.

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 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.

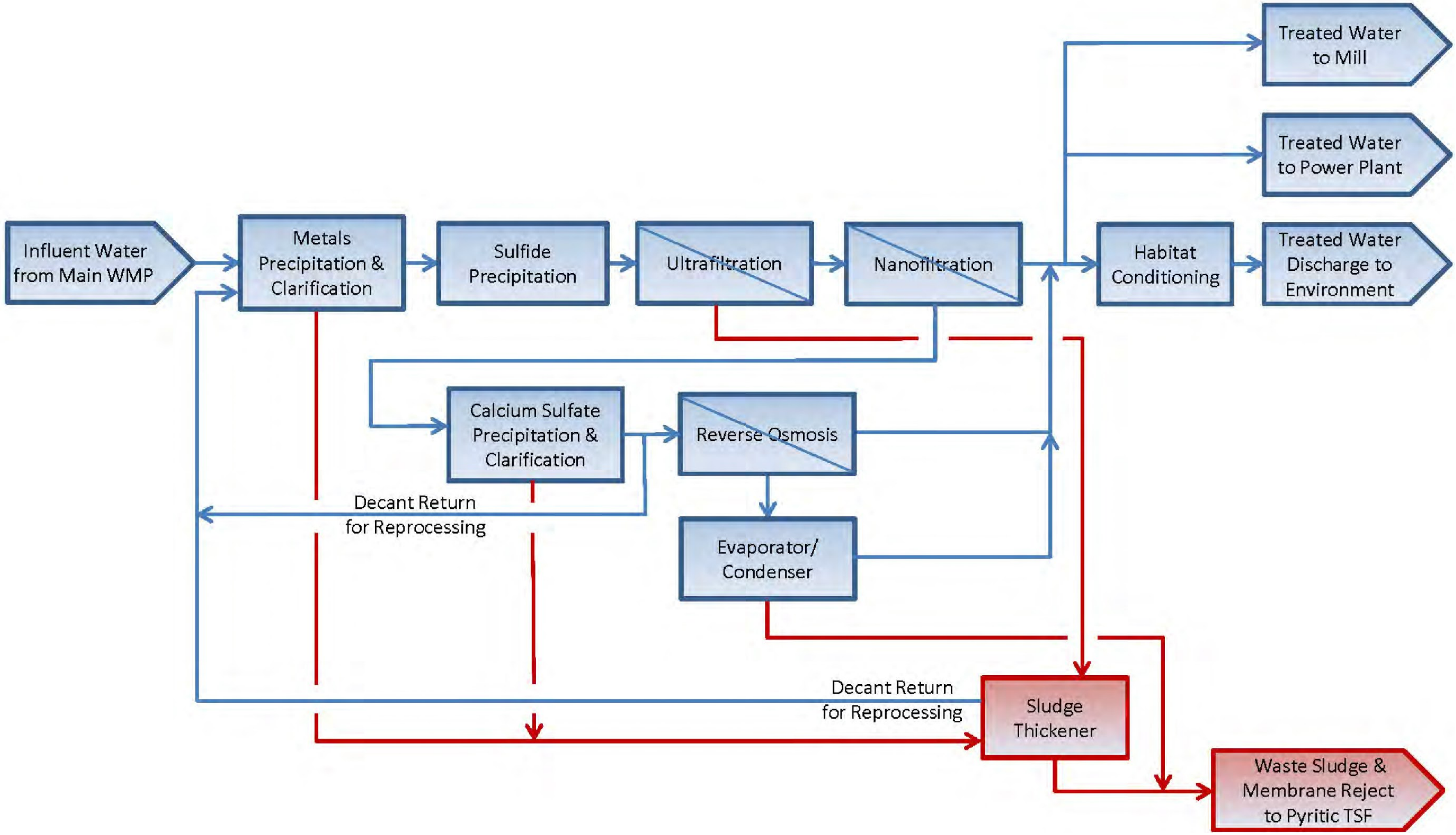
Water collection, management, and transfer would be accomplished through a system of TSF underdrains, water management channels, ponds, and pump, pipeline and outfall configurations. These systems would be designed to handle the large flows that occur during spring thaw, late summer/fall rains, and fall-to-spring 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 trace elements, filtration, reverse osmosis, and evaporation to meet final discharge criteria.

The mine area would have two WTPs: the open pit WTP (WTP #1), and the main WTP (WTP #2). Both would be constructed with multiple independent treatment trains, which would enable ongoing water treatment during mechanical interruption of any one train. WTP #1 would treat water from the open pit WMP and would have two treatment trains to meet the influent flow of 14 cubic feet per second (cfs) (HDR 2018a). WTP #2 would treat water from the main WMP and would have four treatment trains to meet the influent flow of 29 cfs (HDR 2018a). 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 main WTP treatment process and open pit WTP treatment process, respectively. The treatment process for each WTP is described in Appendix K4.18. WTP discharge locations are shown on Figure 2-3.



Sources: PLP 2018

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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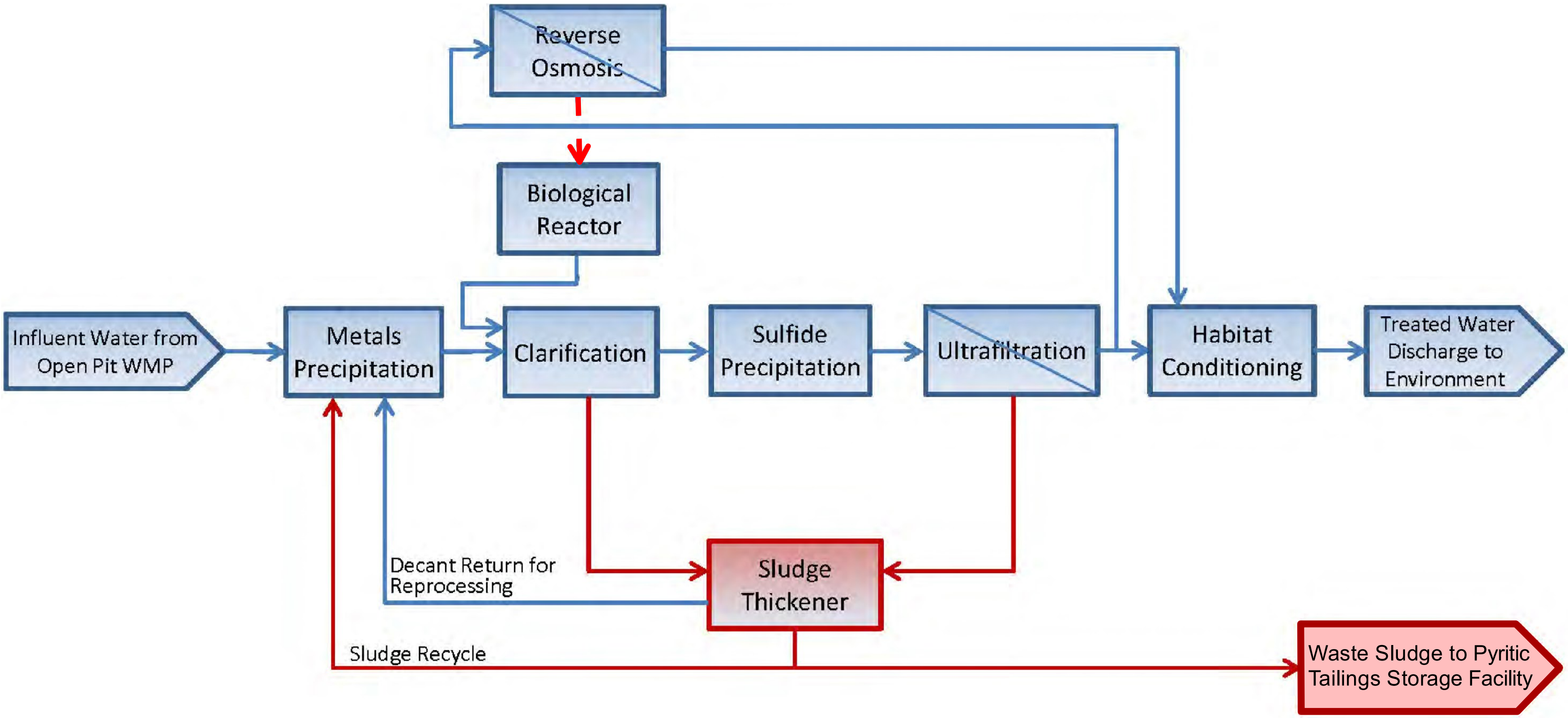
ACTION ALTERNATIVE 1 - MAIN WATER TREATMENT PLANT PROCESS SCHEMATIC



Sources: PLP 2018

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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ACTION ALTERNATIVE 1 - OPEN PIT WATER TREATMENT PLANT PROCESS SCHEMATIC

Closure/Post-Closure Phase Water Management Plan

Closure and post-closure water management would address both the immediate physical closure of the site and associated reclamation activities, as well as the long-term post-closure period and associated maintenance and monitoring activities. 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.
- Minimize post-closure impacts to downstream flows and habitat.

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. Further detail would be developed in support of state permitting and the Reclamation Plan Approval requirements. A reclamation schedule that describes when key reclamation actions would occur (e.g., timing for physical reclamation, tailings consolidation, open pit filling, and discharge) is provided in the Closure Water Management Plan (Knight Piésold 2018a).

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 all required 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.

A temporary closure plan would be required as part of the preliminary and detailed design per ADSP guidelines. All design, construction, and operations activities would need to be integrated with the closure requirements. Further detail would need to be developed in support of state permitting and the Reclamation Plan Approval requirements, and Closure Cost Estimate and bonding requirements. The water management plan during the closure phase and post-closure can be summarized as follows:

<u>Years 0-15</u>:

- The open pit WTP would be reconfigured to treat contact water.
- Excess and seepage water from the bulk TSF would be pumped to the main WMP.
- Seepage water from the pyritic TSF would be pumped to the main WMP.

- Water from the main WMP that is not needed for mine or process operations would be treated at the main WTP and released to the downstream environment.
- Open pit water that is not needed for mine or process operations would be pumped to the open pit WTP for purposes of drawing down the water to maintain safe work conditions in the open pit for both removing the PAG waste rock and hauling it to the pyritic TSF, and for extracting the ore and hauling it to the process facility.
- Treated water from the open pit WTP would be released to the downstream environment.
- The open pit WMP would be reclaimed.

Year 16 until the open pit reaches the control elevation (approximately Year 20):

- The main WTP would be decommissioned once it is no longer required.
- The pyritic TSF and associated seepage collection ponds would be reclaimed, and surface water runoff from the area discharged to the downstream environment once the runoff has been demonstrated to meet water quality criteria.
- The main WMP would be reclaimed, and surface water runoff from the area discharged to the downstream environment once the runoff has been demonstrated to meet water quality criteria.
- Bulk TSF and seepage collection pond water would be pumped to the open pit.
- The open pit fills to the control elevation.
- The basis for this phase of the water balance is that no water would be treated during this phase; however, an adaptive management strategy would be used, and water would be directed to the open pit WTP for treatment and released if required to maintain downstream flows.

Post-Closure:

- Year 20 until the bulk TSF consolidation is complete (approximately Year 50):
  - Bulk TSF seepage and runoff water would be pumped to the open pit.
  - Water levels in the open pit would be maintained below the control elevation by treating and releasing surplus water from the open pit.
- Runoff water from the surface of the reclaimed Bulk TSF would be directly discharged from the TSF surface to the NFK catchment once it has been demonstrated to meet water quality criteria.
- Seepage water that might continue to flow out from under the reclaimed Bulk TSF would be captured and pumped to the open pit.
- Water levels in the open pit would be maintained below the main management level by treating and releasing surplus water from the open pit.

Closure/Post-Closure Water Treatment

Water treatment during this phase would use the facilities as outlined above for the Closure/Post-Closure Phase Water Management Plan; however, WTP #1 would be reconfigured and redesignated WTP #3 to meet specific closure water treatment needs. 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. In closure phases 3 and 4 the seepage collection pond WTP would operate as a stand-alone treatment plant within the same housing as WTP #3 to treat surplus water from the seepage collection pond. This WTP would not treat water from other waste streams. The WTPs would be constructed with instrumentation to monitor parameters of the influent and effluent water, and the effluent would be sampled 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 met. Specific details on compliance monitoring and a detailed monitoring plan would be developed during the state permitting process. Reclamation and closure required by the State of Alaska would include provisions for periodic replacement of water treatment facilities, and ongoing operating and monitoring costs over the long-term, post-closure period.

Waste Management and Disposal

A landfill and incinerator would be constructed and operated at the mine site for domestic waste handling (see 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 and back-loaded into empty containers 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 located at the camp and the process plant. Plans for each plant would be reviewed and approved by the 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. Treated water would be discharged to the TSF, and 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).

Closure and Reclamation

Reclamation and closure of the project would fall under the jurisdiction of the ADNR Division of Mining, Land, and Water; and the ADEC. The Alaska Reclamation Act (Alaska Statute 27.19) is administered by the ADNR; it applies to state, federal, municipal, and private land and water subject to mining operations. A reclamation and closure plan, including actions for temporary closure if and when they might be needed, would be developed during preliminary and detailed design work in accordance with the ADSP guidelines and ADNR requirements.

According to PLP, the project incorporates a holistic design-for-closure or cradle-to-grave philosophy that considers and integrates closure and post-closure site management requirements and plans for closure during all planning, design, construction, and operating phases. These include:

- Segregated storage of bulk and pyritic tailings. Bulk tailings would remain in place at closure, but some surface grading would be required at closure to maintain a water-free surface for post-closure so that the bulk TSF would revert to a landform.
- A lined pyritic TSF. PAG and ML waste rock would be stored with pyritic tailings in the lined pyritic TSF during operations. At closure, the stored waste rock in the pyritic TSF would be backhauled to the open pit and the pyritic tailings pumped to the open pit for storage in the pit lake after mining has ceased. Storage of PAG/ML waste rock and pyritic tailings in the pit lake would avoid post-closure management of the pyritic TSF.
- Segregated waste rock and overburden materials stockpiled and maintained at strategically placed locations to optimize the use of these materials for closure restoration and reclamation purposes, and to continue to minimize haulage distances and environmental impacts during closure construction activities.
- Schematic WTP flow sheets of treatment processes included in a response to RFI-106 (HDR 2019). The flow sheets are for the open pit WTP and SCP WTP at different phases of closure. According to HDR, the flow sheets were developed based on evaluation of available data and preliminary treatment process designs for worst-case scenarios during closure and post-closure.
- WTPs to be designed with a modular approach using multiple identical treatment trains operating in parallel. This would allow for additional trains to be installed as needed if it becomes necessary to treat more water than originally anticipated.
- WTPs to be designed with robustness and flexibility to adjustment chemical feed rates, if needed.

Physical Reclamation and Closure

The physical site closure work would commence as operations end.

- Active mining and pit dewatering would stop. The mine open pit would be stabilized to meet the requirements of 11 AAC 97.200(c) and would become a pit lake. Open pit water levels would be maintained at the pre-determined control elevation by pumping water out of the open pit as needed to provide safe access for the placement of pyritic tailings and PAG waste rock, and to ensure that there is adequate volume available for the pyritic tailings and PAG waste rock storage.
- Pyritic tailings and PAG waste rock would be placed into the open pit for long-term storage below the pit lake water level. Once the material has been transferred to the open pit, water would continue to enter the open pit and would be allowed to rise to the pre-determined control elevation threshold.
- The mill, pyritic TSF, main WMP, and other infrastructure not required for post-closure would be removed from the site, and/or reclaimed as part of the site closure and reclamation. Any hazardous materials that cannot be stored permanently on the site would be transported off-site and delivered to a licensed hazardous waste storage facility.
- The bulk TSF would be closed by grading its surface so that all drainage would be directed off the TSF, and then the tailings surface would be covered with soil and/or rock and possibly a geomembrane or other synthetic material. This would prevent water from ponding on the TSF surface and is known as a dry closure.

- However, before constructing the cover over the Bulk TSF surface, the tailings would need to be allowed to consolidate enough to allow for placement of the cover with acceptable risk that any further tailings consolidation would not damage the cover and compromise its purpose of diverting water off the surface.
- Once this surface runoff from the bulk TSF is demonstrated to meet water quality criteria, it would be directly discharged to the environment. Bulk TSF seepage water would be pumped to the open pit.
- The open pit water level would be maintained at a level to ensure inward flow of surrounding groundwater and prevent contact water from getting into the groundwater.

All mill and support facilities not required for post-closure, including the pyritic TSF, main WMP, and open pit WMP embankments and liners, would be fully reclaimed in accordance with State of Alaska requirements. Embankments associated with reclaimed facilities would be breached and flattened. Gravel pads and areas of fill would be contoured and graded to conform to the surrounding landscape and promote natural runoff and drainage (PLP 2018-RFI 024). Concrete pads and foundations would be left in place and broken up so that they do not act as an impermeable impediment to water flows.

Disturbed areas would be contoured, graded, ripped, and scarified. Top soil and growth media would be placed as needed, and sites would be seeded for revegetation. Surface runoff from the disturbed areas would be collected; and either treated in the WTPs or directed to the pit lake until it is found to be suitable for direct discharge to the downstream drainages.

A spillway would be constructed from the bulk TSF. Late in the operating phase, tails in the bulk TSF would be spigoted to allow for surface drainage toward the closure spillway. As milling operations cease, free water would be pumped from the surface of the bulk tails, and they would be allowed to consolidate until the surface is suitable for equipment traffic on the surface. The tailings would be re-graded as needed to facilitate drainage. A low-permeability soil cover with the ability to support vegetation growth would be placed over the surface of the tailings and on the crest and downstream slopes of bulk TSF embankments. This soil cover would be seeded with the objective of having vegetation grow on it and blend the former TSF in with the surrounding environment.

Seepage water from the bulk TSF main and south embankment SCPs would be collected and pumped to the open pit and discharged into the pit lake. This would require the construction and operations of pump and pipeline systems from the SCPs to the open pit. The design of this system would need to be completed as part of the closure. Key factors in the design would be the post-mine site-topography and the elevations of the pump intakes at the SCPs, and the crest access at the crest of the open pit.

When no longer required for post-closure water management and treatment, the SCPs and WMPs and the main WTP would be removed and reclaimed. Power generation facilities, limited camp and storage facilities, access roads required for site maintenance and monitoring, and the mine water treatment plant would remain to support post-closure water treatment, and site monitoring and stabilization activities.

Post-Closure Management

The pit lake would fill during the closure period. Surface runoff from the walls would result in leaching of accumulated metals from the walls. The pit lake is expected to stratify during the closure period, with surface waters retaining a neutral to slightly basic pH over time. Water quality parameters showing predictions that exceed discharge limits include hardness and several trace elements.

Pit lake water quality would be monitored, and appropriate precautions would be taken to manage wildlife activity on the lake. Once the level of the pit lake has risen to the control elevation (about 890 feet), water would be pumped from the open pit, treated as required, and discharged to the environment. By maintaining the water level at this elevation, which is at least 50 feet below the elevation at which groundwater flow would be directed outward from the open pit, upset conditions resulting in an unplanned discharge would be avoided, because there would be time to address any problems with the WTP before flows reverse (e.g., a potential need for the installation of additional water treatment trains).

Seepage water from the bulk TSF embankment SCPs would be collected and either treated in the WTPs or directed to the pit lake until determined to be suitable for discharge—anticipated after approximately Year 50 post-closure.

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 Reclamation and Closure Plan and financial assurance obligations would be updated on a 5-year cycle, in accordance with State of Alaska regulatory requirements, to address any changes in closure and post-closure requirements and cost obligations.

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

2.2.2.2 Transportation Corridor

The transportation corridor, which would connect the mine site to Amakdedori port on Cook Inlet, has three main components (see Figure 2-13):

  - Mine access road (346 acres): A private, unpaved, two-lane road extending approximately 29 miles south from the mine site to a ferry terminal on the northern shore of Iliamna Lake (includes a short spur near the mine site near UTC) (see Figure 2-14).
  - 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 (408 acres): A private, unpaved, two-lane road extending approximately 37 miles southeast from the south ferry terminal to Amakdedori port on Cook Inlet (see Figure 2-15).

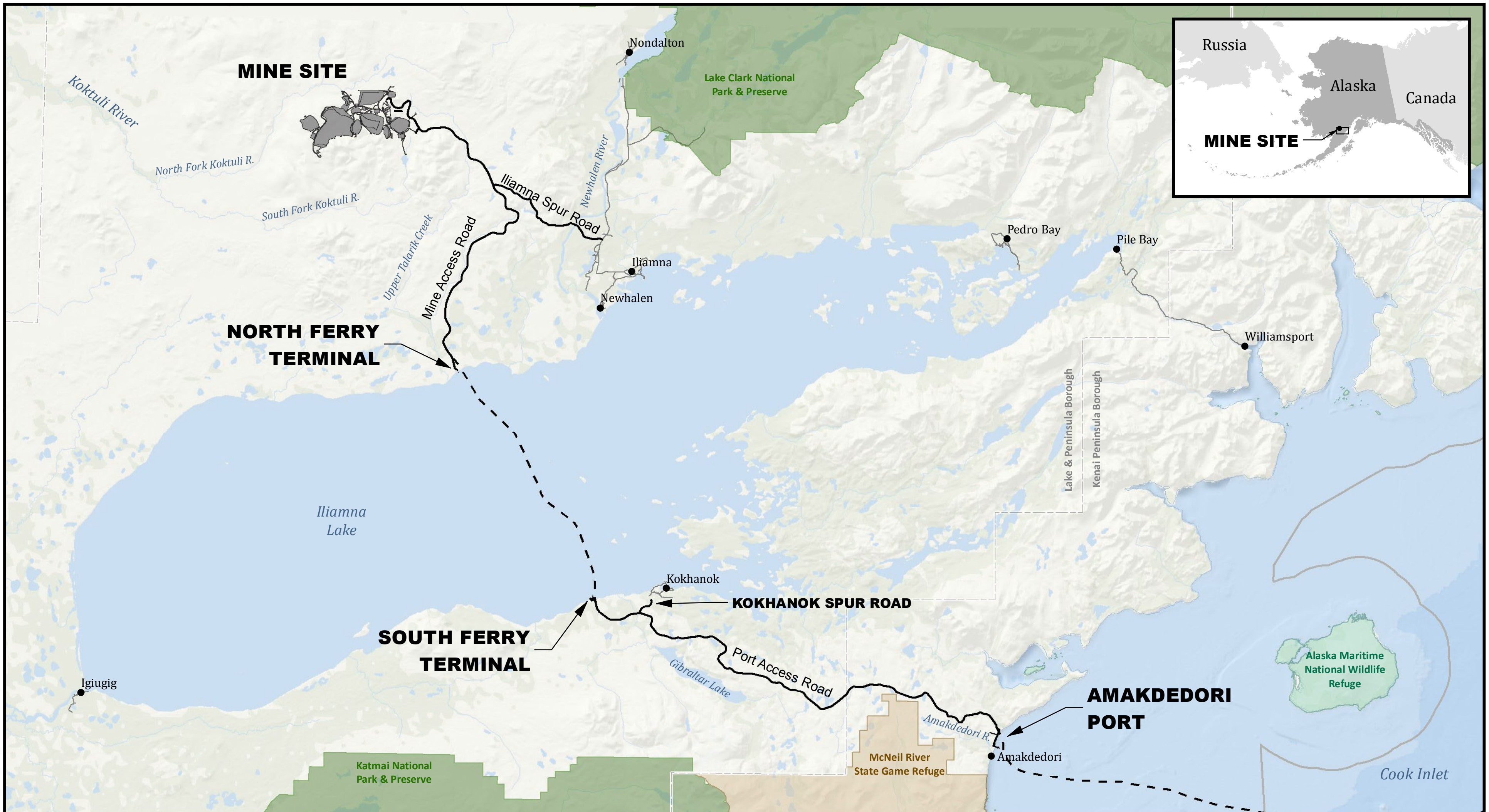
- Separate spur roads, approximately 134 acres and 11 miles in total length, would connect the transportation corridor to the communities of Iliamna, Newhalen, and Kokhanok. See Figure 2-16, which shows the typical access road cross section. Apart from a small network of local roads near these communities, the transportation corridor area is undeveloped.

Road System

The main access roads would be designed as private gravel roads with a 30-foot-wide driving surface to enable two-way traffic and would be 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).

The road system would include nine bridges, six of which would be single-span, two-lane bridges that range in length from approximately 30 to 125 feet. There would be three multi-span, two-lane bridges at Newhalen River (575 feet), Gibraltar River (470 feet), and Sid Larsen Creek (160 feet). Road culverts at stream crossings would be divided into categories based on whether the streams are fish-bearing. Culverts at streams without fish would be designed and sized for drainage only, and culverts at streams with fish would be designed and sized for fish passage in accordance with regulatory standards. The Alternative 1 design currently estimates 86 culverts; of these, 41 would be designed as fish passage culverts. The exact number and design of waterbody crossings would be determined during final design and permitting. 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. See Figure 2-17, Figure 2-18, and Figure 2-19 for typical waterbody crossing structures.

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).



Sources: PLP 2018; ADNR

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

US Army Corps of Engineers®

N

5 0 5 10

Miles

Action Alternative 1
- Transportation Corridor
- Natural Gas Pipeline
- Mine Site

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

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

ACTION ALTERNATIVE 1 - TRANSPORTATION FACILITIES OVERVIEW

PEBBLE PROJECT EIS

FIGURE 2-13

Sources: PLP 2018; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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2 0 2 4
Miles

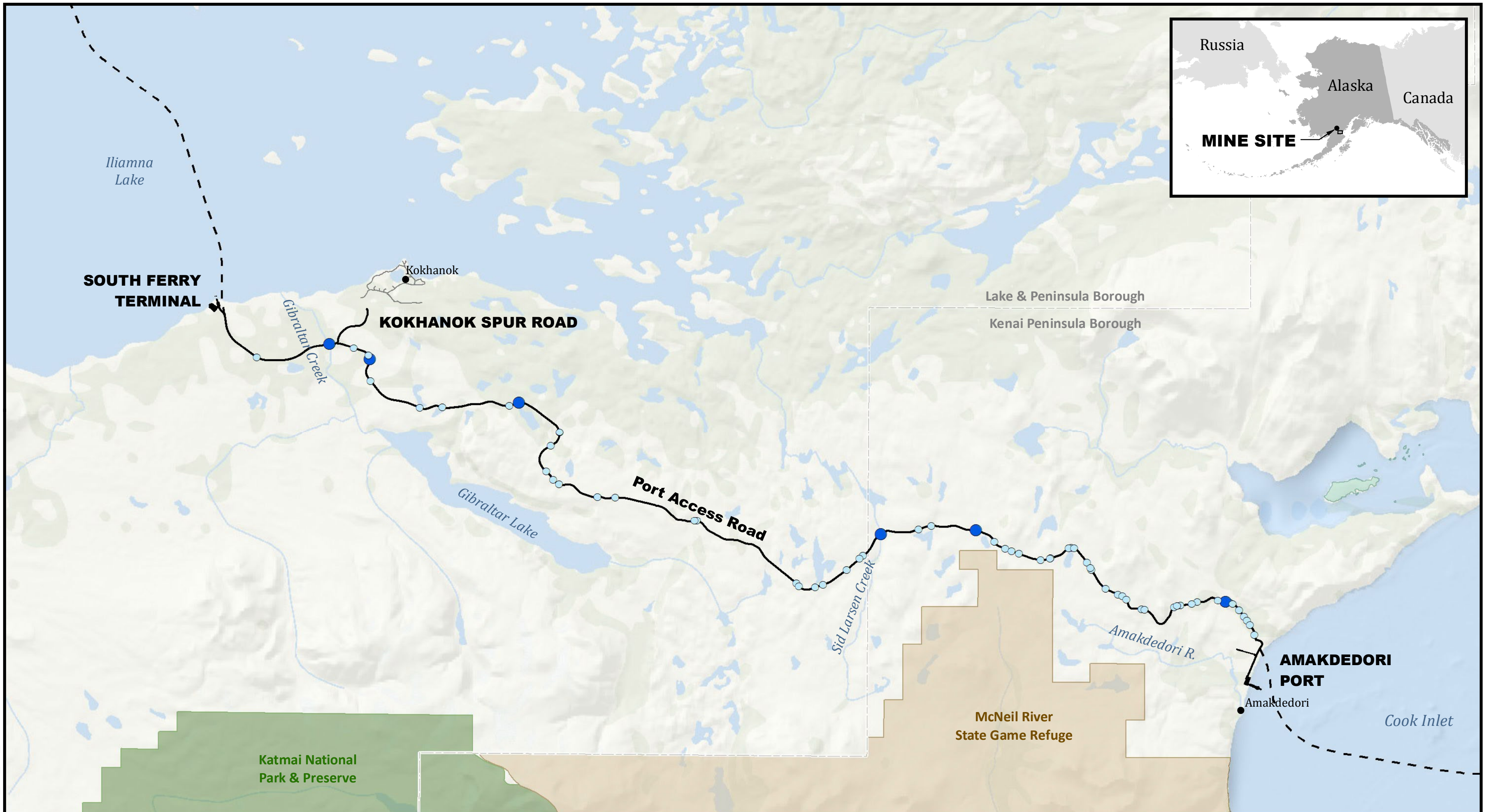
Action Alternative 1
- Bridge
- Culvert
- Transportation Corridor
- Natural Gas Pipeline
- Mine Site

Other Features
- Local Roads
- National Park

ACTION ALTERNATIVE 1 - MINE ACCESS ROAD AND ILIAMNA SPUR ROAD

PEBBLE PROJECT EIS

FIGURE 2-14



Sources: PLP 2018; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

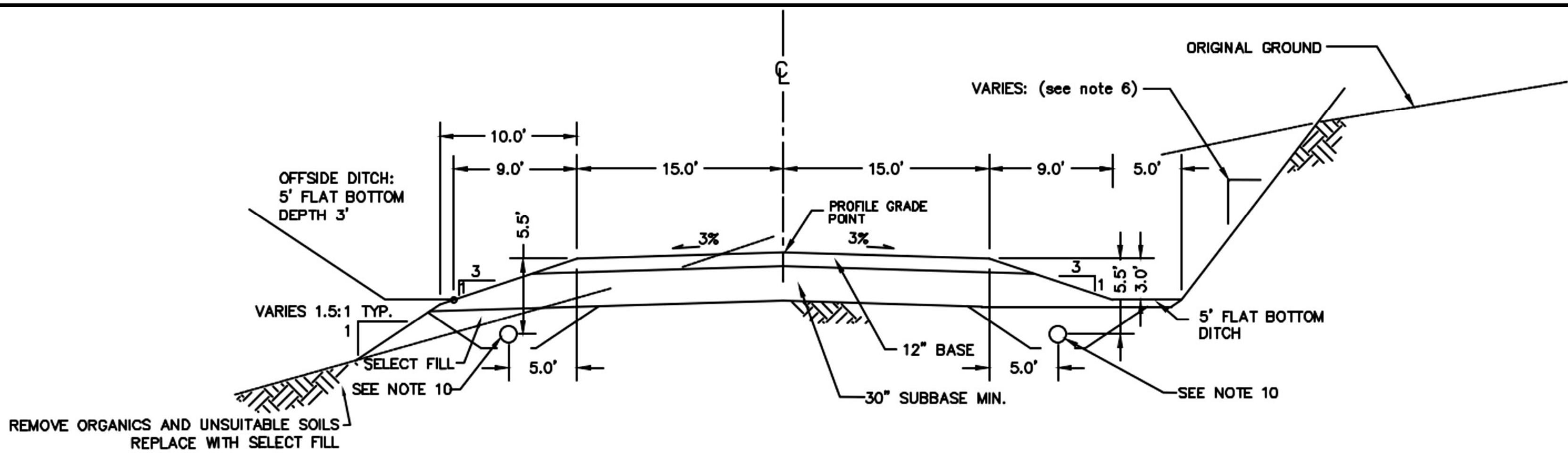
2 0 2 4
Miles

Action Alternative 1
- Bridge
- Culvert
- Transportation Corridor
- Natural Gas Pipeline
- Mine Site

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

ACTION ALTERNATIVE 1 - PORT ACCESS ROAD AND KOKHANOK SPUR ROAD

PEBBLE PROJECT EIS **FIGURE 2-15**



NOTES:

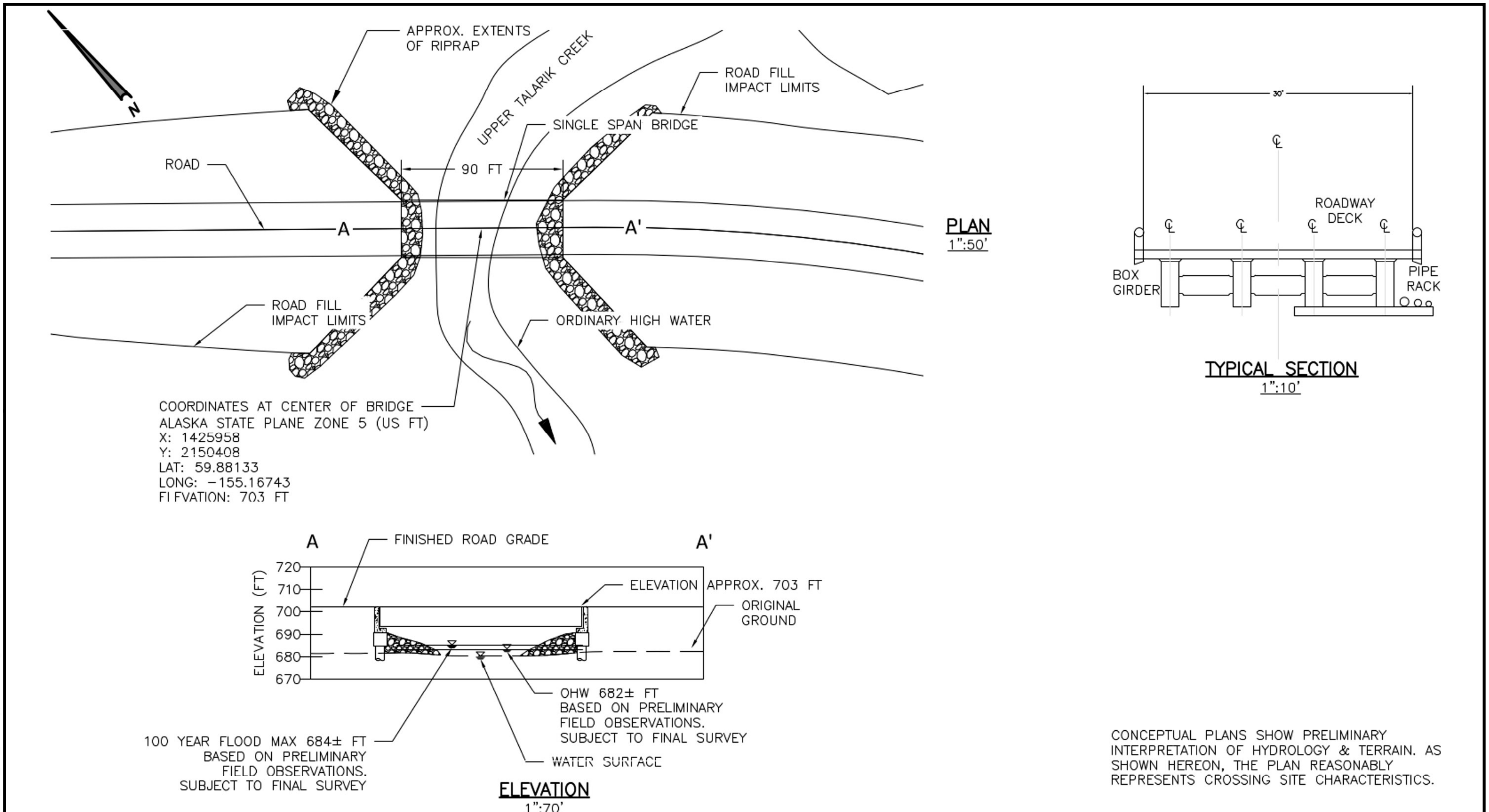
1. CLEARING LIMITS MIN. TO TOP OF CUT OR TOE OF FILL.
2. BASE TO CONSIST OF 2 in MINUS, DURABLE, WELL GRADED, CRUSHED ROCK WITH 6 TO 10% PASSING THE 200 SIEVE. MATERIAL TO BE DURABLE. 12" MIN DEPTH.
3. SUBBASE TO CONSIST OF DURABLE COARSE ROCK OR GRAVEL. NON-FROST-SUSCEPTIBLE. 30" MIN DEPTH
4. SELECT 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. 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
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. NATURAL GAS PIPELINE TO BE INSTALLED EITHER RIGHT OF 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.
11. **KOKHANOK AIRPORT SPUR ROAD AND ILIAMNA SPUR ROAD DO NOT INCLUDE A NATURAL GAS PIPELINE**

ROAD TYPICAL SECTION FOR MODERATE TERRAIN WITH ROCK CUTS

Sources: PLP 2017

US Army Corps of Engineers®

ACTION ALTERNATIVE 1 - TYPICAL ROAD SECTION



Sources: PLP 2017

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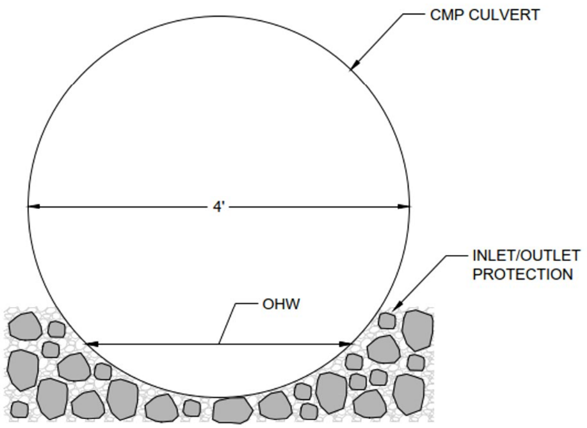
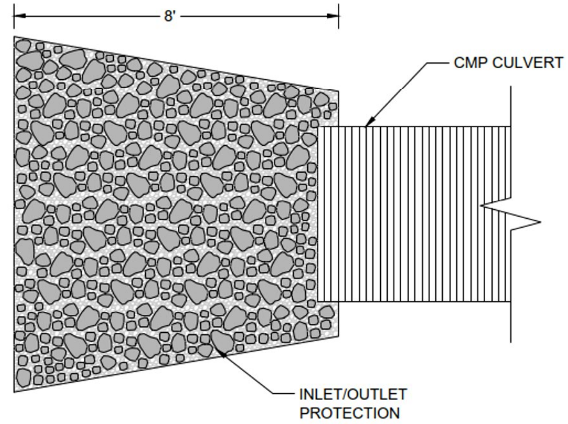
ACTION ALTERNATIVE 1 - TYPICAL BRIDGE CROSSING

PEBBLE PROJECT EIS

FIGURE 2-17



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.

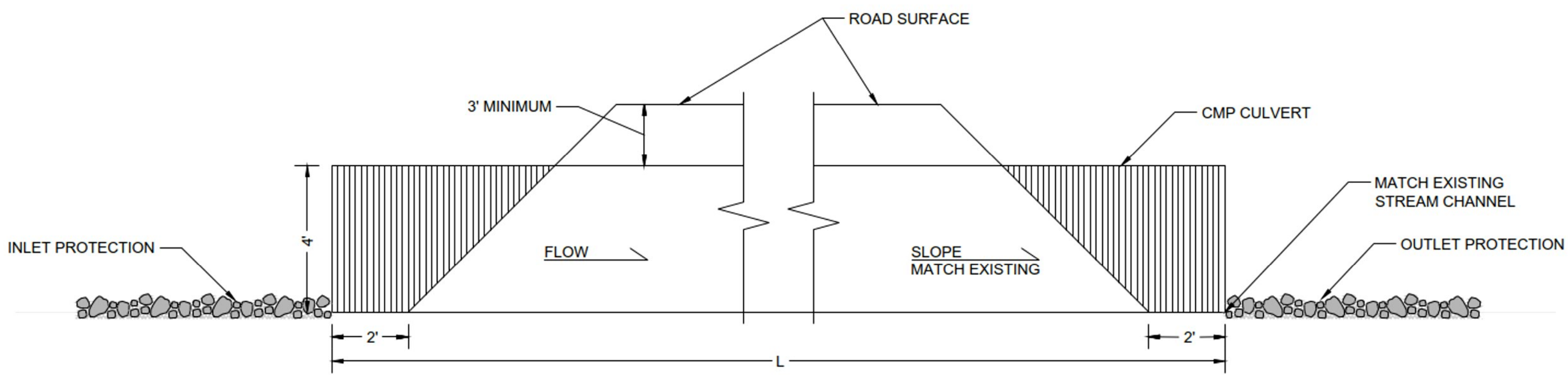
DIAMETER SHALL BE 4'.

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.

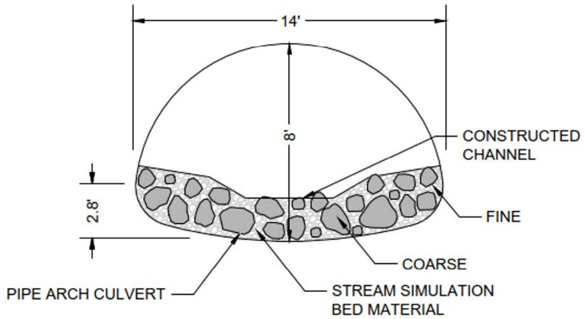


TYPICAL PROFILE
NTS

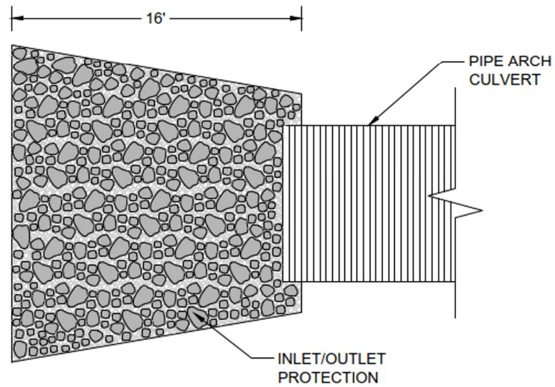
Sources: PLP 2017

US Army Corps of Engineers

ACTION ALTERNATIVE 1 - TYPICAL CULVERT CROSSING



TYPICAL SECTION
NTS



TYPICAL INLET/OUTLET PROTECTION
NTS

CATEGORY 6 CULVERTS SHALL BE INSTALLED IN MAPPED STREAMS WHERE FISH PASSAGE IS REQUIRED AND THAT HAVE A STREAM WIDTH BETWEEN 6' & 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.

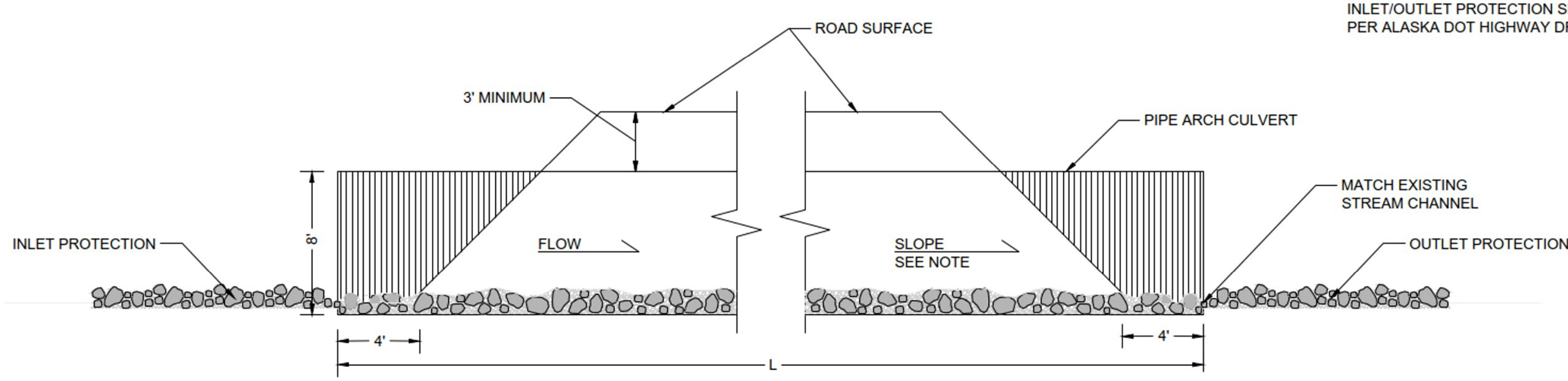
STREAM BED SLOPE THROUGH CULVERT SHALL MATCH CHANNEL BED SLOPE TO MAXIMUM EXTENT PRACTICABLE, BUT NO GREATER THAN CHANNEL BED SLOPE +1%.

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 2017

US Army Corps of Engineers®

ACTION ALTERNATIVE 1 - TYPICAL FISH PASSAGE CULVERT CROSSING

PEBBLE PROJECT EIS

FIGURE 2-19

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. The Applicant's proposed alternative (Action Alternative 1) 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.

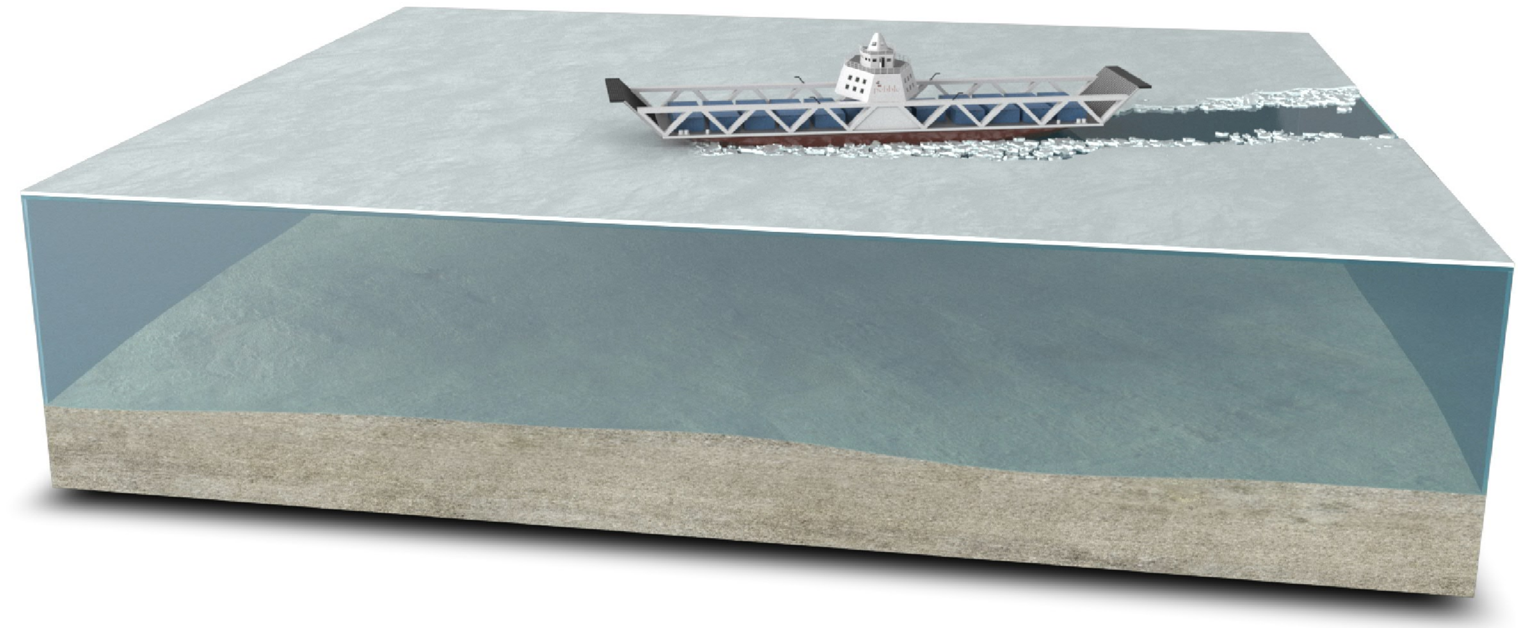
A custom-designed ferry would transit Iliamna Lake, carrying inbound supplies from Amakdedori port to the mine site, and returning with copper-gold and molybdenum concentrates, backhauled waste, and empty shipping containers. The one-way ferry trip is about 18 miles and would take approximately 3 hours to complete in ice conditions, or 1.5 hours in open water. 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 2-20, Figure 2-21, and Figure 2-22 present digital simulations of the ferry vessel, the north ferry terminal, and the south ferry terminal, respectively. Figure 2-23 and Figure 2-24 show the north ferry terminal layout and cross sections, respectively. Figure 2-25 and Figure 2-26 show the south ferry terminal layout and cross sections, respectively.

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 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 and 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.

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

Two ferry terminals are proposed: one on the north shore (north ferry terminal [4 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.



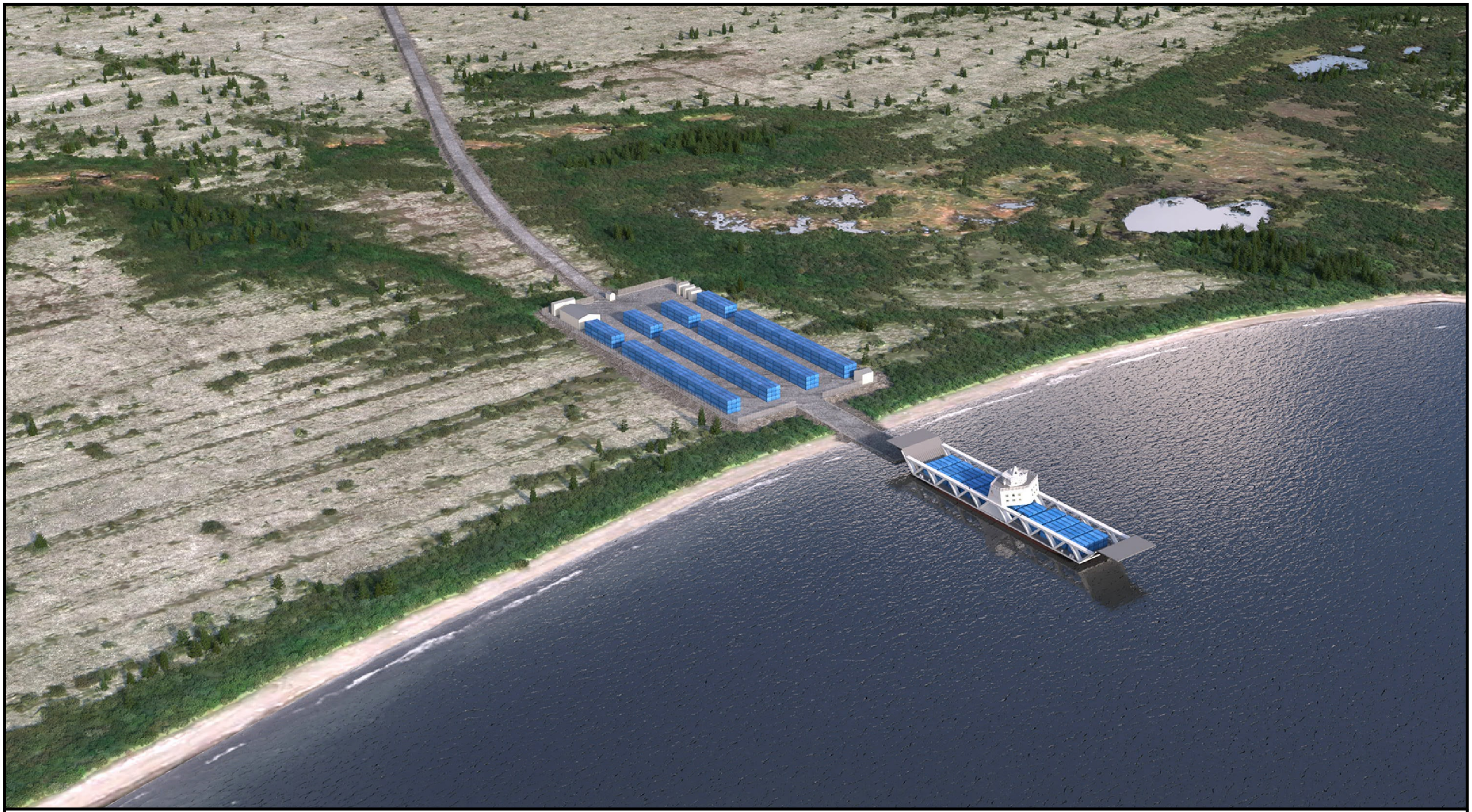
Sources: PLP 2018-RFI 034d.

US Army Corps of Engineers®

DIGITAL SIMULATION OF FERRY VESSEL

PEBBLE PROJECT EIS

FIGURE 2-20



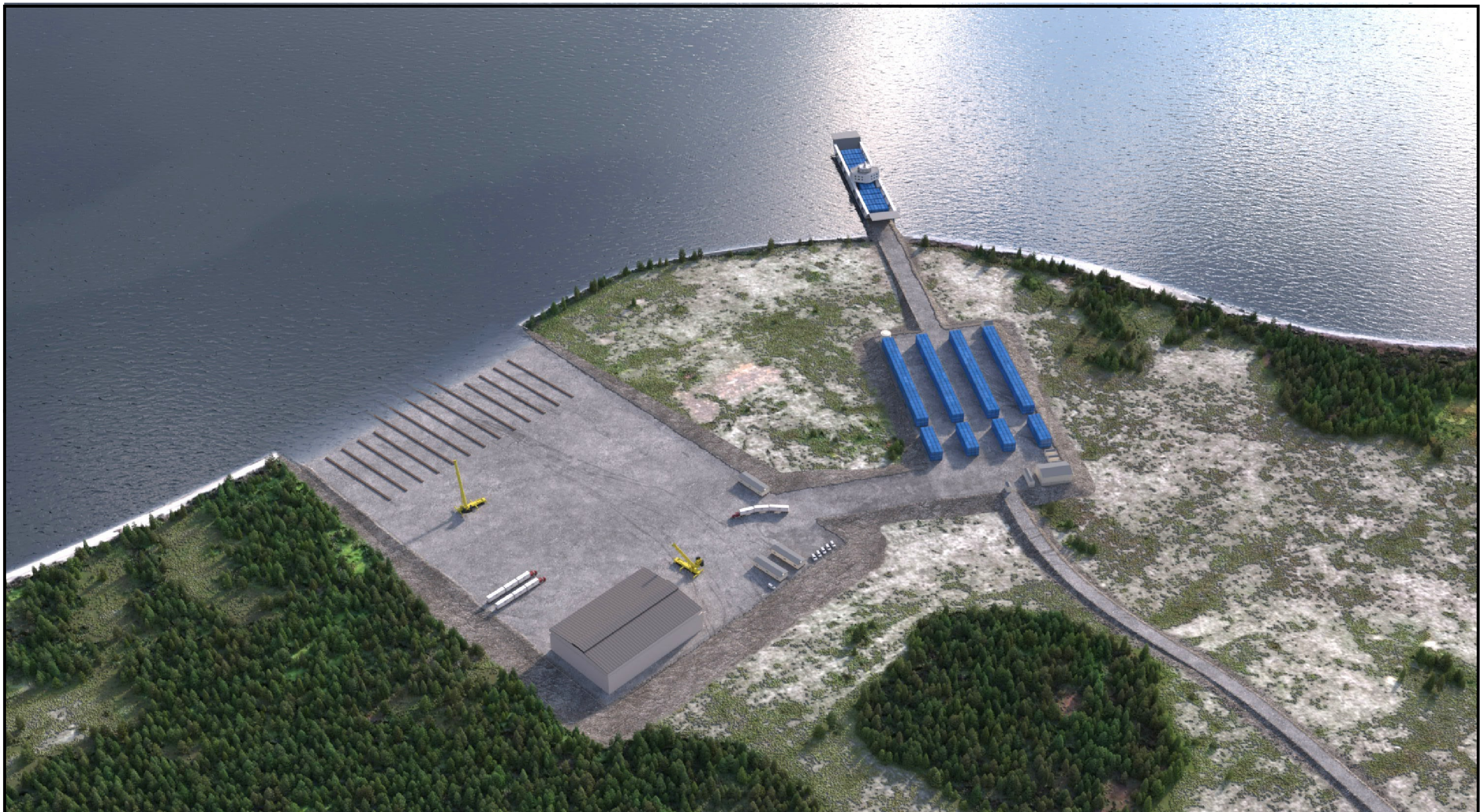
Sources: PLP 2018-RFI 034d.

US Army Corps
of Engineers®

DIGITAL SIMULATION OF NORTH FERRY TERMINAL

PEBBLE PROJECT EIS

FIGURE 2-21



Sources: PLP 2018-RFI 034d.

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DIGITAL SIMULATION OF SOUTH FERRY TERMINAL

Sources: PLP2018

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

US Army Corps of Engineers

100 0 100 200

Feet

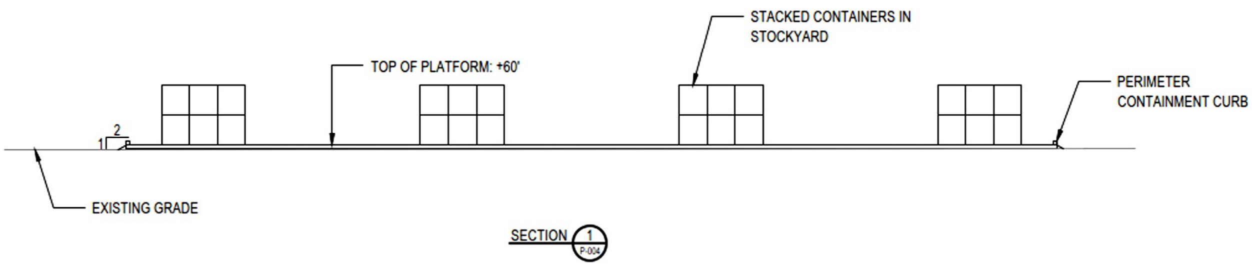
Action Alternative 1

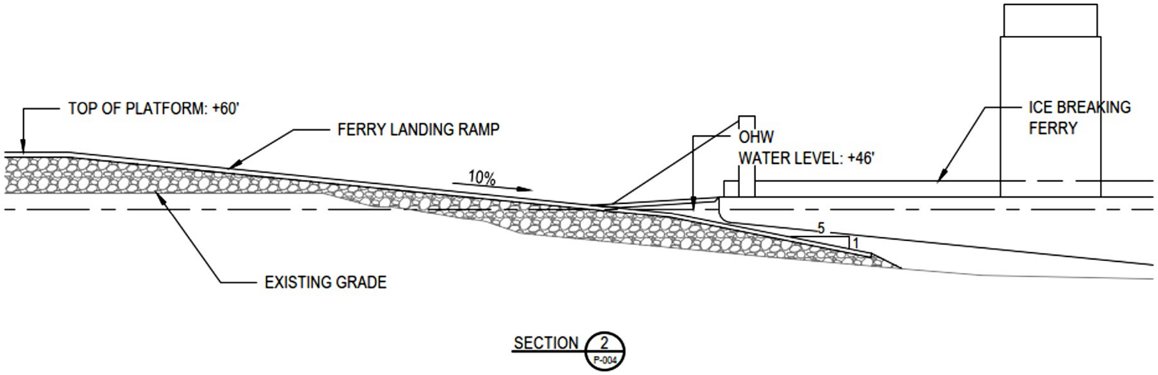
- Natural Gas Pipeline
- North Ferry Terminal
- Transportation Corridor
- Ordinary High Water

ACTION ALTERNATIVE 1 - NORTH FERRY TERMINAL

PEBBLE PROJECT EIS

FIGURE 2-23





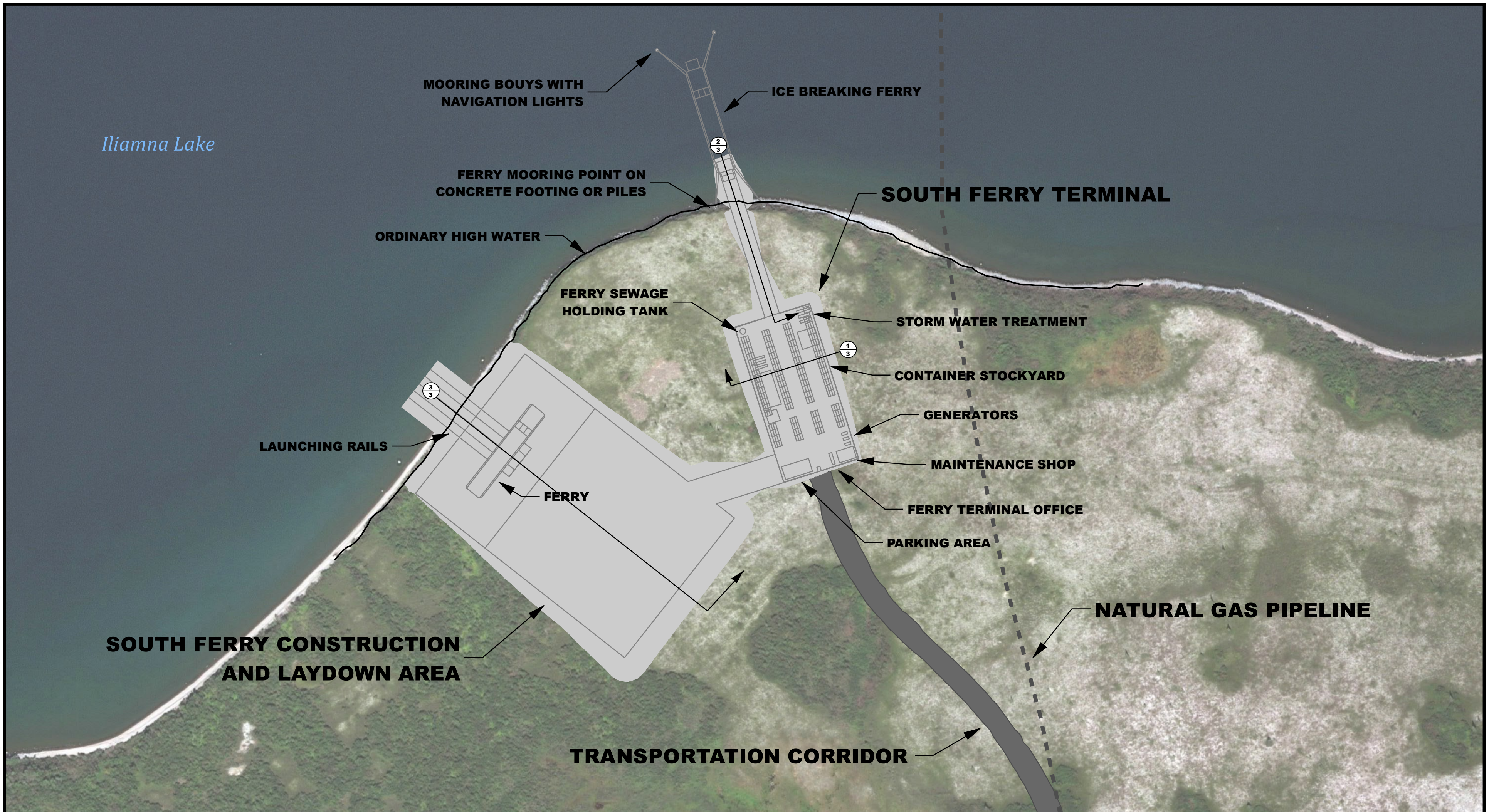
NOTES:

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®

ACTION ALTERNATIVE 1 - NORTH FERRY TERMINAL CROSS SECTIONS



Sources: PLP 2018
Note: The displayed features are the permanent footprint unless otherwise specified.

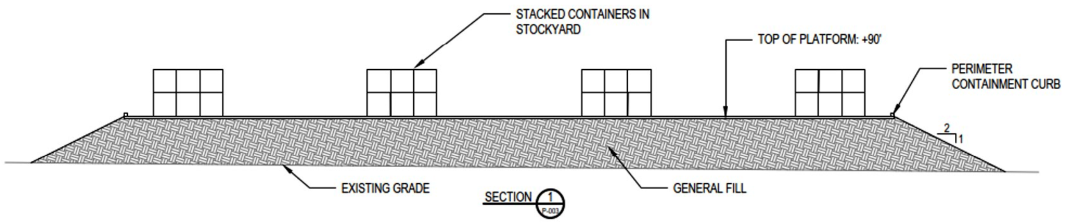
US Army Corps of Engineers®

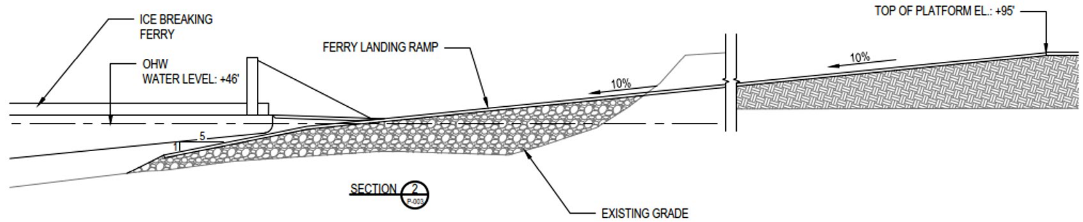
200 0 200 400
Feet

Action Alternative 1
- Natural Gas Pipeline
- South Ferry Terminal
- Transportation Corridor
- Ordinary High Water

ACTION ALTERNATIVE 1 - SOUTH FERRY TERMINAL

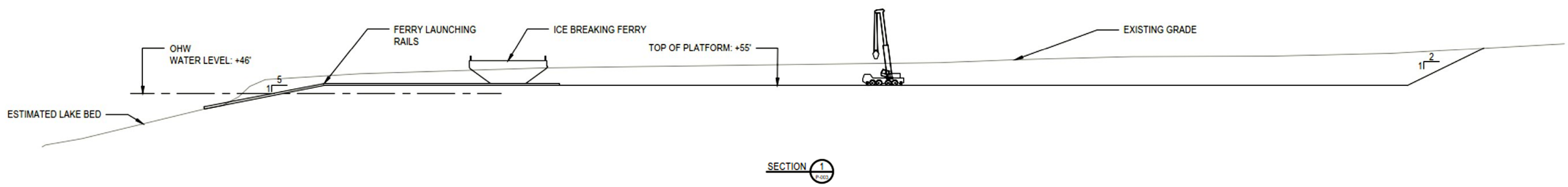
PEBBLE PROJECT EIS **FIGURE 2-25**





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 2018-RFI-093

US Army Corps of Engineers®

ACTION ALTERNATIVE 1 - SOUTH FERRY TERMINAL CROSS SECTIONS

FIGURE 2-26

The permanent facilities at the ferry terminals would include container handling and storage facilities, office and maintenance buildings, 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. 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 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.

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).

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 18 material sites (241 acres) would be required for construction and maintenance of access roads and the natural gas pipeline for Action Alternative 1. Appendix K2 provides information for each material site, including the estimated quantities, size, type of material, use of material, and if blasting is required. Figures in Appendix K2 show the location of material sites proposed for Action Alternative 1. 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. The amount of material estimated to be required for the road and pipeline is approximately 7.3 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 – rock, gravel, etc.

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 waterbody type, use, years and season of use, and estimated extraction rate and volumes. Figures in Appendix K2 show the location of water extractions sites proposed for Action Alternative 1. 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.

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 about 1 mile in overall length and would encompass up to 5 acres total.

Temporary Facilities and Initial Site Access

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. The beachheads at the ferry terminal sites would 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 camps would be established at the ferry landings to support road construction; and at the south ferry landing the camp would also support assembly of the ferry. 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). 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.

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 Amakdedori 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 containing about 38 tons of concentrate, with removable locking lids. 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 39 round trips per day for each leg of the road, including three loads of fuel per day (PLP 2018-RFI 065). The ferry would require one round trip across the lake per day. Figure 2-27 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).

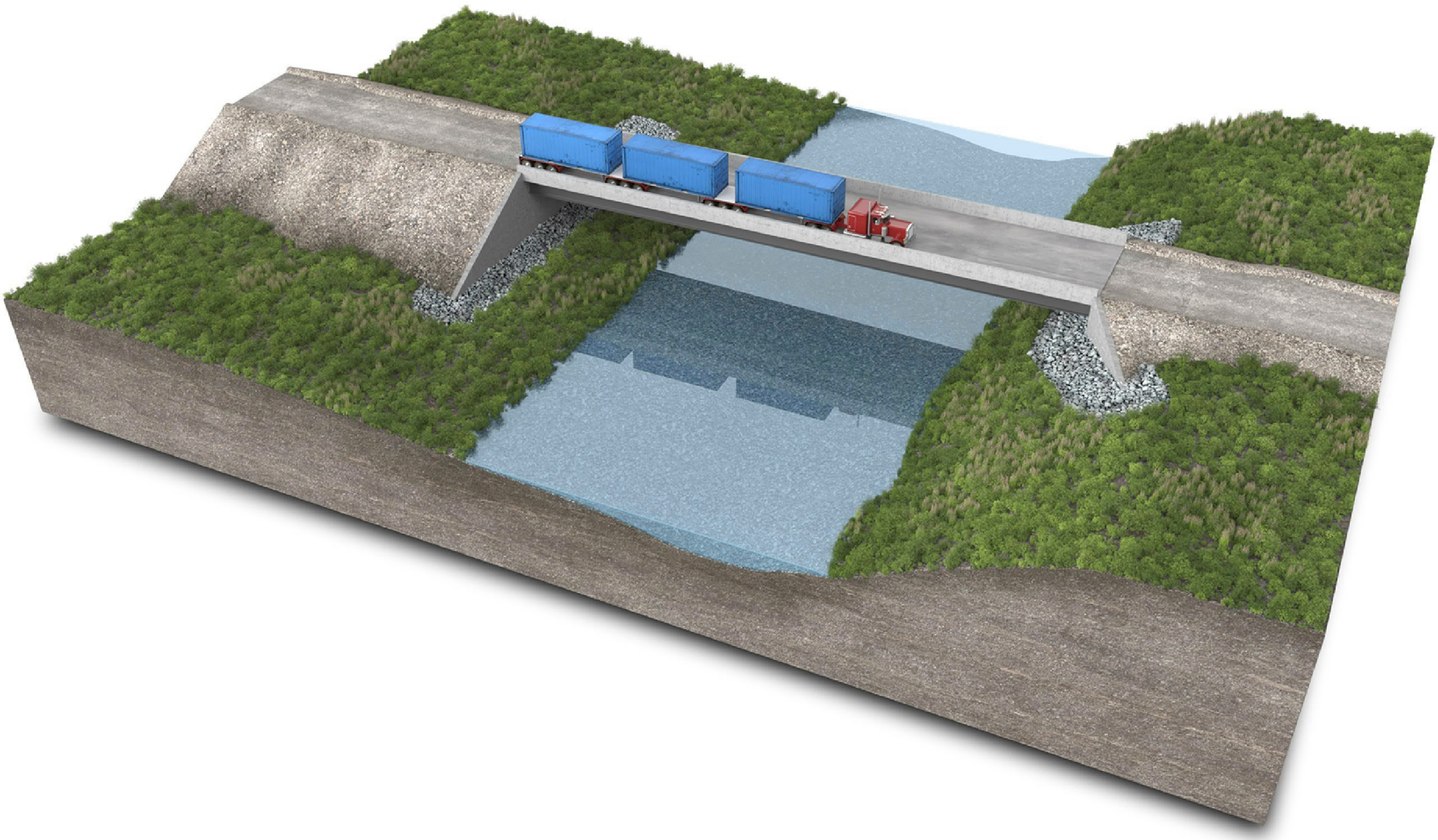
The Iliamna airport is capable of handling all aircraft anticipated to be used for the project, and no improvements are expected. PLP expects the facility at Kokhanok would be used to provide commuter service for work rotations for the port, ferry terminal, and road facility crews. Some minor freight 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.

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.

A detailed reclamation plan would be prepared in compliance with state requirements during the state permitting and ROW lease processes prior to construction.



Sources: PLP 2018-RFI 034d.

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DIGITAL SIMULATION OF HAUL TRUCK

PEBBLE PROJECT EIS

FIGURE 2-27

2.2.2.3 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 (see Figure 2-28). The port site area is currently undeveloped, and not served by any transportation or utility infrastructure.

The proposed port site (30 acres) would include a permanent port site airstrip (6 acres), as well as shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project. The shore-based facilities (14 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 sufficient to address tidal surge from major storms and potential tsunamis. The Amakdedori airstrip would be used primarily for construction but would be retained for incidental/emergency access.

Marine facilities[9] (11 acres) would include an earthen access causeway (maximum width of 500 feet by 1,200 feet long) extending out to a marine jetty located in -15 feet mean lower low water (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 sheetpile would be installed. Two floating ramps would extend down on 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. See Figure 2-29 for cross sections of the Amakdedori port.

Two lighted navigation buoys (3 feet in diameter) would be located on the reefs framing the entrance to the Amakdedori port (see Figure 2-28). 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).

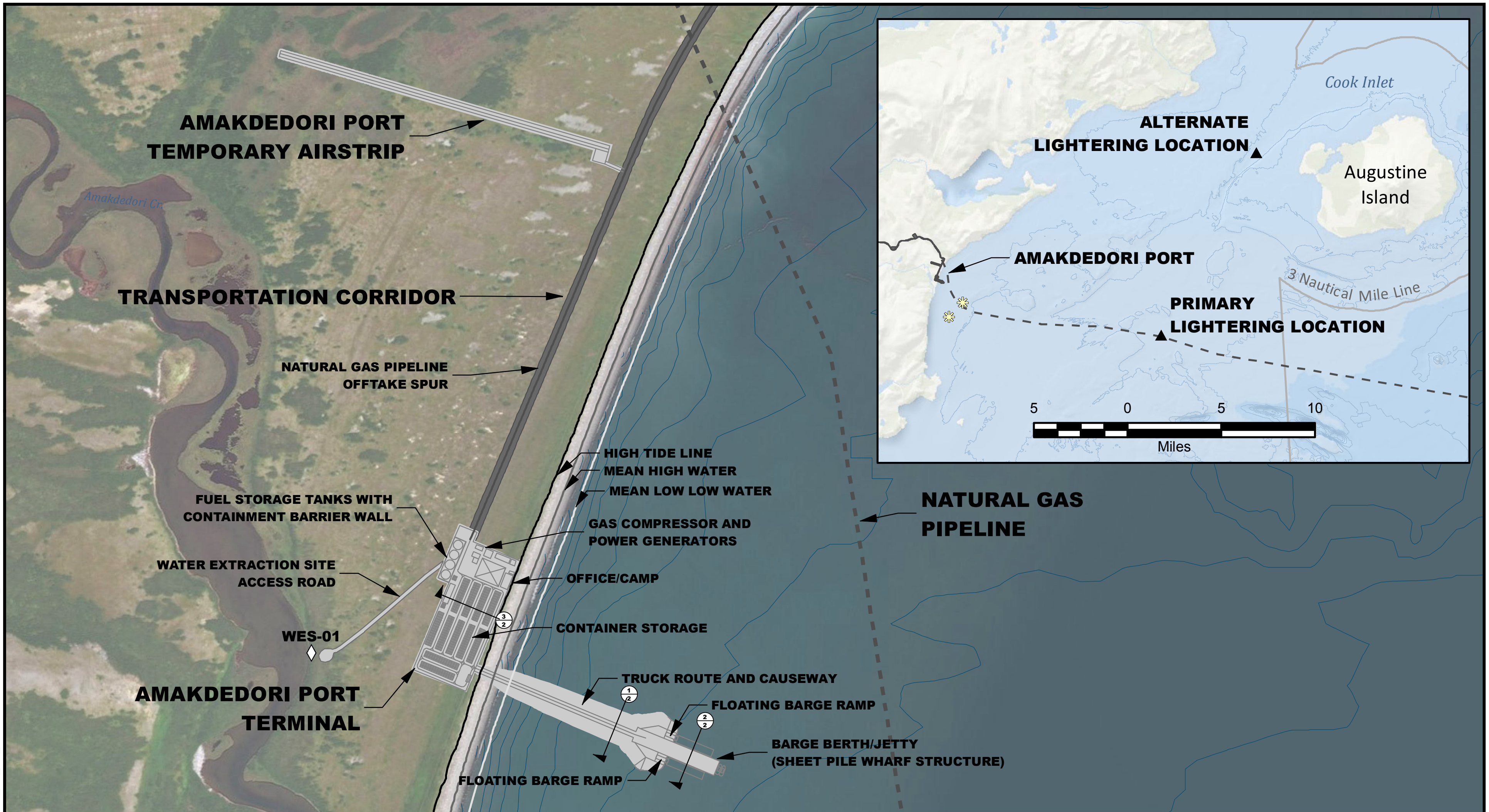
Permanent structures mounted on the causeway and or dock would include a fuel pipeline for unloading barges, a powerline for vessel shore power, a water supply line for firefighting, and illumination and navigation lights. No permanent cranes or fuel storage would be located on the dock.

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.

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 proposed Amakdedori port; an alternate lightering location is approximately 18 miles east-northeast of the proposed Amakdedori 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 2-30 presents a digital simulation of concentrate transfer operations at a lightering site.

[9] 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 2018
Note: The displayed features are the permanent footprint unless otherwise specified.

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500 0 500 1,000
Feet

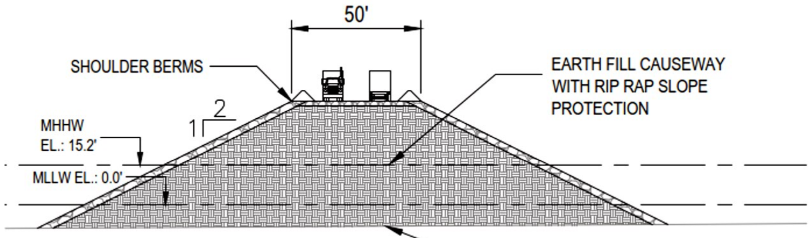
Action Alternative 1
- Lightering Locations
- Navigation Lights
- Water Extraction Site
- Natural Gas Pipeline
- Amakdedori Port
- Transportation Corridor

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

ACTION ALTERNATIVE 1 - AMAKDEDORI PORT AND LIGHTERING LOCATIONS

PEBBLE PROJECT EIS

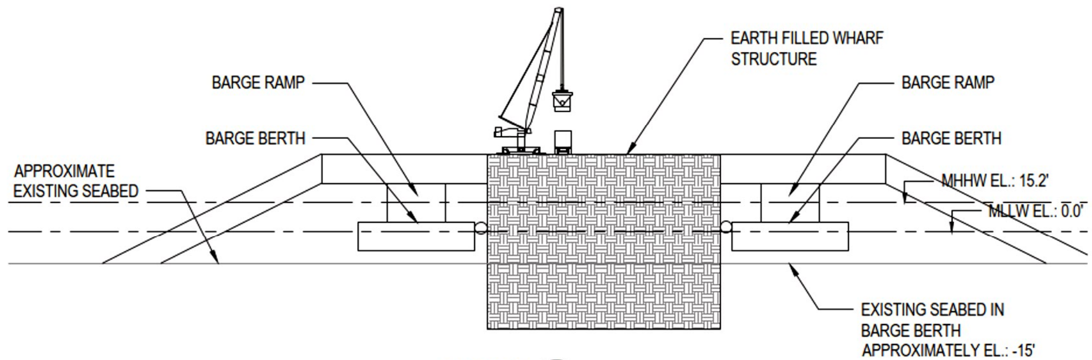
FIGURE 2-28



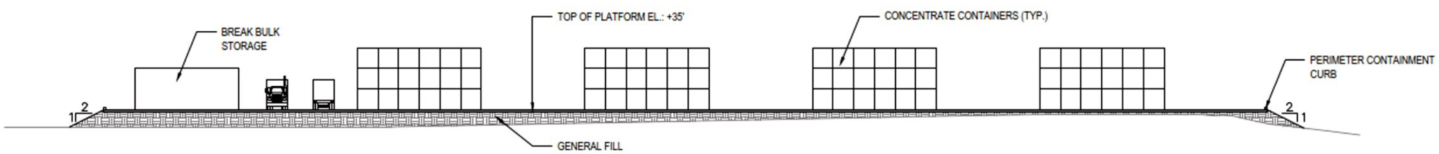
SECTION 1 P-002

NOTES:

1. DIMENSIONS IN FEET
3. HORIZONTAL DATUM TO UTM NAD83, ALASKA STATE PLANE ZONE 5, US SURVEY FEET
4. ELEVATIONS ARE IN FEET TO MEAN LOWER LOW WATER (MLLW)
5. OFFSHORE CONTOURS DEVELOPED FROM TERRASOND BATHYMETRIC SURVEY DATED AUGUST 20 TO 27, 2017. ELEVATIONS SURVEYED TO GEODETIC DATUM (GEOID 99) AND ARE SHIFTED TO MEAN LOWER LOW WATER (MLLW) LEVEL BASED ON LIMITED FIELD MEASURED TIDAL DATA. PRELIMINARY SHIFT BETWEEN GEODETIC AND MLLW IS +8.37' (0' GEODETIC = 8.37' MLLW).



SECTION 2 P-002



SECTION 3 P-002

Sources: PLP 2018-RFI-093

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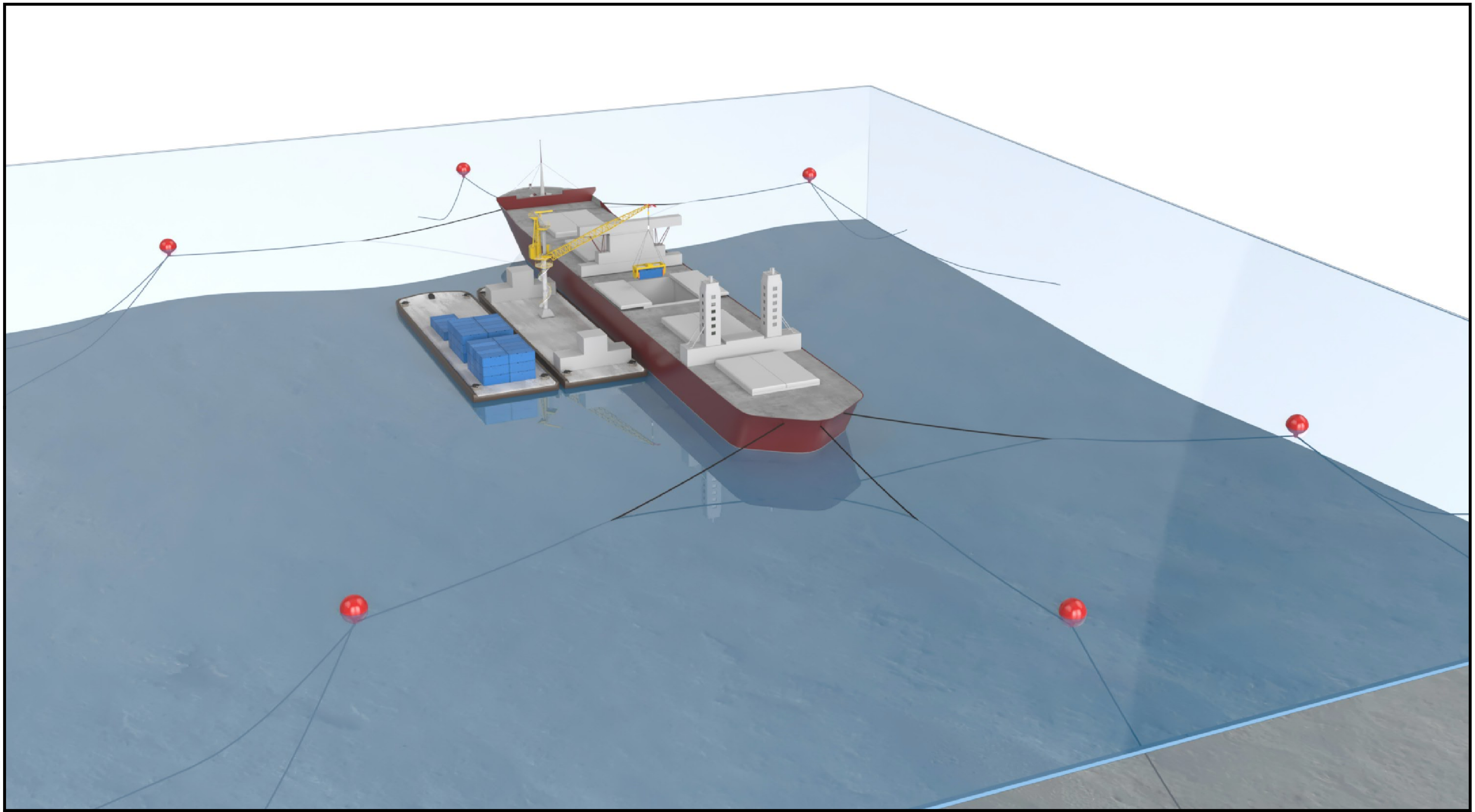
ACTION ALTERNATIVE 1 - AMAKDEDORI PORT CROSS SECTIONS

PEBBLE PROJECT EIS

FIGURE 2-29



Sources: PLP 2018-RFI 034d.

US Army Corps of Engineers®

DIGITAL SIMULATION OF CONTAINER TRANSFER AT LIGHTERING SITE

PEBBLE PROJECT EIS

FIGURE 2-30

Figure 2-31 shows the proposed mooring 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 set on the sea floor using a pattern similar to that shown on Figure 2-31. On arrival, the bulk carriers would attach mooring lines to the buoys, anchoring themselves in place (PLP 2018-RFI 081).

The layout for the permanent anchors (10 to 12) 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 (see Figure 2-32). Alternatives that might be used if sea floor conditions are not suitable for the use of gravity anchors as outlined include (PLP 2018-RFI 081):

1) Large spade anchors (similar to a conventional boat anchor).
2) Spiral screw anchors that would be twisted into the seabed using a hydraulic drill. This does not work in areas of rock or hard cobbles.
3) For areas of rock seabed, anchors may be drilled into the seabed.
4) Depending on the ground conditions at the designated mooring area, the anchoring system may involve drilling into the subsurface rock as an alternative to a gravity anchor system. The mooring spread measures approximately 2,300 feet by 1,700 feet, but the impact footprint on the sea bottom is limited to the 10 anchor locations.

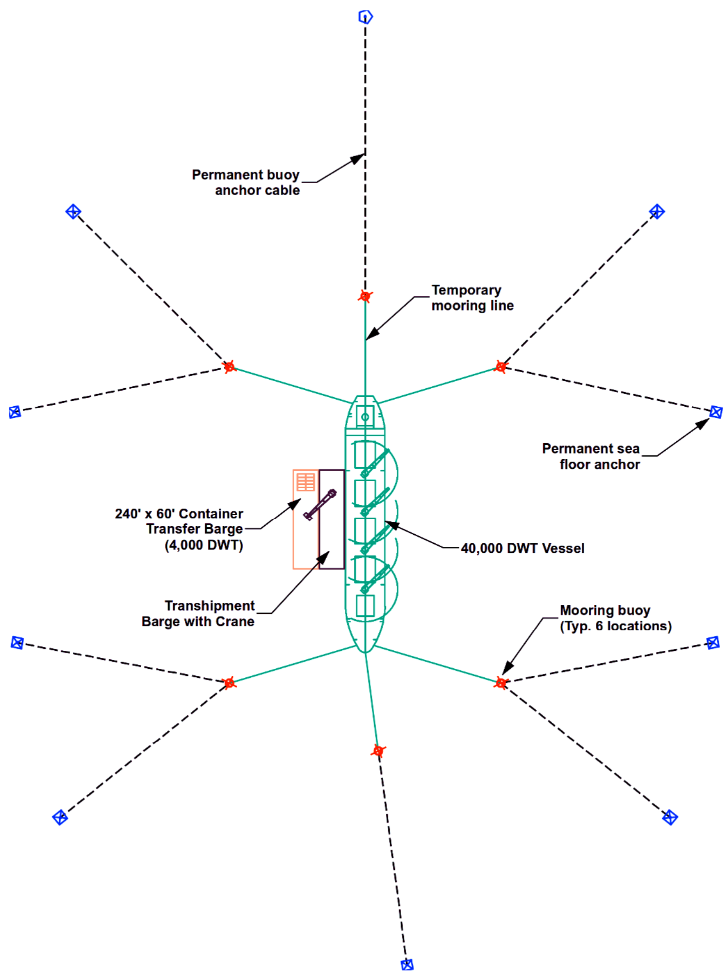
Temporary Facilities and Initial Site Access

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, environmental protection features, the permanent port site airstrip, and service facilities. All temporary facilities at the port would be located 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.

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 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 incidental/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 2018-RFI 041).

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.



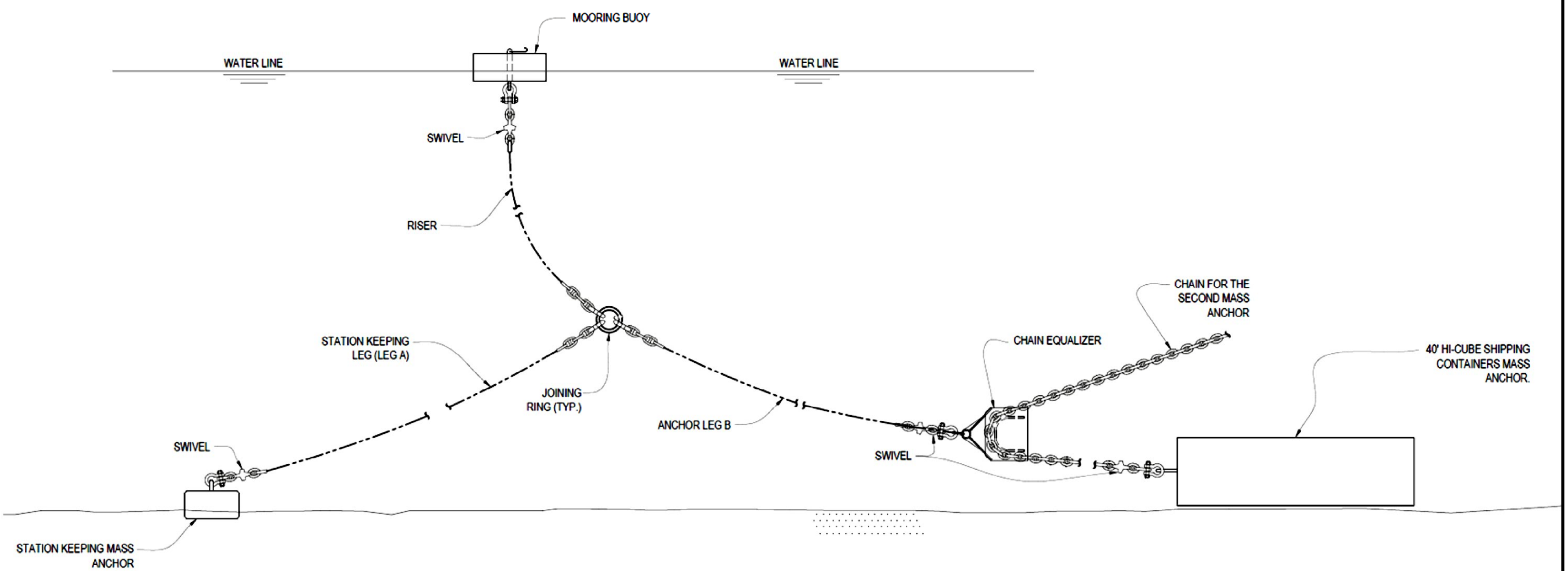
Sources: PLP 2018-RFI-081

US Army Corps of Engineers®

OFFSHORE LIGHTERING MOORING ARRANGEMENT

PEBBLE PROJECT EIS

FIGURE 2-31



Sources: PLP 2018-RFI-081

US Army Corps of Engineers®

TYPICAL ANCHOR DESIGN

PEBBLE PROJECT EIS

FIGURE 2-32

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 trucked to the mine site. Figure 2-33 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 and 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 inside 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. 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. This containerized bulk handling system minimizes dust emissions and the risk of spills.

Empty containers would be washed inside a closed building at the port and then returned to the laydown pad. The wash water would be recycled, or when needed, treated and released. There would be no direct discharge of wash water. Solids collected during the washing process would be returned to the mine site for disposal in the pyritic TSF.

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 also be installed to respond to oil spills, and crews would be appropriately 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.

Sources: PLP 2018-RFI 034d.

US Army Corps of Engineers®

ACTION ALTERNATIVE 1 - DIGITAL SIMULATION OF BARGES AT AMAKDEDORI PORT

PEBBLE PROJECT EIS

FIGURE 2-33

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, or shipped offsite to a disposal facility. Treated water would be released from a discharge point at the end of the dock facility, in accordance with an Alaska Pollutant Discharge Elimination System (APDES) permit (PLP 2018-RFI 087).

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 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).

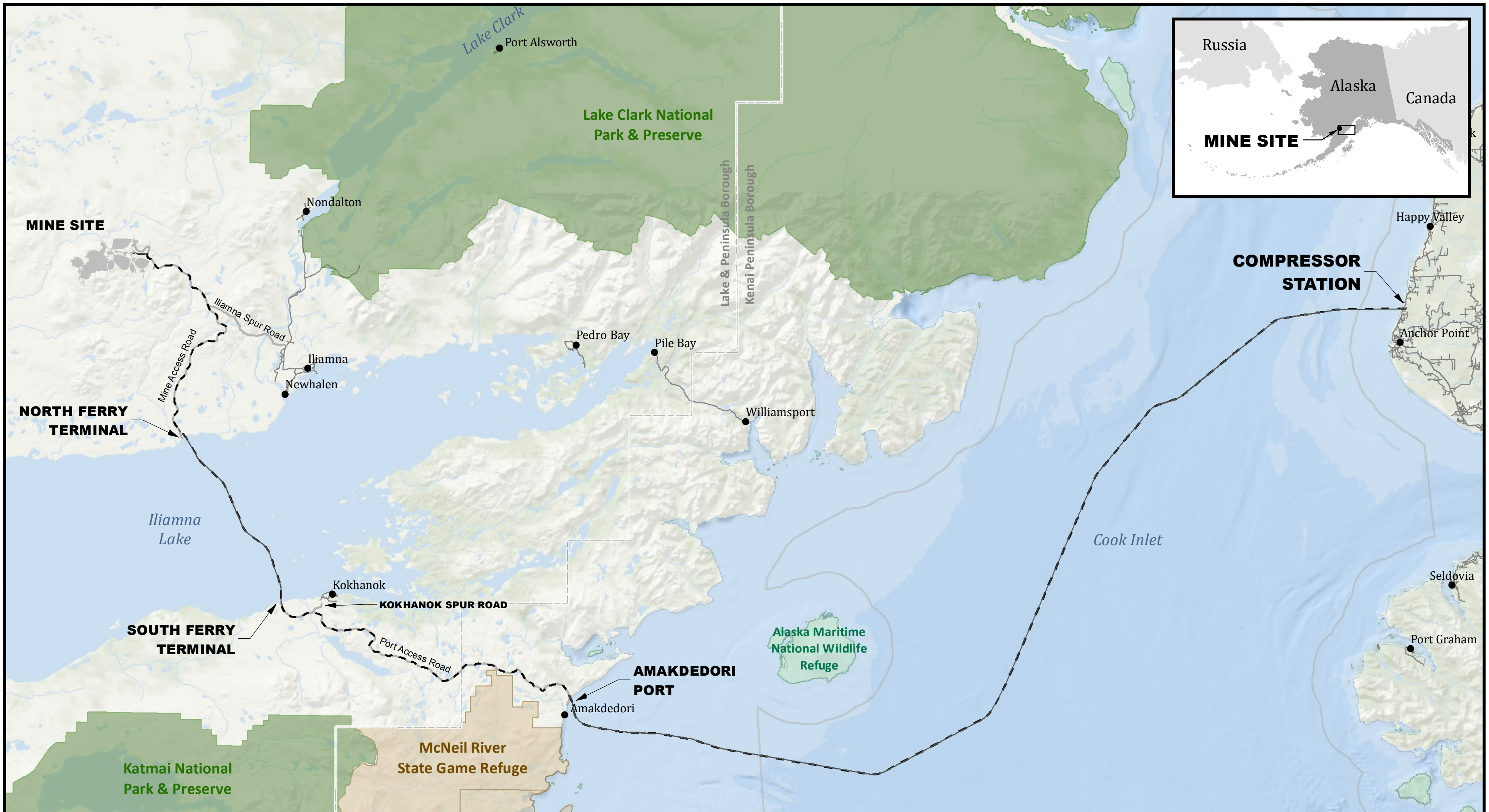
2.2.2.4 Natural Gas Pipeline

Natural gas, sourced through the existing natural gas supply infrastructure for the Cook Inlet area, would be the primary energy source for the project. As required for the granting of both a state and federal ROW, the pipeline would be open access; more specifically, a contract carrier. PLP has committed to providing community access to the gas line.

Natural Gas Pipeline Corridor and Ancillary Facilities

The natural gas would be supplied to Amakdedori port and the mine site by pipeline (Figure 2-34). 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 (5 acres) at the offtake point, sited on a land parcel on the eastern side of the Sterling Highway (Figure 2-35). Figure 2-36 provides a simulation of the stations and facility on the gravel pad. The steel pipeline would be 12 inches in diameter and would be designed to meet all applicable state and federal regulations.



Sources: PLP 2018; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

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N

5 0 5 10
Miles

Action Alternative 1
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site

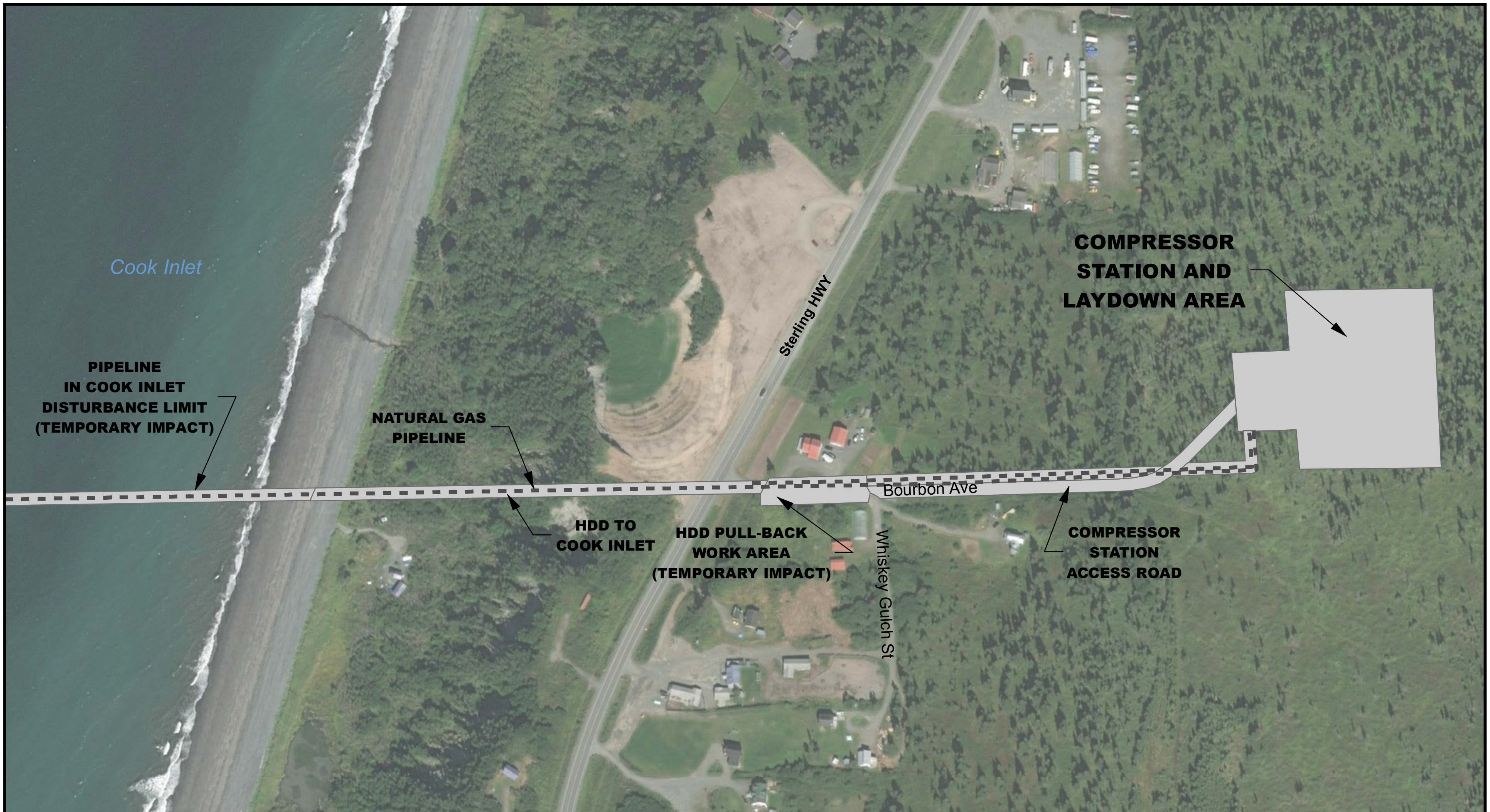
Other Features
- Local Roads
- Borough Boundary
- Three Nautical Mile Line

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

ACTION ALTERNATIVE 1 - NATURAL GAS PIPELINE ALIGNMENT

PEBBLE PROJECT EIS

FIGURE 2-34



Sources: PLP 2018
Note: The displayed features are the permanent footprint unless otherwise specified.

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200 0 200 400
Feet

Natural Gas Pipeline
Compressor Station

COMPRESSOR STATION PLAN VIEW

PEBBLE PROJECT EIS

FIGURE 2-35

Sources: PLP 2018-RFI 034d.

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of Engineers®

DIGITAL SIMULATION OF COMPRESSOR STATION

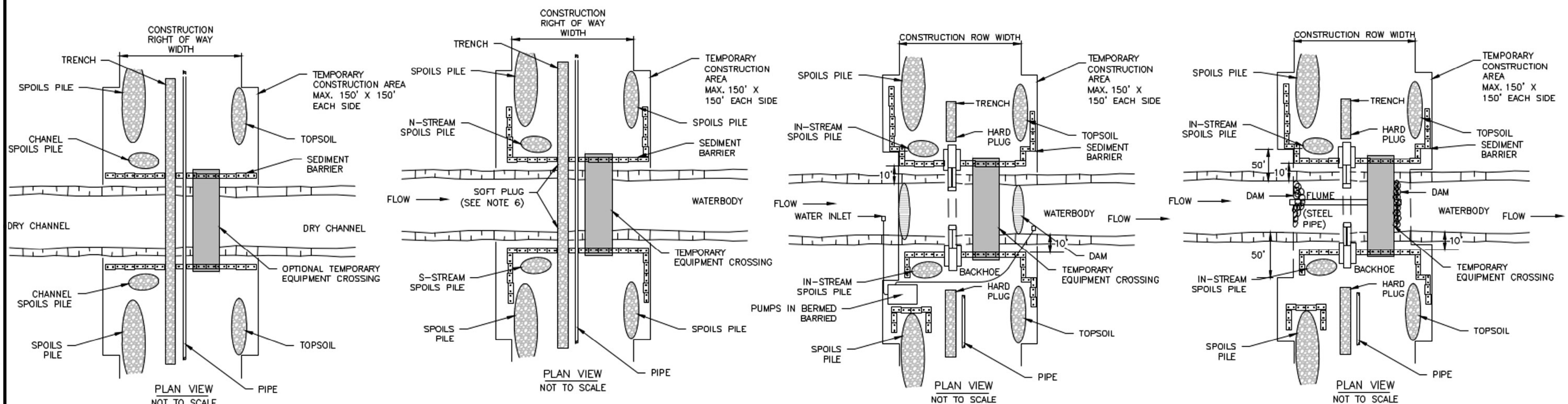
The compressor station would feed a 104-mile subsea pipeline that would be constructed using heavy-wall 12-inch-diameter pipe designed to have negative buoyancy and provide erosion protection against tidal currents. Horizontal directional drilling (HDD) would be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards. From this point, the heavy-wall pipe would either be placed on the sea floor and anchored or supported as required, or trenched using a clam shell dredge, extended reach backhoe, suction dredge, or jet sled working from barges. The temporary construction area corridor width would be 30 feet to include space for pipeline placement activities (PLP 2018-RFI 082). Although the anchoring/support and trenching area details would be determined in final design, they would be in the 30-foot construction area.

The pipeline would come ashore at Amakdedori port using trenching or HDD, 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 mine site would consist of three sections. The first section would follow the access road to the south ferry terminal. The pipeline would be buried in a trench adjacent to the road bed shoulder. 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 18-mile lake crossing. The design of this section of the pipe would be similar to the Cook Inlet crossing, and the shore transitions would use trenching or HDD. 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 road route to the mine site.

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 (see Figure 2-15). At bridged crossings, the pipeline would be attached to the bridge structures; otherwise, the pipeline would use trenching or HDD to cross streams. See Figure 2-37 and Figure 2-38 for the typical open-cut and HDD crossings, respectively.

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. Anode bed and rectifier locations would be determined based on specific local conditions and field observations. Metering stations and pig launching and receiving facilities would be located at the compressor station and offtake points as appropriate. Mainline sectionalizing valves would be installed as required by code, with a spacing of no more than 20 miles for the onshore sections of the pipeline.



TYPICAL NON-FLOWING WATERBODY CROSSING OPEN-CUT

TYPICAL FLOWING WATERBODY CROSSING OPEN-CUT

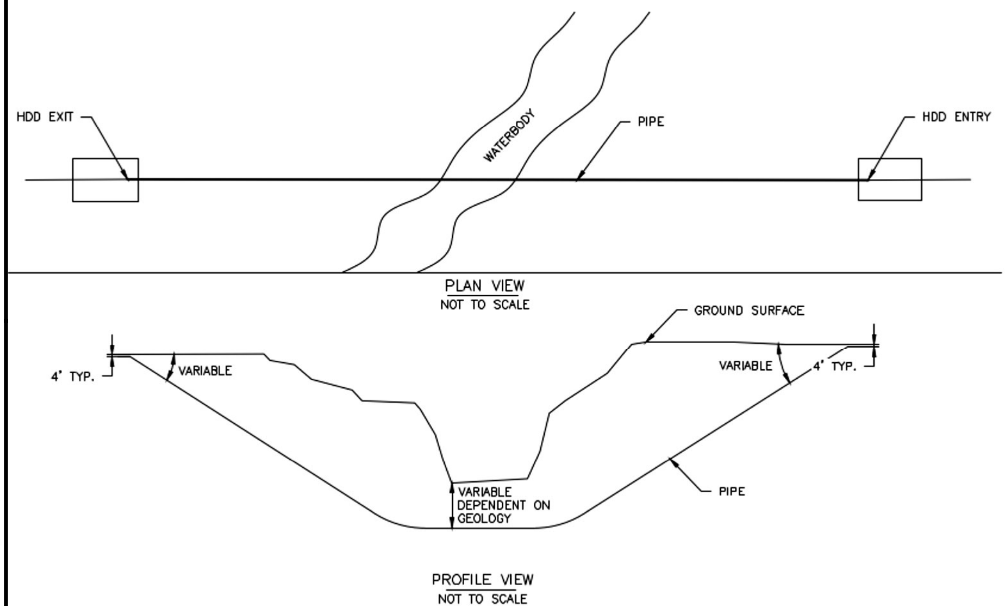
TYPICAL FLOWING WATERBODY CROSSING OPEN-CUT DAM & PUMP

TYPICAL FLOWING WATERBODY CROSSING OPEN-CUT DRY FLUME

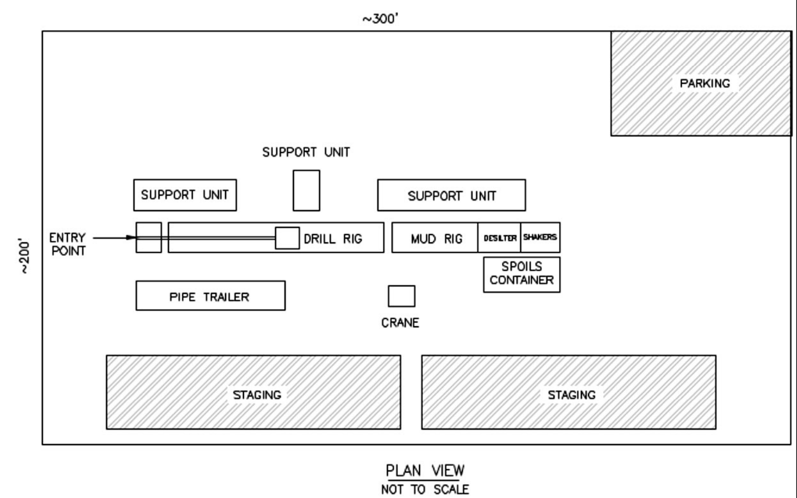
Sources: PLP 2018

US Army Corps of Engineers®

ACTION ALTERNATIVE 1 - TYPICAL PIPELINE OPEN-CUT WATERBODY CROSSING



TYPICAL HDD PLAN & PROFILE



TYPICAL HDD ENTRY/EXIT SITE
EQUIPMENT LAYOUT

Sources: PLP 2018

US Army Corps
of Engineers®

ACTION ALTERNATIVE 1 - TYPICAL PIPELINE HDD CROSSING

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 and locations would be developed in accordance with the APDES General Permit AKG320000 – Statewide Oil and Gas Pipelines prior to filing a Notice of Intent for coverage. Specific BMPs for the test water discharge would be developed, as required by the general permit.

Material sites and water extraction sites for road and pipeline construction are discussed above.

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.

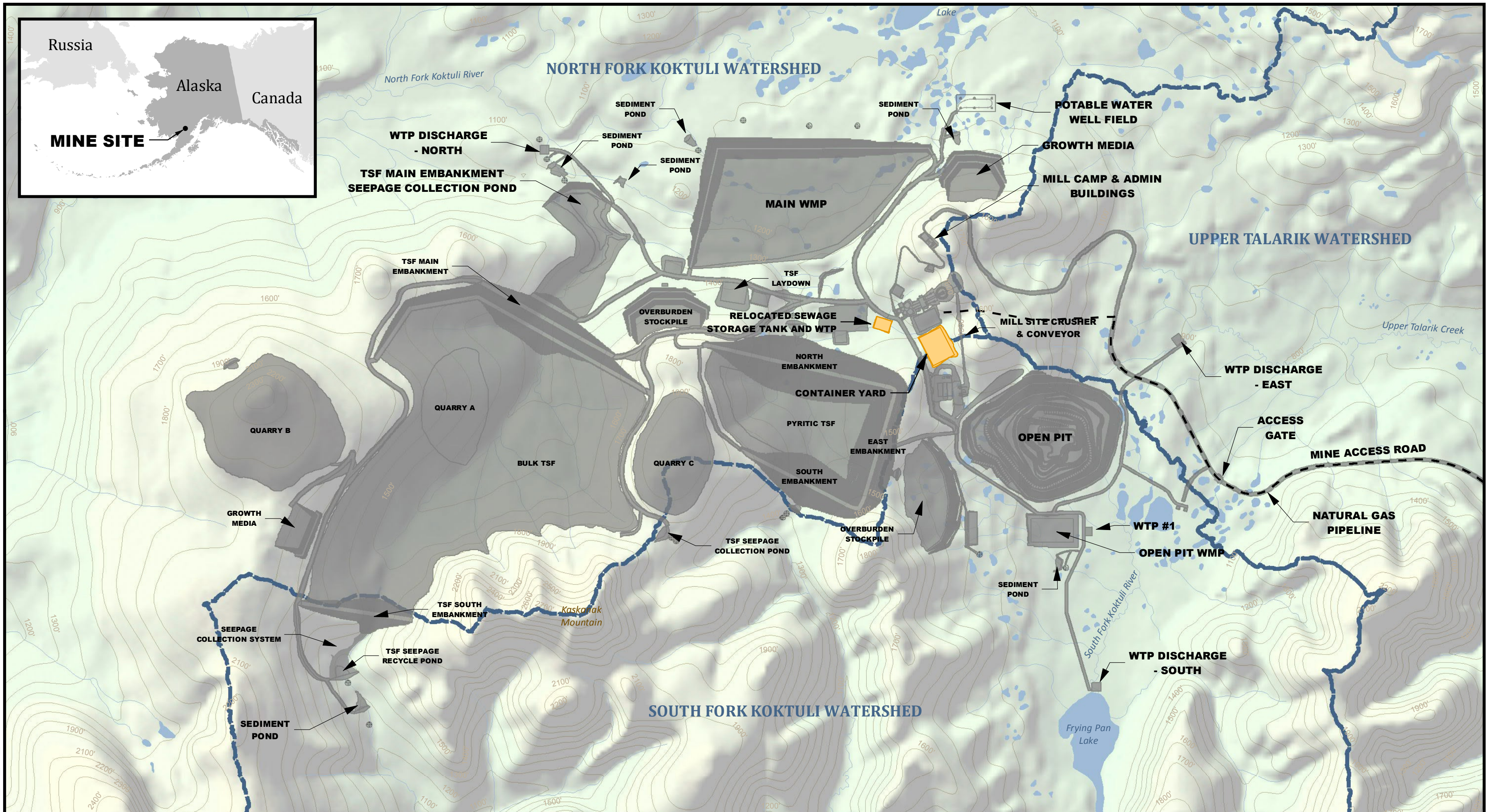
2.2.2.5 Action Alternative 1 – Summer-Only Ferry Operations Variant

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 (container yard: 38 acres) (PLP 2018-RFI 065). The sewage tank pad would be relocated to provide space for the additional laydown space in proximity to the mill (less than 0.5-acre increase). See Figure 2-39 for 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 Action 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.



Sources: PLP 2018-RFI-065; 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

Action Alternative 1 Variant

- Summer-Only Ferry Operations Mine Site Arrangements

Action Alternative 1

- Monitoring Wells
- Natural Gas Pipeline
- Mine Site Footprint

Other Features

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

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

PEBBLE PROJECT EIS

FIGURE 2-39

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 making two trips per day on average would be necessary; or possibly two ferries making one trip per day each on average.

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 78 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 onsite, 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). See Figure 2-40, which shows the concentrate storage yard at Amakdedori port.

2.2.2.6 Action Alternative 1 – Kokhanok East Ferry Terminal Variant

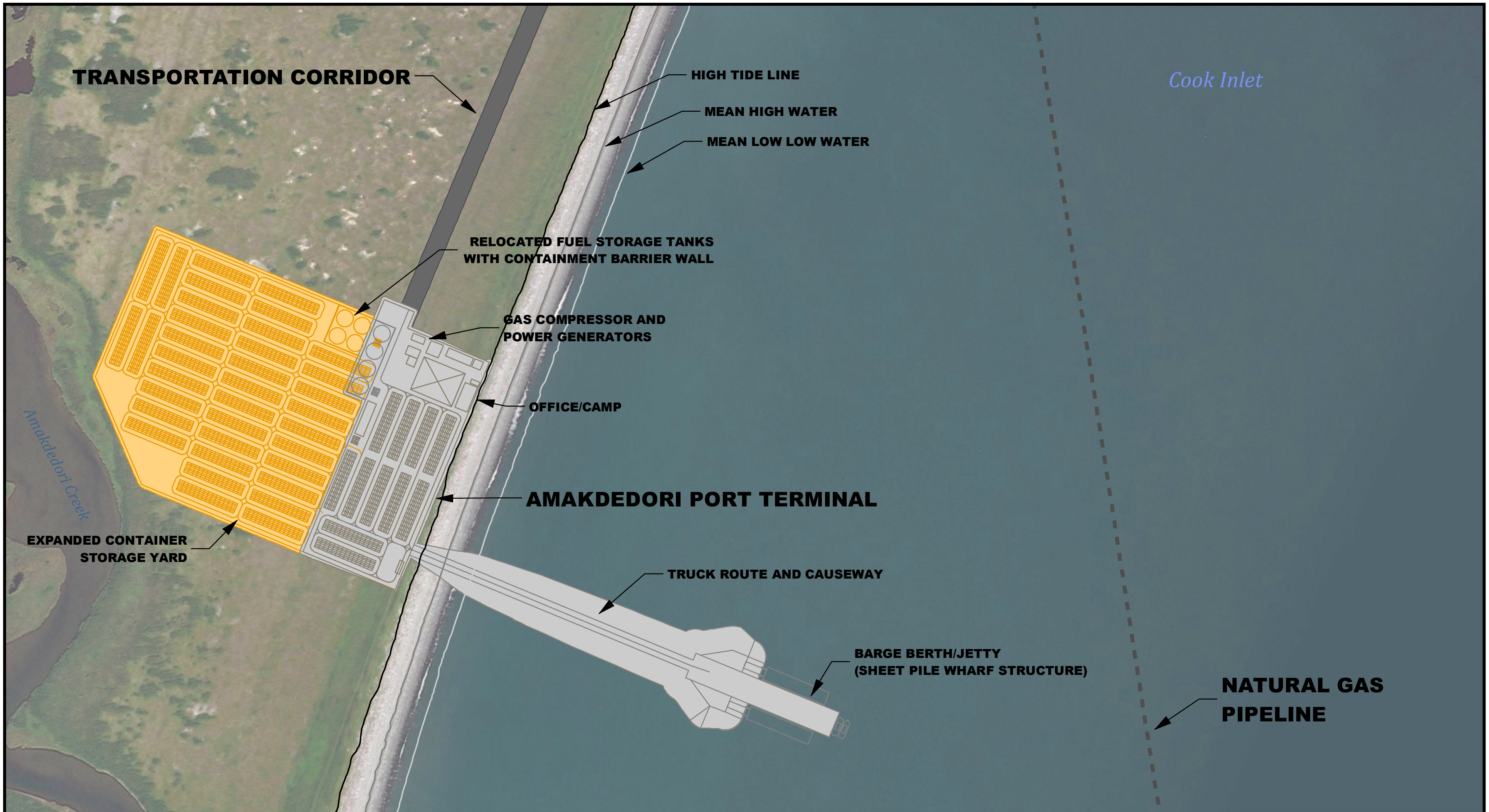
Evaluation of alternative ferry terminal locations was suggested during scoping. This variant considers an alternate south ferry terminal site east of Kokhanok: the Kokhanok east ferry terminal site (see Figure 2-41). Changes to the transportation corridor and natural gas pipeline components with incorporation of this variant are described below. This variant does not involve changes to the mine site and port components.

Transportation Corridor

The ferry would cross to one ferry terminal site variant (PLP 2018-RFI 078), the Kokhanok east ferry terminal site (15 acres). The layout of Kokhanok east ferry terminal would be similar to the Kokhanok west ferry terminal (see Figure 2-42). The one-way ferry trip is about 27 miles and would take approximately 4.5 hours to complete in ice conditions, or 2.25 hours in open water. On average, one round trip per day across the lake would be required.

The transportation corridor access roads with incorporation of this variant are as follows (see Figure 2-41):

- Mine access road (346 acres): A private, unpaved, two-lane road extending approximately 29 miles south from the mine site to a ferry terminal on the northern shore of Iliamna Lake (includes a short spur near the mine site near UTC) (same as Alternative 1 base case).
- Port access road (298 acres): A private, unpaved, two-lane road extending approximately 27 miles southeast from the Kokhanok east ferry terminal to Amakdedori port on Cook Inlet.



Sources: PLP 2018-RFI-065

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

US Army Corps of Engineers

200 0 200 400

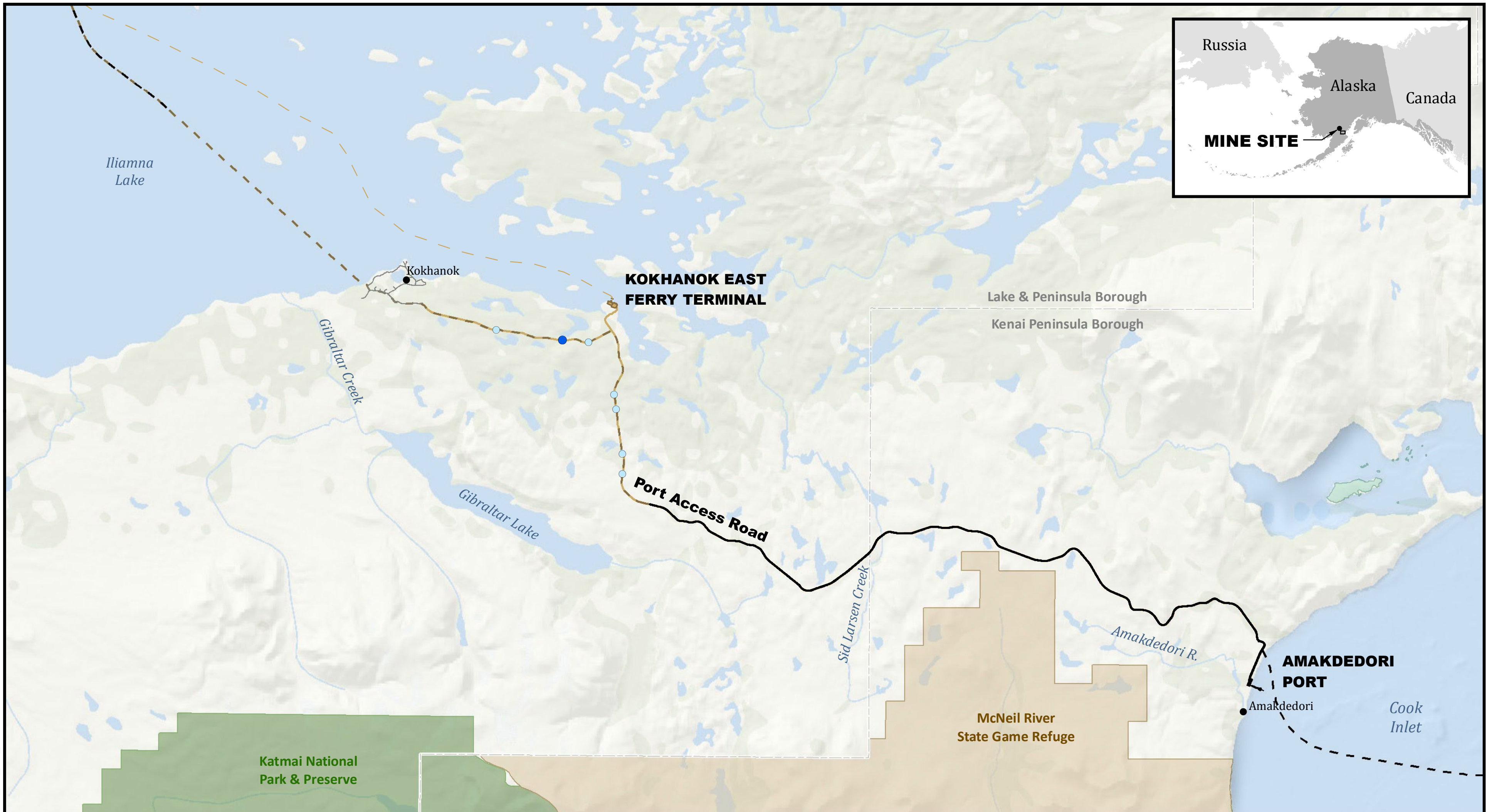
Feet

Action Alternative 1 Variant
- Summer-Only Ferry Operations Amakdedori Port

Action Alternative 1
- Amakdedori Port
- Transportation Corridor
- Natural Gas Pipeline

WaterLevelName
- High Tide Line
- Mean High Water
- Mean Low Low Water

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



Sources: PLP 2018-RFI-078; ADNR

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

US Army Corps of Engineers

2 0 2 4

Miles

Action Alternative 1 Kokhanok East Variant

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

Action Alternative 1

- Transportation Corridor
- Natural Gas Pipeline

Other Features

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

ACTION ALTERNATIVE 1 - KOKHANOK EAST FERRY TERMINAL VARIANT

Sources: PLP 2018-RFI-078
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers®

Action Alternative 1 Kokhanok East Variant — Ordinary High Water

Ferry Terminal

ACTION ALTERNATIVE 1 - KOKHANOK EAST VARIANT - FERRY TERMINAL LAYOUT

A separate spur road (approximately 5 miles and 66 acres), would connect the port access road to the community of Kokhanok.

The port access road to the Kokhanok east ferry terminal site would not require a crossing of the Gibraltar River and would also have less overall stream crossings. Alternative 1 access roads with incorporation of this variant would include seven bridges, five of which would be single-span, two-lane bridges that range in length from approximately 40 to 125 feet. There would be two multi-span, two-lane bridges: one at Sid Larsen Creek (160 feet), and the other at Newhalen River (575 feet). There would be approximately 78 culverts; of these, 33 would be designed as fish passage culverts. Typical bridge and culvert designs would be the same as described above for Action Alternative 1. The exact number and design of waterbody crossings would be determined during final design and permitting.

Incorporation of this variant would result in a total of up to 18 material sites (up to 349 acres) for construction and maintenance of access roads and the natural gas pipeline for Action Alternative 1. Appendix K2 provides information for each material site, including the estimated quantities, size, type of material, use of material, and if blasting is required. Figures in Appendix K2 show the location of material sites proposed for Action Alternative 1 – Kokhanok East Ferry Terminal Variant. 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 7.4 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 the Action Alternative 1 – Kokhanok East Ferry Terminal Variant. 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 proposed for Action Alternative 1 – Kokhanok East Ferry Terminal Variant. The proposed annual volume of water that would be extracted for all water extraction sites with incorporation of 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 Action Alternative 1 base case.

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 2-41). 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 Action Alternative 1.

2.2.2.7 Action 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. See Figure 2-43 for 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. All piles would be 48 inches in diameter, with a 1.5-inch wall thickness. The piles would be vibrated into place and then driven to refusal with an impact hammer. The total port footprint would be approximately 19 acres, and the footprint of pilings would be approximately 3,200 square feet. Other than pilings, no in-water fill material would be placed below mean high water of Cook Inlet with this variant. All other facilities and operations at the port would be the same as described for Action Alternative 1.

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

2.2.3 Action Alternative 2 – North Road and Ferry with Downstream Dams

This section summarizes Action Alternative 2 – North Road and Ferry with Downstream Dams (Action Alternative 2). 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.

Action Alternative 2 considers: 1) downstream construction methods for the north bulk TSF embankment; 2) an alternate transportation corridor route (access roads and ferry) on the north end of Iliamna Lake; 3) an alternate port site at Diamond Point; and 4) an alternate natural gas pipeline alignment on the northern end of Iliamna Lake (see Figure 2-1 and Figure 2-44). Appendix K2 provides a summary of the Action 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.

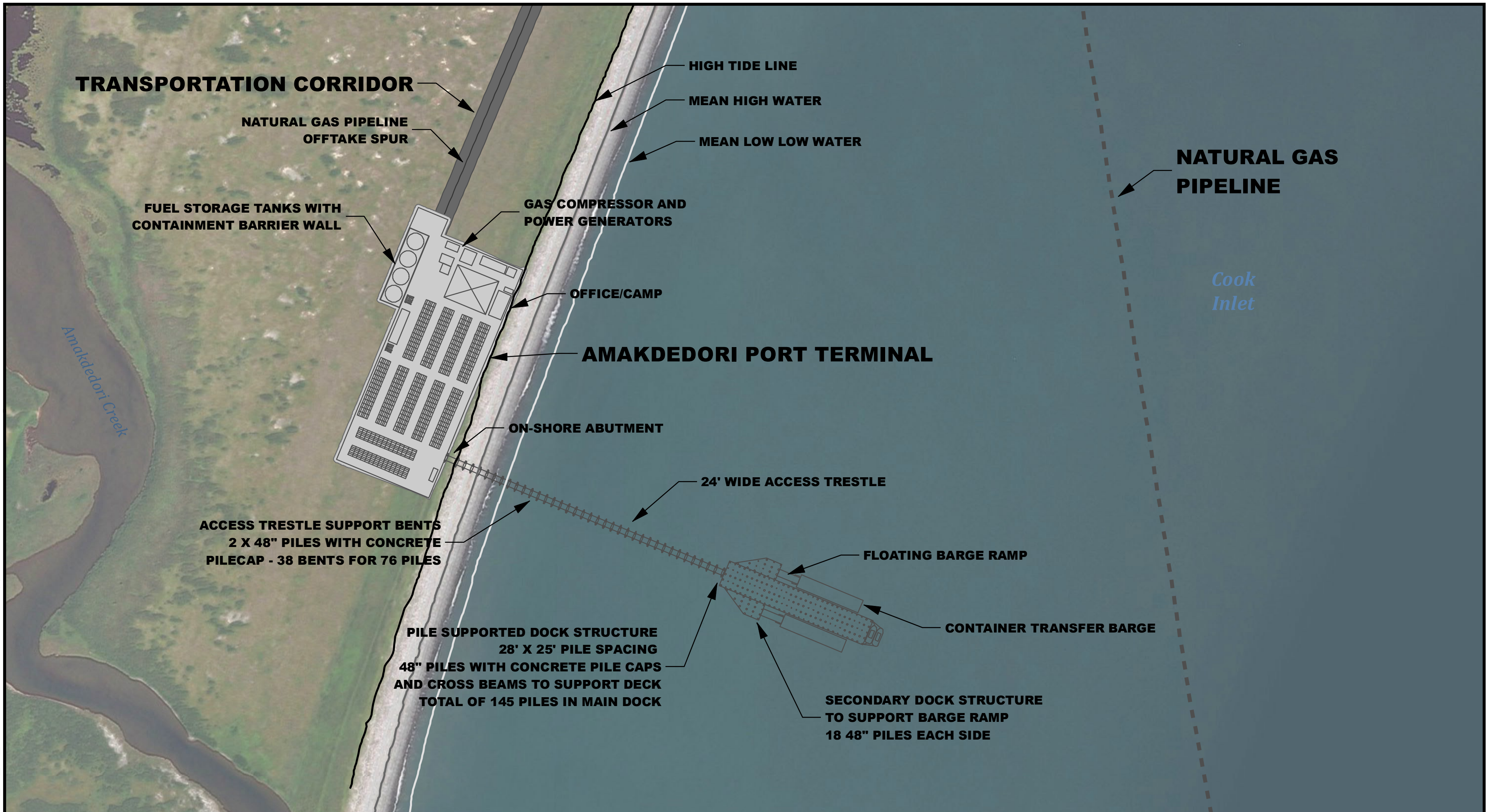
2.2.3.1 Mine Site

The mine site layout and processes under Action Alternative 2 (Figure 2-45) would be the same as Action Alternative 1, with the exception of the construction methods for the north embankment of the bulk TSF. Under Action Alternative 2, the north bulk TSF embankment would be constructed using the downstream method with buttresses, instead of the centerline method proposed under Action Alternative 1. There would also be minor adjustments to the infield access roads to accommodate the bulk TSF design. The overall mine site footprint for Action Alternative 2 would be 8,241 acres.

Under this alternative, the overall 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. The embankment fill would increase from 78 million to 124 million yd^3, and the impoundment footprint area would increase by 162 acres (PLP 2018-RFI 075a; see Figure 2-46 and Figure 2-47).

2.2.3.2 Transportation Corridor

The transportation corridor under Action Alternative 2 would connect the mine site to the Diamond Point port in Iliamna Bay (Figure 2-48). It has three main components:



Sources: PLP 2018-RFI-072
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers®

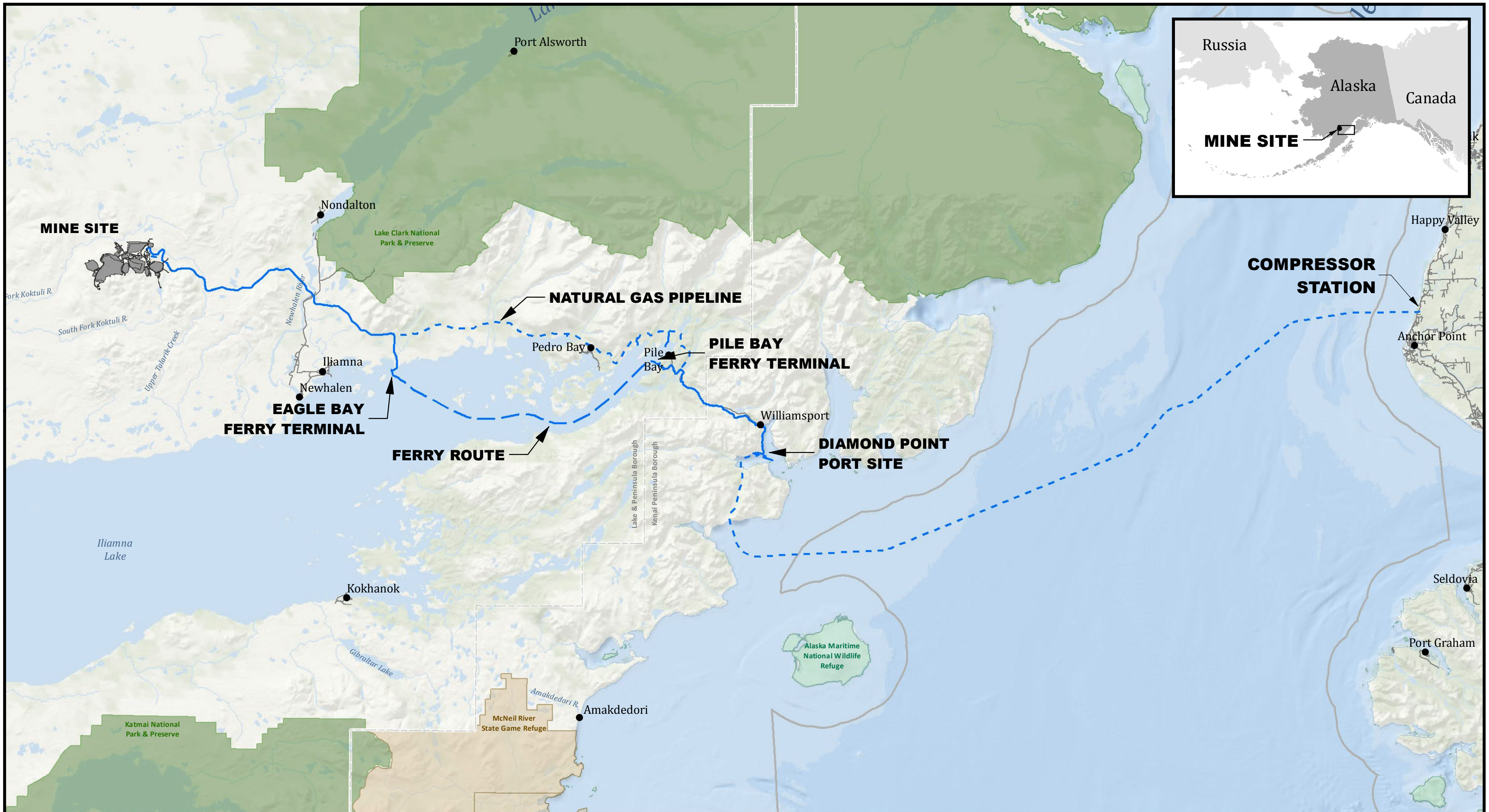
200 0 200 400
Feet

Action Alternative 1 Pile-Supported Dock Variant
Amakdedori Port

Action Alternative 1
Transportation Corridor
Natural Gas Pipeline

High Tide Line
Mean High Water
Mean Low Low Water

ACTION ALTERNATIVE 1 - AMAKDEDORI PORT PILE-SUPPORTED DOCK VARIANT



Sources: PLP 2018; ADNR

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

US Army Corps of Engineers

5 0 5 10

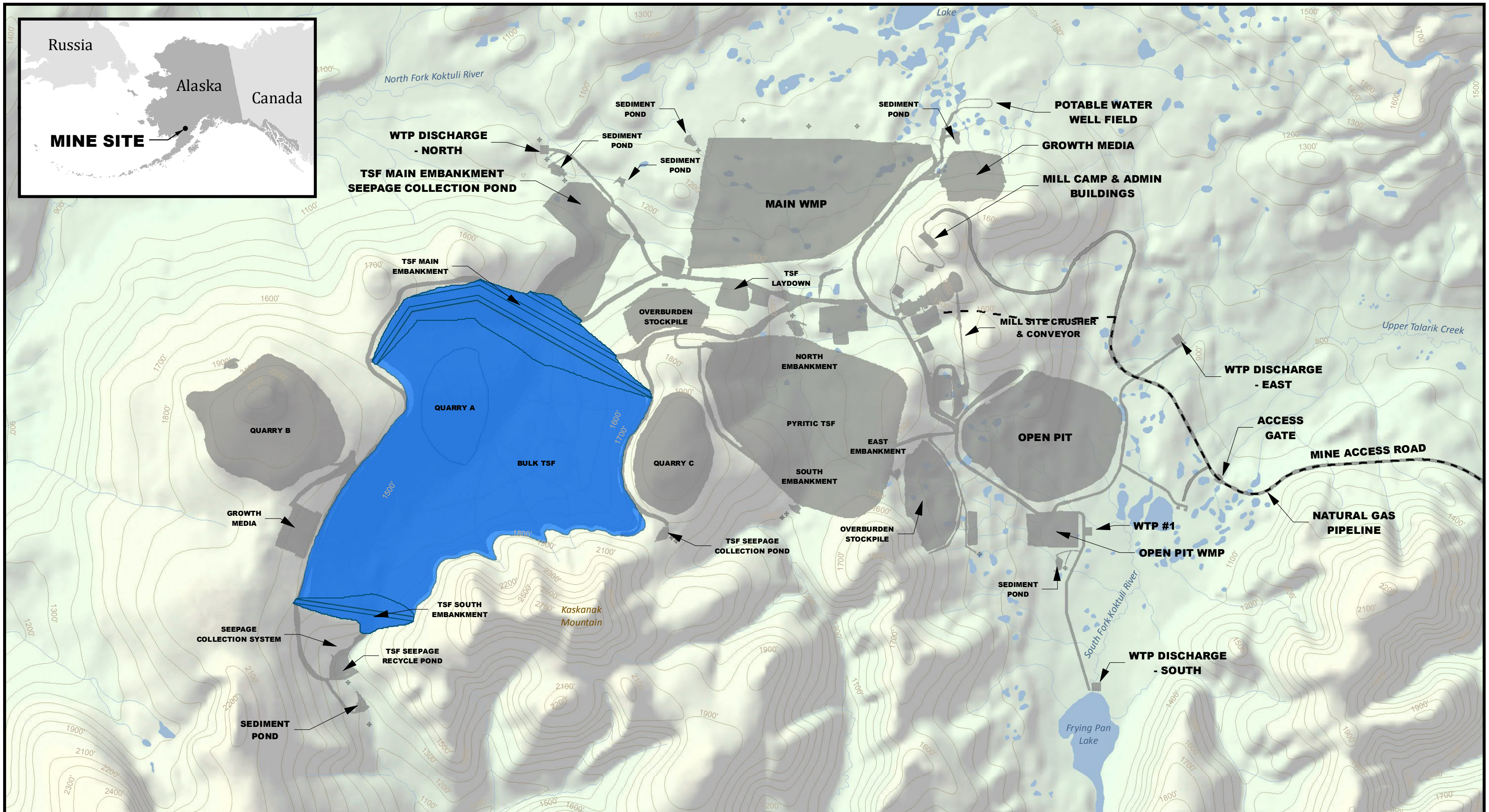
Miles

Action Alternative 2	Action Alternative 1	Other Features	
Transportation Corridor	Mine Site	Local Roads	National Park
Ferry Route		Borough Boundary	National Wildlife Refuge
Natural Gas Pipeline		Three Nautical Mile Line	State Game Refuge/Sanctuary

ACTION ALTERNATIVE 2 - GENERAL PROJECT LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-44



Sources: PLP 2018-RFI-065, 2018-RFI-075a; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

0.5 0 0.5 1
Miles

Action Alternative 2
- Bulk TSF Downstream

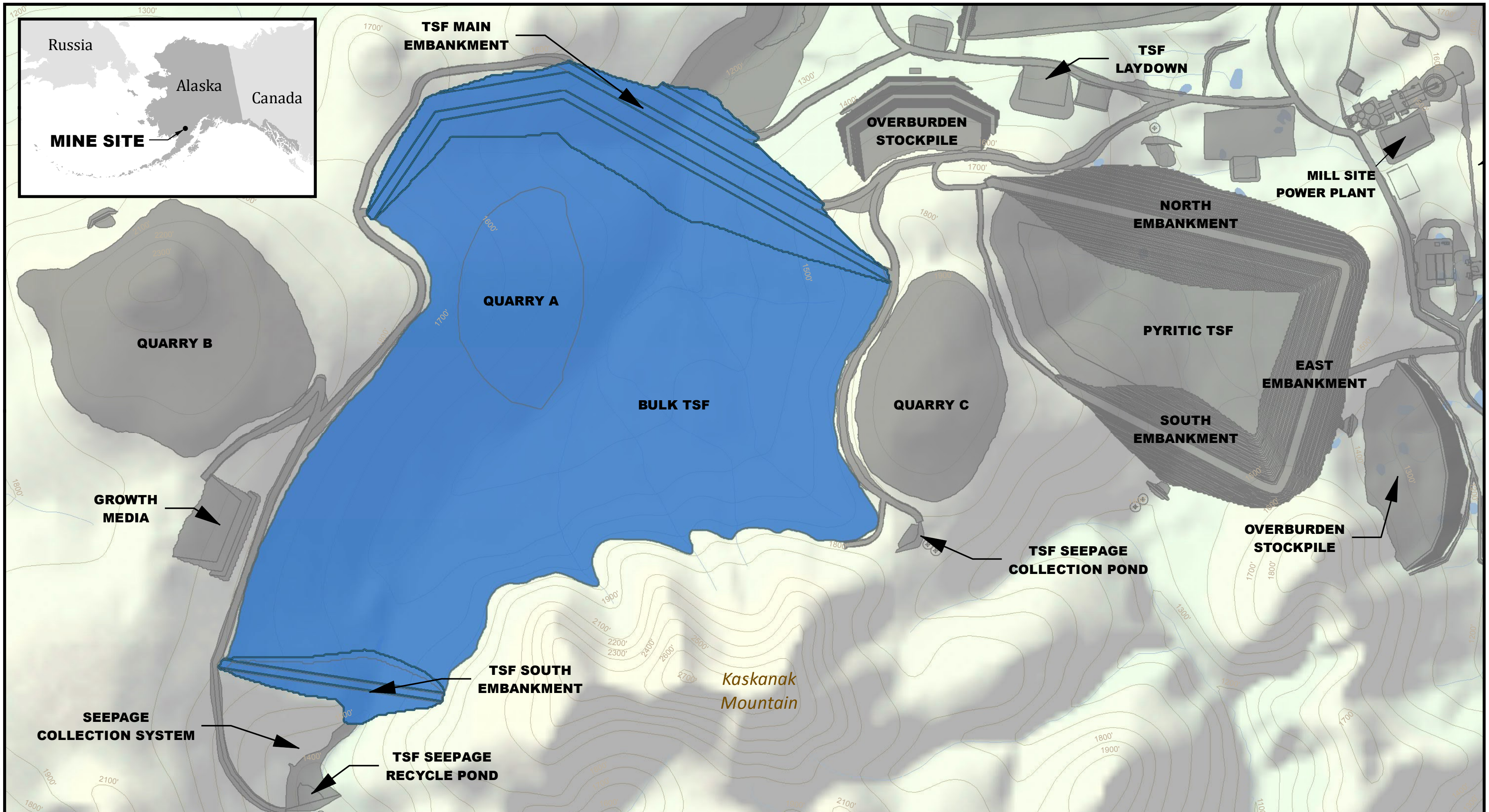
Action Alternative 1
- Monitoring Wells
- Natural Gas Pipeline
- Mine Site Footprint

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

ACTION ALTERNATIVE 2 - MINE SITE LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-45



Sources: PLP 2018-RFI-075a
Note: The displayed features are the permanent footprint unless otherwise specified.

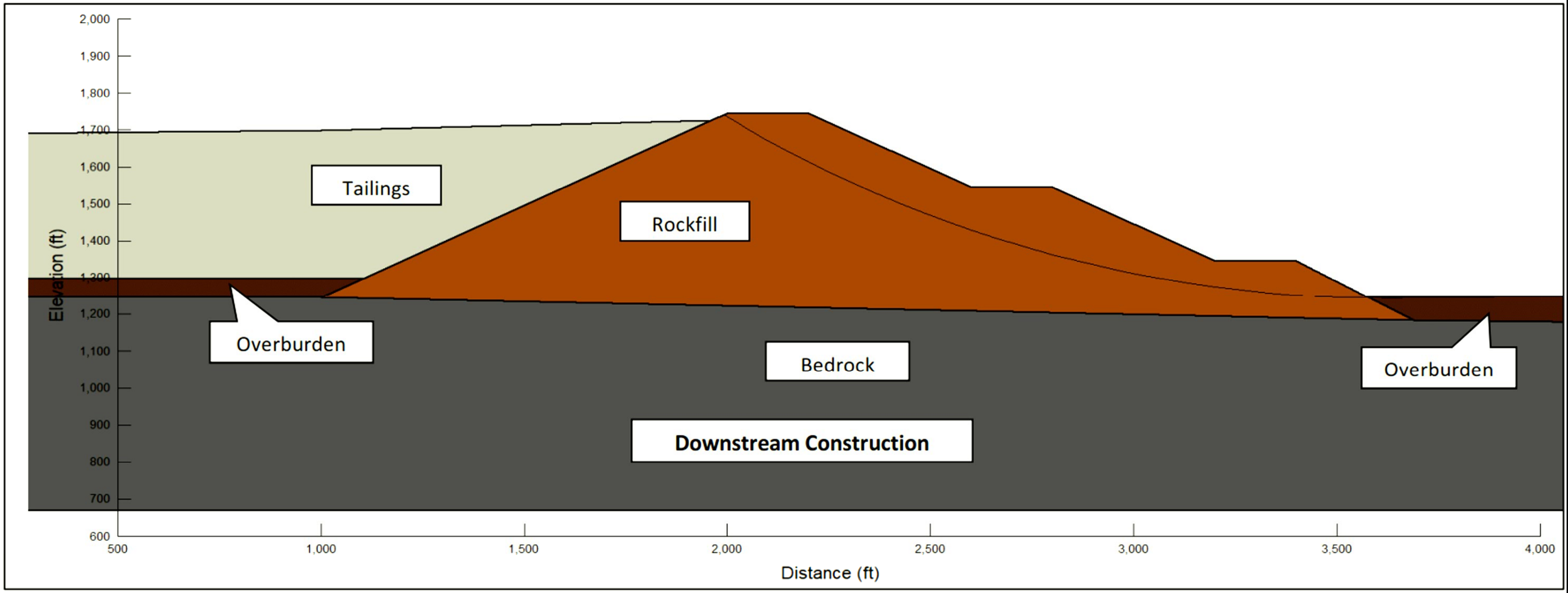
US Army Corps of Engineers®

1,000 0 1,000 2,000
Feet

Action Alternative 2
- Monitoring Wells
- Bulk TSF Downstream
- Mine Site Footprint

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

ACTION ALTERNATIVE 2 - BULK TSF LAYOUT



NOTES:

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

Sources: PLP 2018-RFI-075a

US Army Corps of Engineers®

ACTION ALTERNATIVE 2 - BULK TSF NORTH EMBANKMENT CROSS SECTION

Sources: PLP 2018; ADNR

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

US Army Corps of Engineers

5 0 5 10

Miles

Action Alternative 2

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

Other Features

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

ACTION ALTERNATIVE 2 - TRANSPORTATION FACILITIES OVERVIEW

PEBBLE PROJECT EIS

FIGURE 2-48

- Mine access road (505 acres): A private, unpaved two-lane road extending 35 miles east from the mine site to a ferry terminal on the northern shore of Iliamna Lake at Eagle Bay (see Figure 2-49).
- 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 (see Figure 2-50).

This corridor would act as the main access route to and from the mine for the transportation of materials, equipment, and concentrate. The ferry, truck transportation, and the Diamond Point port would operate year-round. The general descriptions for temporary facilities, transportation corridor traffic, and material transport, and physical reclamation and closure, would be the same as Action Alternative 1 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 Action Alternative 1. 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 main access road design would be the same as Action Alternative 1—a 30-foot-wide gravel road 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 corridor would be north of Iliamna Lake, where it would connect with the existing Williamsport-Pile Bay Road in the vicinity of Pile Bay, and then continue to the Diamond Point port site on Cook Inlet. The road would bypass all but 5 miles of the existing Williamsport-Pile Bay Road.

Action Alternative 2 road system would include seven bridges that range in length from approximately 55 to 625 feet, and approximately 39 culverts (18 of which would be designed as fish passage culverts). Typical bridge and culvert designs would be the same as described for Action Alternative 1. The exact number and design of waterbody crossings would be determined during final design and permitting.

Ferry

The ferry vessel design and operations would be year-round, the same as Action Alternative 1 but would have different ferry terminals. The north shore ferry terminal (7 acres) would be at Eagle Bay (Eagle Bay ferry terminal) and would have a similar layout, facilities, and operations as Alternative 1. 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; see Figure 2-51).

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

Sources: PLP 2018; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

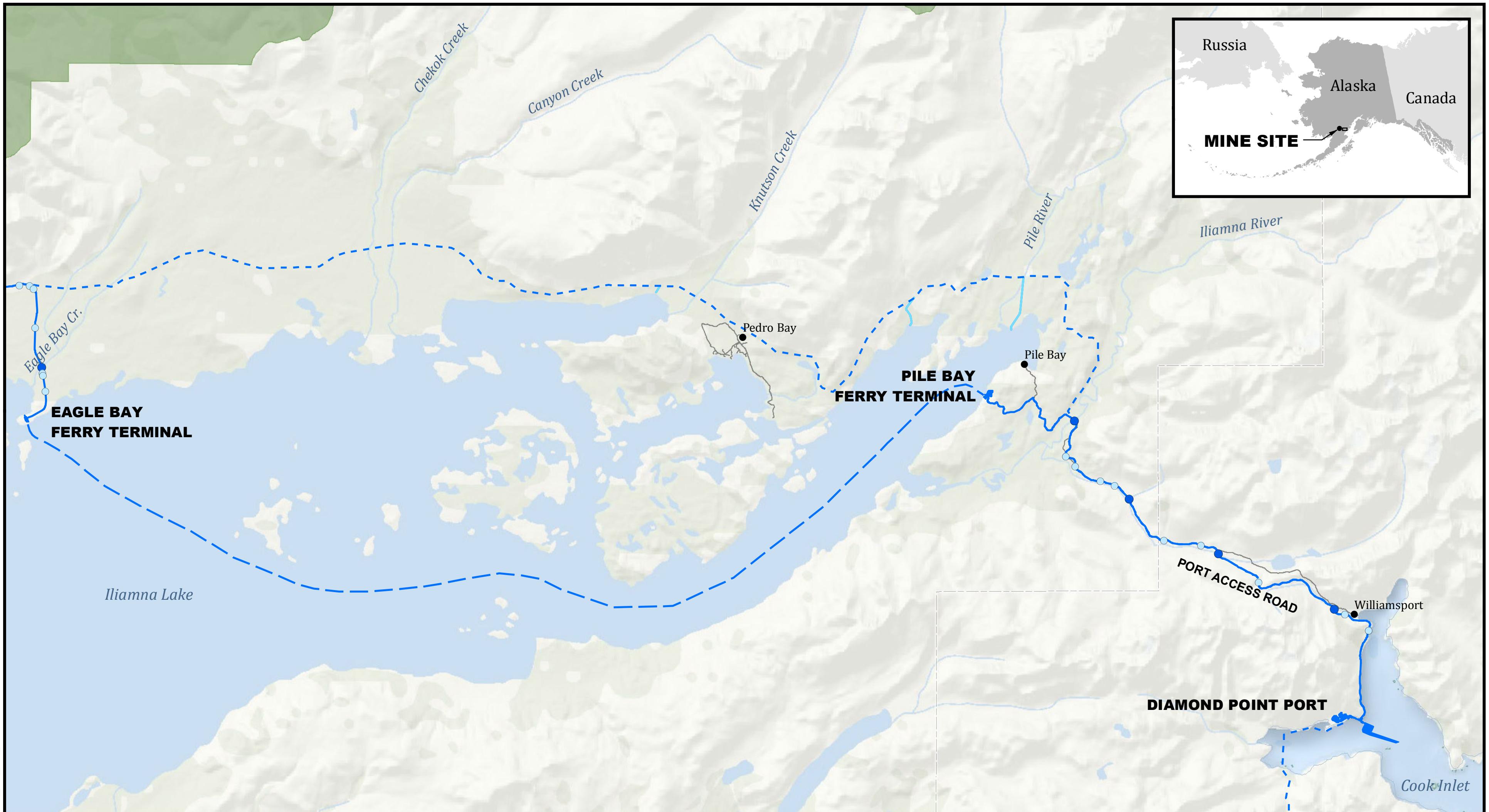
US Army Corps of Engineers

2 0 2 4
Miles

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

Other Features
- Local Roads
- National Park

ACTION ALTERNATIVE 2 - MINE ACCESS ROAD



Sources: PLP 2018; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

2 0 2 4
Miles

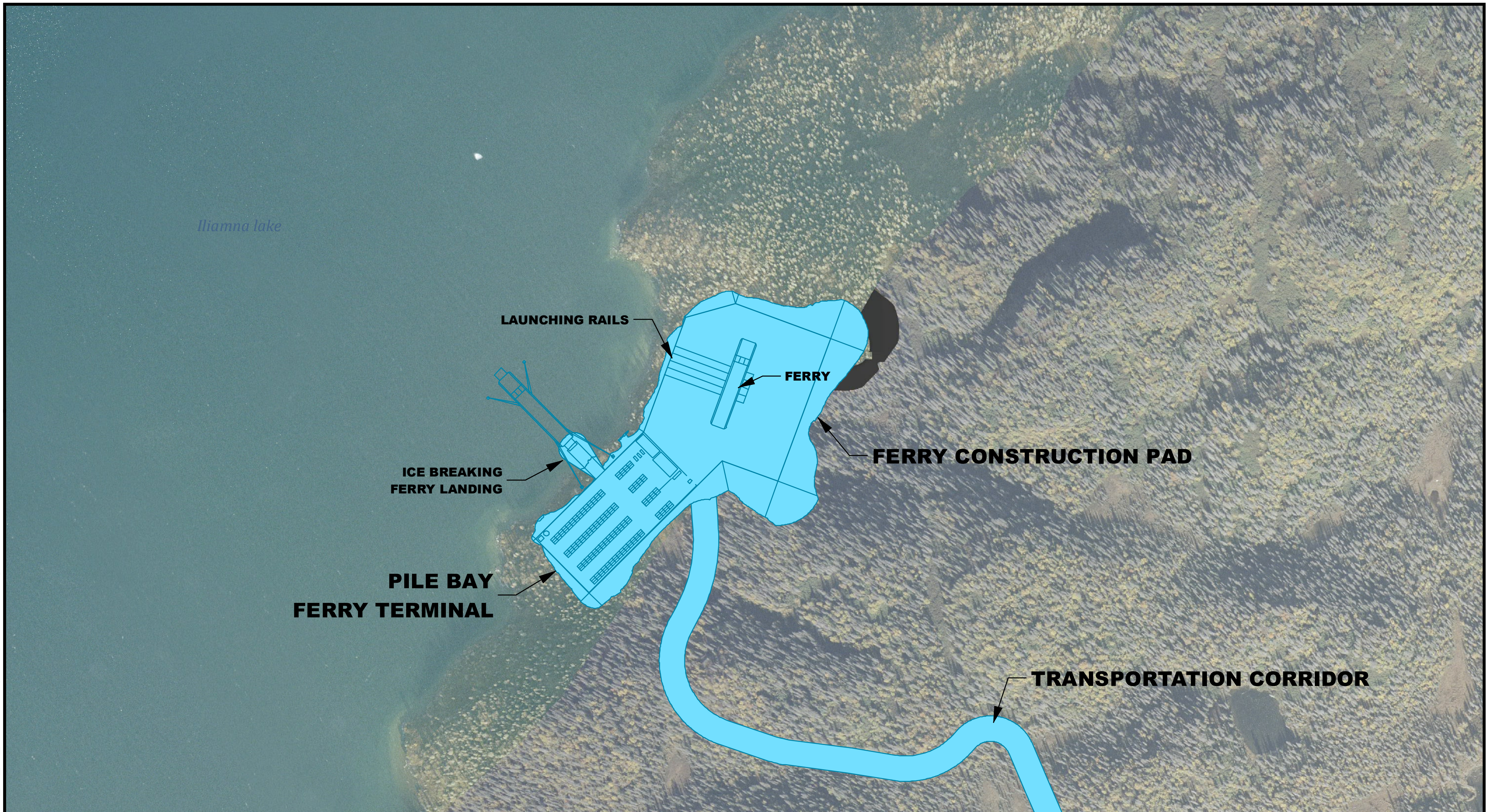
Action Alternative 2
- Bridge
- Culvert
- Transportation Corridor
- Ferry Route
- Natural Gas Pipeline
- Pipeline Construction Access

Other Features
- Local Roads
- Borough Boundary
- National Park

ACTION ALTERNATIVE 2 - PORT ACCESS ROAD

PEBBLE PROJECT EIS

FIGURE 2-50



Sources: PLP 2018-RFI-080

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

US Army Corps of Engineers

200 0 200 400

Feet

Action Alternative 2

Ferry Terminal

ACTION ALTERNATIVE 2 - PILE BAY FERRY TERMINAL LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-51

Material Sites

Construction materials would be excavated from material sites along the transportation corridor. An estimate of up to 16 material sites (up to 422 acres) would be required for construction and maintenance of access roads and the natural gas pipeline for Action Alternative 2. Appendix K2 provides information for each material site, including the estimated quantities, size, type of material, use of material, and if blasting is required. Figures in Appendix K2 show the location of material sites identified for Action Alternative 2. 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 6.2 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 seven potential water extraction sites have been identified to support project construction and operations of Action Alternative 2. 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 Action Alternative 2. The estimated annual volume of water that would be extracted for all water extraction sites is 132 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 Action 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 about 1 acre total.

Temporary Facilities and Initial Site Access

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

Transportation Corridor Traffic and Materials/Personnel Transport

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

For personnel transport under Action 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.

2.2.3.3 Diamond Point Port and Lightering Locations

Action 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 Action Alternative 1 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

Action Alternative 2 includes construction of Diamond Point port (112 acres), a new year-round port at Iliamna Bay (Figure 2-52). 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 (25 acres) would include separate facilities for the 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 sufficient to address tidal surge from major storms and potential tsunamis.

The marine facilities (14 acres) would be similar to the Amakdedori port design under Action 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 2-53 shows a digital simulation of the Diamond Point port. Approximately 1,800 linear feet of sheetpile would be installed. A floating ramp would extend down from the 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. Navigation buoys would not be necessary at the Diamond Point port site.

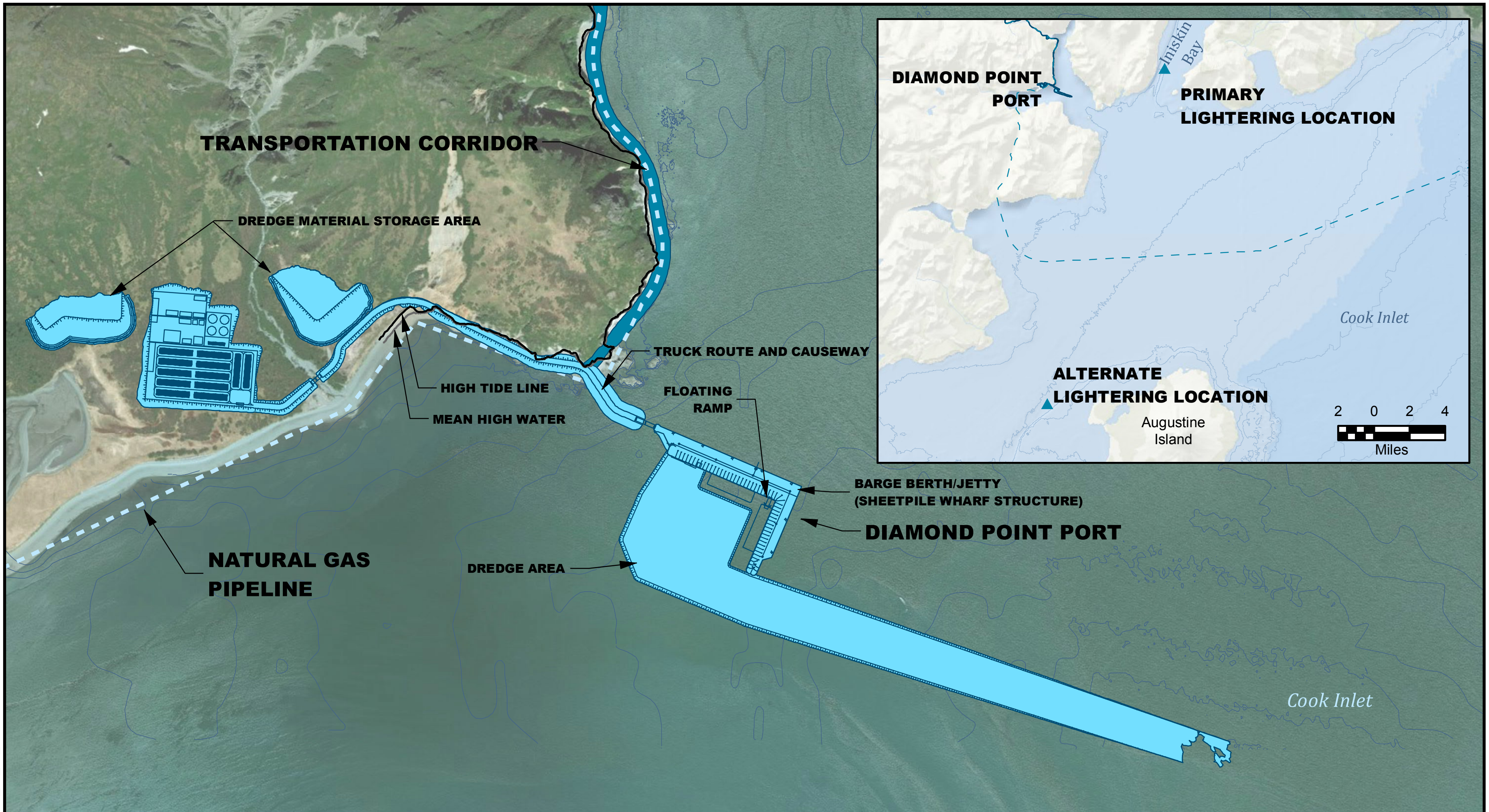
The shallow approach at this port site would require dredging to -20 feet MLLW to ensure year-round access by vessels requiring 15-foot water depth. Dredged channels are prone to sedimentation; therefore, over-dredging would reduce the frequency of maintenance dredging. The frequency of required maintenance 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 onshore in two bermed facilities (16 acres) 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 and would be permitted and treated, as required, to all meet applicable state and federal regulations.

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 2-52). 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 2-52 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 Action Alternative 1.



Sources: PLP 2018-RFI-081
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

500 0 500 1,000
Feet

Action Alternative 2
- Lightering Location
- Natural Gas Pipeline
- Diamond Point Port
- Transportation Corridor
- High Tide Line
- Mean High Water
- Bathymetric Contour (2ft)

ACTION ALTERNATIVE 2 - DIAMOND POINT PORT AND LIGHTERING LOCATIONS

Sources: PLP 2018

US Army Corps of Engineers®

ACTION ALTERNATIVE 2 - DIGITAL SIMULATION OF DIAMOND POINT PORT

PEBBLE PROJECT EIS

FIGURE 2-53

2.2.3.4 Natural Gas Pipeline Corridor

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

Natural Gas Pipeline Corridor and Ancillary Facilities

Natural gas would be supplied to Diamond Point port and the mine site by pipeline (164 miles) (Figure 2-54). 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 Action Alternative 1.

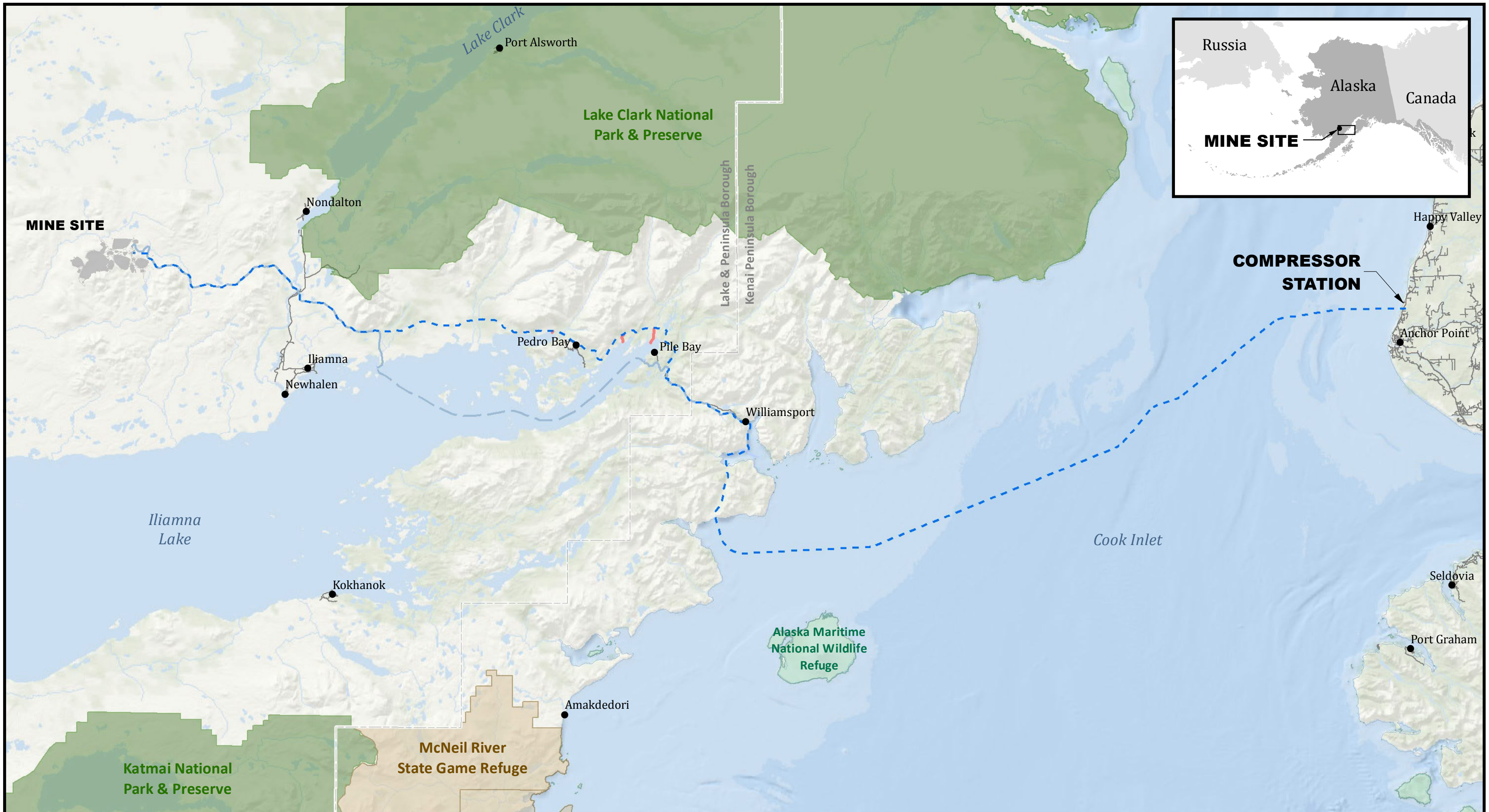
The pipeline across Cook Inlet (75 miles) would be constructed as described for Alternative 1, but the alignment would come ashore at Ursus Cove. The temporary construction corridor for the Cook Inlet crossing would be the same as described for Action Alternative 1.

From Ursus Cove, the pipeline would be routed north, running overland to Cottonwood Bay. A 150-foot temporary construction ROW is proposed to allow for adjustment of the final route to suit terrain. Access for construction would be by barge landings from each end of the ROW. The ROW would be reduced to a 50-foot permanent operations ROW following completion of pipeline construction. 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.

From Diamond Point port, the pipeline would be buried in a trench that follows the general Action Alternative 3 north access road alignment (described below) with minor deviations. For segments that follow the Action Alternative 2 access road alignment, the pipeline would be buried in a trench adjacent to the road (see Figure 2-16). For 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. Three construction access points would be required (see Figure 2-54) and would be reclaimed after construction. See Figure 2-55 for 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 stand-alone segments would use trenching or HDD to cross streams (see Figure 2-37 and Figure 2-38).

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 306 acres) would be required for construction of stand-alone segments of the pipeline for Alternative 2. Appendix K2 provides information for each material site, including the estimated quantities, size, type of material, use of material, and if blasting is required. Figures in Appendix K2 show the location of material sites identified for Action Alternative 2. 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 2.2 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.



Sources: PLP 2018; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers®

N

5 0 5 10
Miles

Action Alternative 2
- Natural Gas Pipeline
- Construction Access
- Transportation Corridor
- Mine Site

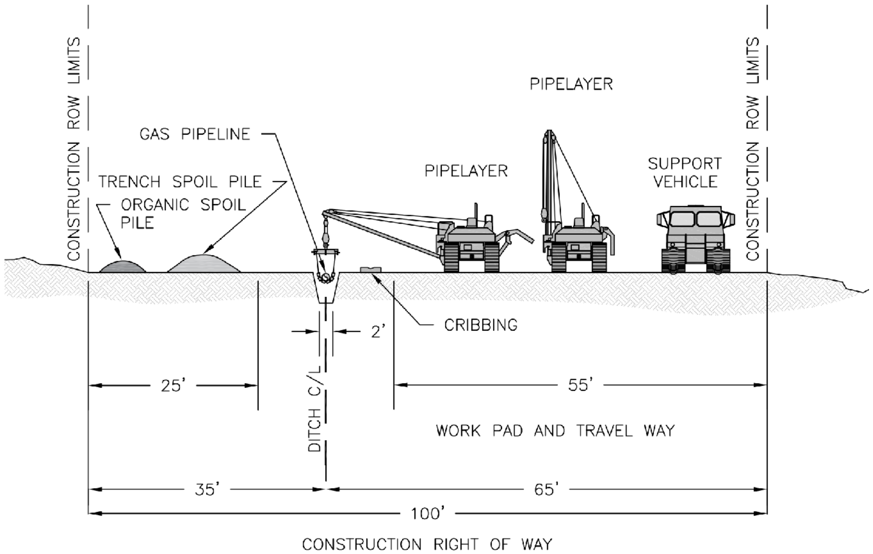
Other Features
- Local Roads
- Borough Boundary

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

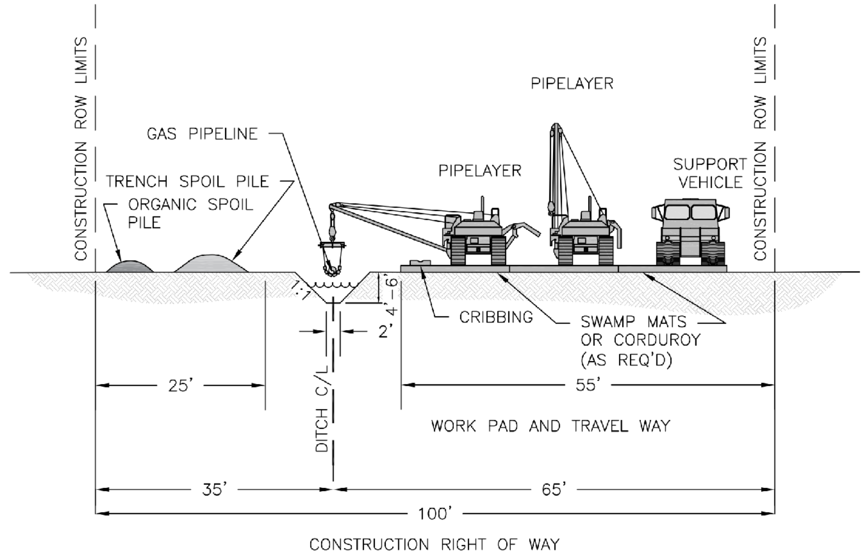
ACTION ALTERNATIVE 2 - NATURAL GAS PIPELINE ALIGNMENT

PEBBLE PROJECT EIS

FIGURE 2-54



Typical Uplands Section



Typical Wetlands Section

Sources: PLP 2018

US Army Corps of Engineers®

ACTION ALTERNATIVE 2 - NATURAL GAS PIPELINE TYPICAL SECTION FOR PIPELINE SEGMENTS NOT ADJACENT TO ACCESS ROAD

In addition to pressure monitoring and automated lead 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).

2.2.3.5 Action Alternative 2 – Summer-Only Ferry Operations Variant

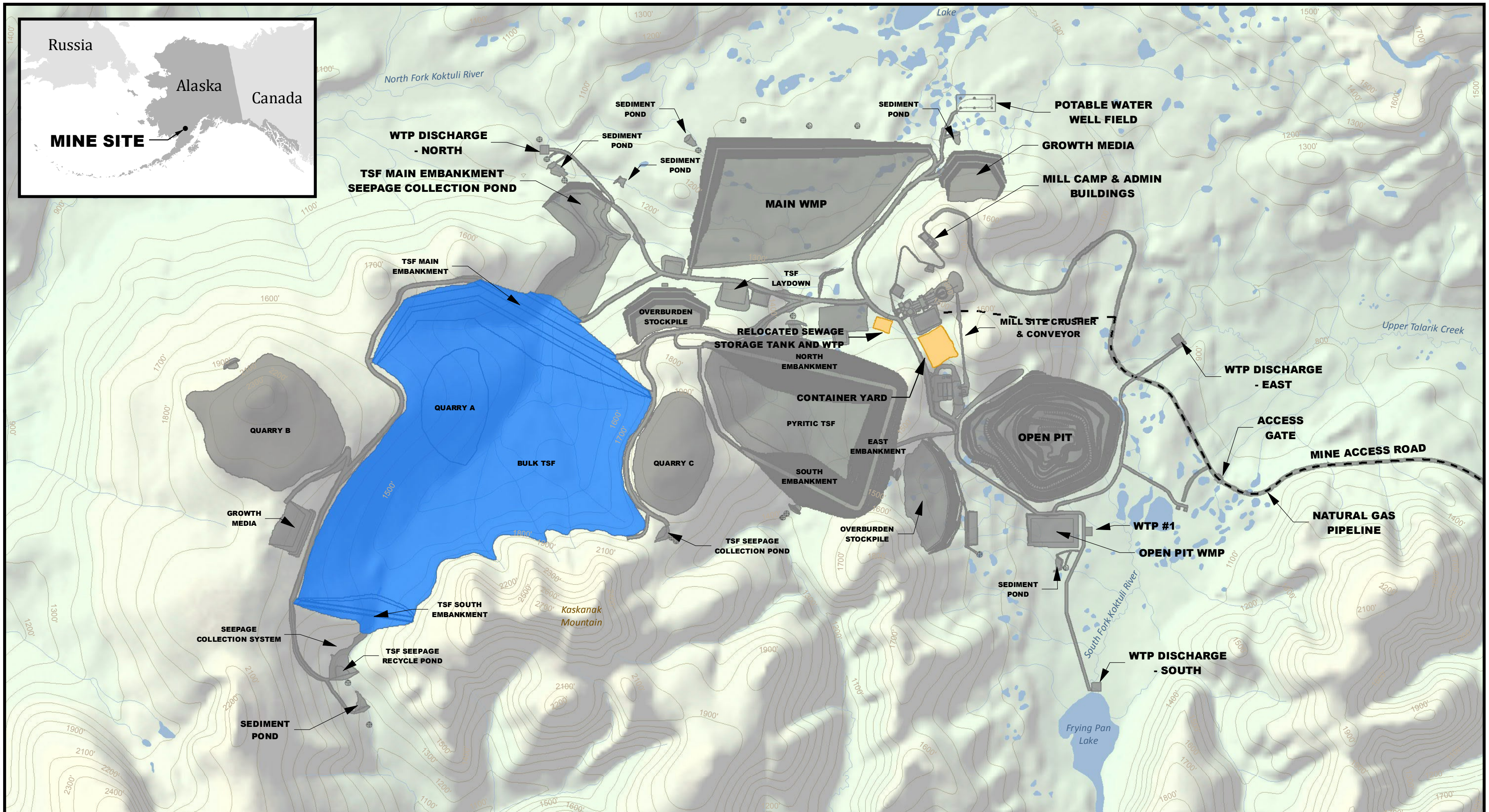
An option to restrict ferry operations to the open water season was suggested during scoping due to concerns with use of an ice-breaking ferry. With this variant, concentrate shipping at the Diamond Point port using lightering and bulk freighters would continue per the year-round schedule even though 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 Action 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 Action Alternative 1 – Summer-Only Ferry Operations Variant (see “Action Alternative 1 – Summer-Only Ferry Operations Variant” section above). Additional storage during the non-operating months of the ferry would be needed for concentrate, consumables, reagents, and diesel. The Action Alternative 2 mine site footprint would increase as a result of an additional container yard (38 acres) and the relocated sewage tank pad (less than 0.5 acre). See Figure 2-56, which shows the Action 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 Action Alternative 1 – Summer-Only Ferry Operations Variant (see “Action Alternative 1 – Summer-Only Ferry Operations Variant” section above). The only difference is that the Action 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 2-57 shows the container yard along the Action Alternative 2 transportation corridor.



Sources: PLP 2018-RFI-065, 2018-RFI-075a; 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

Action Alternative 2 Variant

Summer-Only Ferry Operations Mine Site Arrangements

Action Alternative 2

Monitoring Wells

Natural Gas Pipeline

Mine Site Footprint

Bulk TSF Downstream

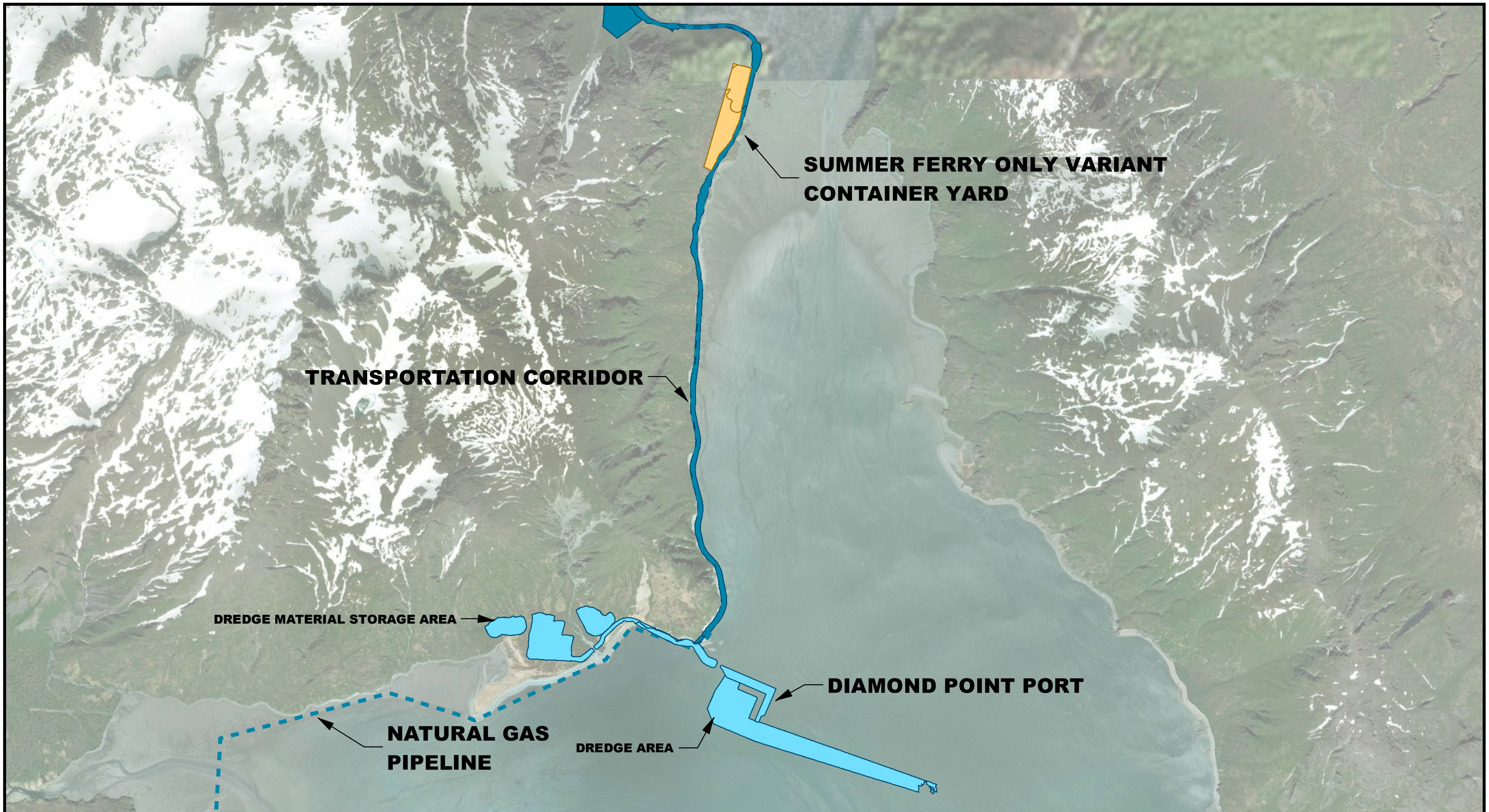
Other Features

River/Stream

Lake/Pond

100' Contour (Existing)

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



Sources: PLP 2018-RFI-065

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

US Army Corps of Engineers®

1,000 0 1,000 2,000

Feet

Action Alternative 2 Variant

Summer-Only Ferry Operations Diamond Point Container Storage Yard

Action Alternative 2

Diamond Point Port

Transportation Corridor

Natural Gas Pipeline

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

2.2.3.6 Action 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. See Figure 2-58 for 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. All piles would be 48 inches in diameter, with a 1.5-inch wall thickness. The piles would be vibrated into place and then driven to refusal with an impact hammer. Dredging would be the same as described for Alternative 2. The total port footprint with this variant would be approximately 101 acres, including the dredge area and onshore dredge material storage area. The footprint of pilings would be approximately 6,500 square feet. Fill placed below mean high water of Cook Inlet would be reduced with this variant.

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

2.2.4 Action Alternative 3 – North Road Only

This section summarizes Action Alternative 3 – North Road Only (Action Alternative 3). 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. Appendix K2 provides a summary of the Action 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.

Action Alternative 3 considers: 1) the same mine site layout and processes as Action Alternative 1; 2) an alternate transportation corridor route on the northern end of Iliamna Lake that does not require a ferry crossing of the lake; 3) the same port site and facilities as Alternative 2 (Diamond Point port); and 4) an alternate natural gas pipeline alignment on the northern end of Iliamna Lake that follows the north road corridor (see Figure 2-1 and Figure 2-59).

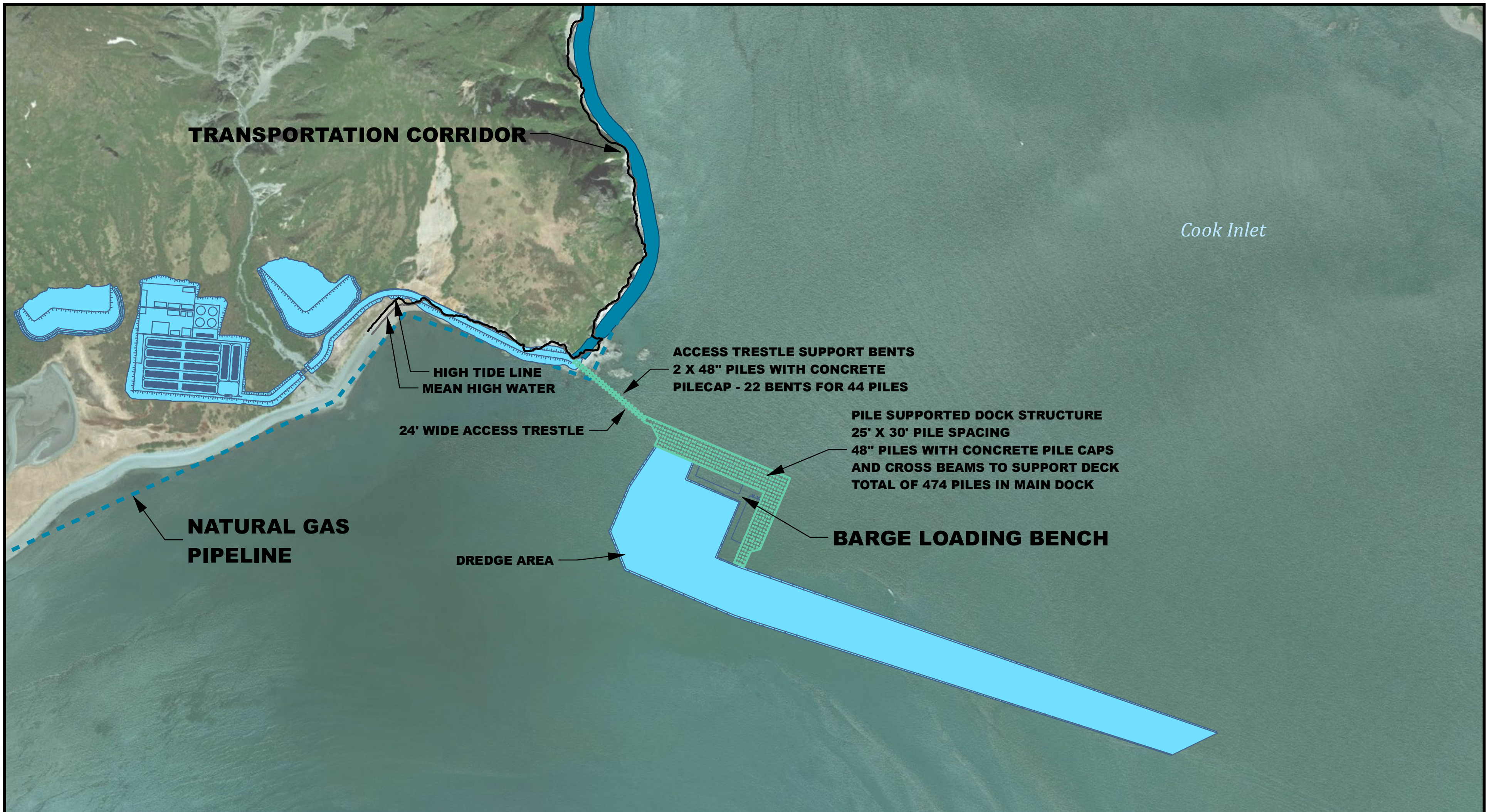
2.2.4.1 Mine Site

The mine site layout and processes under Alternative 3 would be the same as described for Action Alternative 1.

2.2.4.2 Transportation Corridor

The transportation corridor under Action Alternative 3 would connect the mine site to Diamond Point port in Iliamna Bay (Figure 2-60). The project transportation corridor would consist of a double-lane road north of Iliamna Lake, the north access road (approximately 82 miles and 1,036 acres), which would act as the main access route to and from the mine for the transportation of materials, equipment, and concentrate (Figure 2-61). There would be no ferry transportation across Iliamna Lake. The truck transportation and Diamond Point port would operate year-round.

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



Sources: PLP RFI-072

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

US Army Corps of Engineers®

500 0 500 1,000

Feet

Action Alternative 2 Variant

- Pile Supported Dock

Action Alternative 2

- Diamond Point Port
- Transportation Corridor
- Natural Gas Pipeline

- High Tide Line
- Mean High Water

ACTION ALTERNATIVE 2 - DIAMOND POINT PORT PILE-SUPPORTED DOCK VARIANT

PEBBLE PROJECT EIS

FIGURE 2-58

Sources: PLP 2018; ADNR

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

US Army Corps of Engineers®

5 0 5 10

Miles

Action Alternative 3

Transportation Corridor

Natural Gas Pipeline

Mine Site

Other Features

Local Roads

Borough Boundary

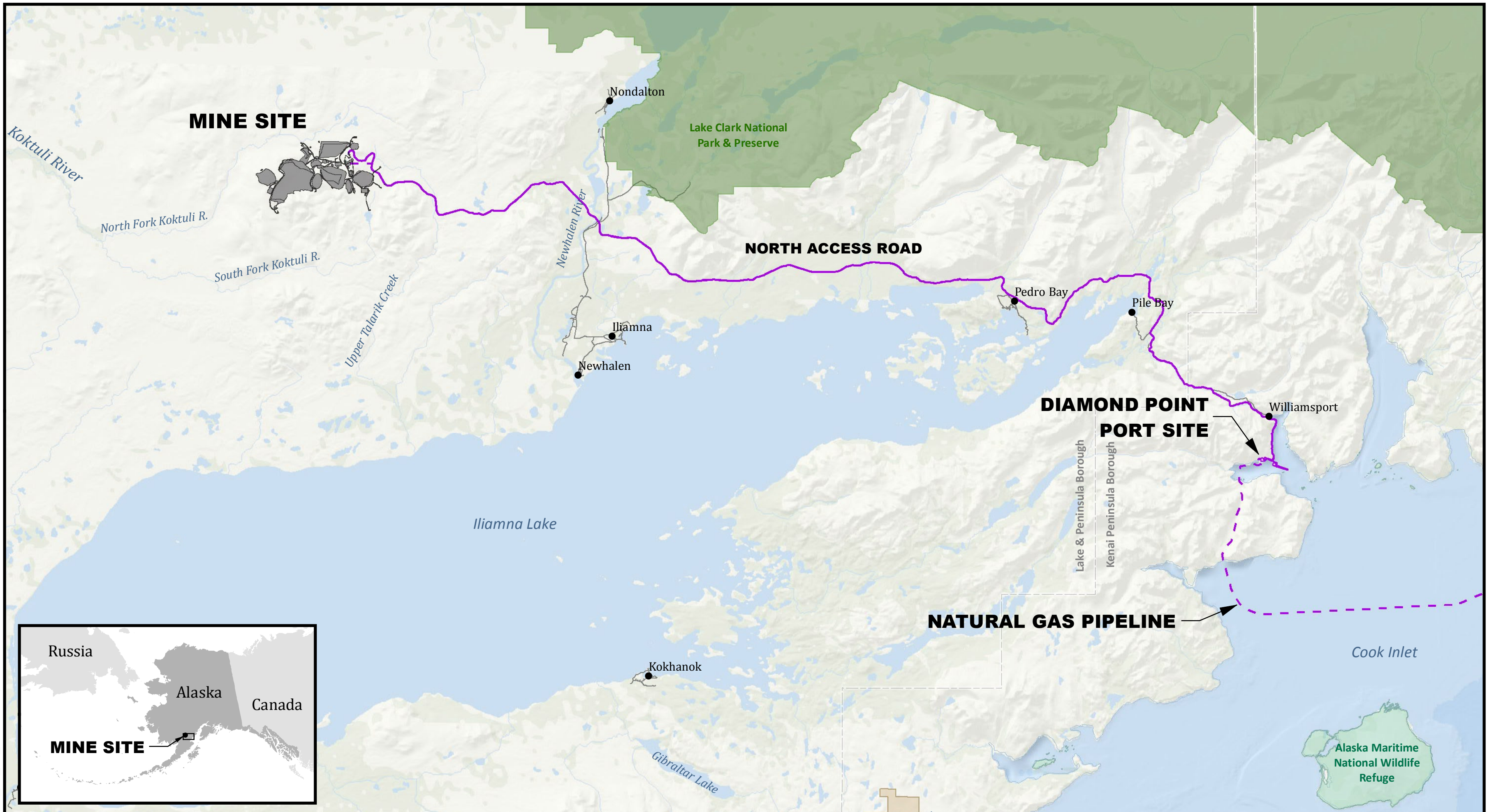
Three Nautical Mile Line

National Park

National Wildlife Refuge

State Game Refuge/Sanctuary

ACTION ALTERNATIVE 3 - GENERAL PROJECT LAYOUT



Sources: PLP 2018; ADNR

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

US Army Corps of Engineers®

5 0 5 10

Miles

Action Alternative 3

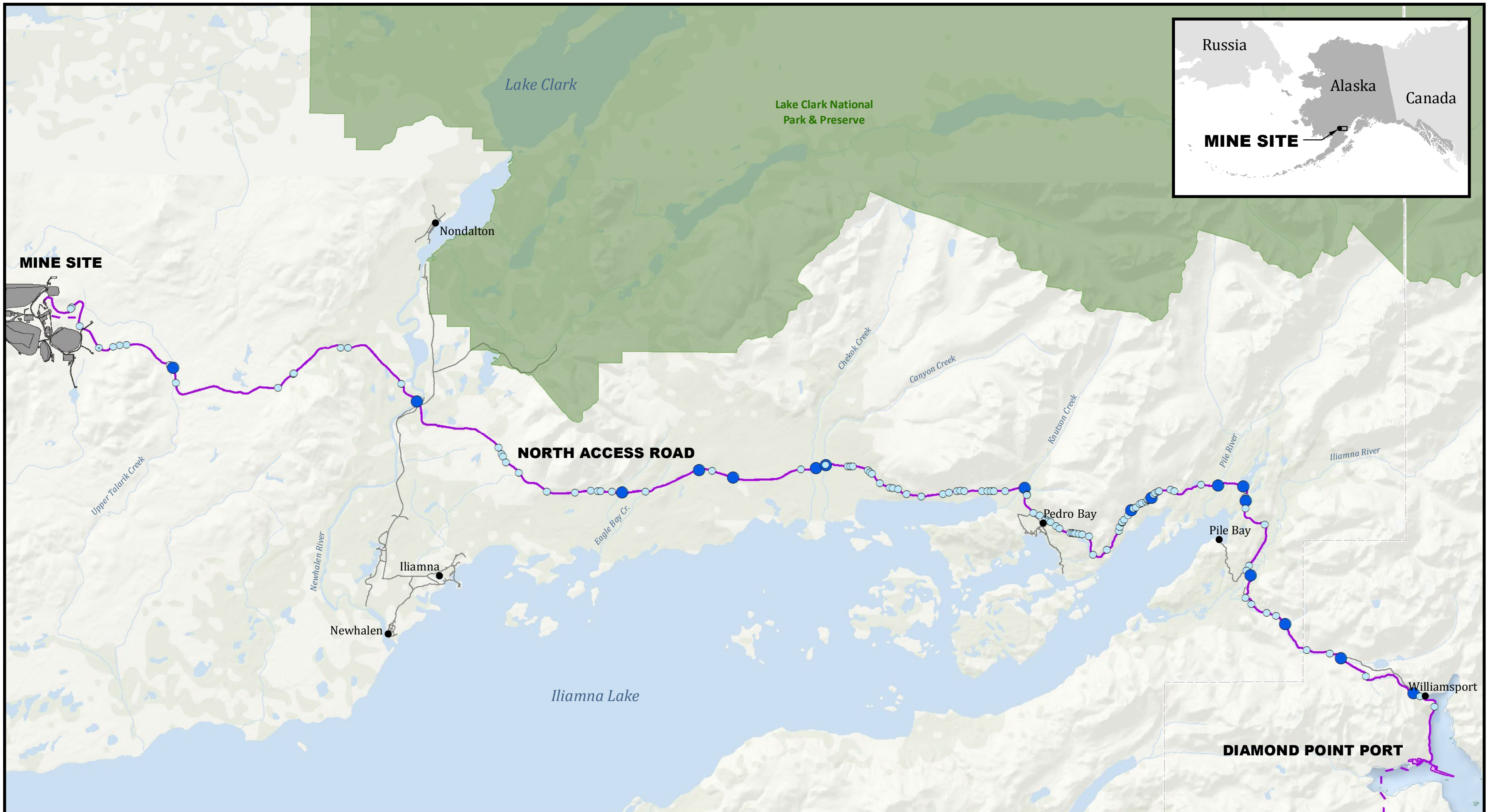
- Transportation Corridor
- Natural Gas Pipeline
- Mine Site

Other Features

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

ACTION ALTERNATIVE 3 - TRANSPORTATION FACILITIES OVERVIEW

PEBBLE PROJECT EIS **FIGURE 2-60**



Sources: PLP 2018; ADNR

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

US Army Corps of Engineers

2 0 2 4

Miles

Action Alternative 3

- Bridge
- Culvert
- Natural Gas Pipeline
- Transportation Corridor
- Mine Site

Other Features

- Local Roads
- Borough Boundary
- National Park

ACTION ALTERNATIVE 3 - NORTH ACCESS ROAD

PEBBLE PROJECT EIS

FIGURE 2-61

Road System

The north access road design criteria would be the same as Action Alternative 1—a private 30-foot-wide gravel road 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 Action Alternative 3 road system would include 17 bridges that range in length from approximately 40 to 625 feet, including multi-span bridges at the Newhalen (625 feet), Pile (245 feet), and Iliamna (205 feet) rivers. There would be approximately 105 culverts (37 of which would be designed for fish passage). Typical bridge and culvert designs would be similar to those described for Action Alternative 1. The exact number and design of waterbody crossings would be determined during final design and permitting.

Material Sites

Construction materials would be excavated from material sites along the transportation corridor. An estimate of up to 26 material sites (up to 717 acres) would be required for construction and maintenance of access roads and the natural gas pipeline for Action Alternative 3. Appendix K2 provides information for each material site, including the estimated quantities, size, type of material, use of material, and if blasting is required. Figures in Appendix K2 show the location of material sites identified for Action Alternative 3. 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 8.8 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

Thirty-five potential water extraction sites have been identified to support project construction and operations of Action Alternative 3. 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 Action Alternative 3. The estimated annual volume of water that would be extracted for all water extraction sites is 121 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 Action Alternative 3. These would be the same as described for Action 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 associated with Action Alternative 3 are assumed to be the same as described for Action Alternative 1 for access roads. There would not be a ferry, so temporary facilities associated with ferry terminals would not apply.

Transportation Corridor Traffic and Materials/Personnel Transport

Trucks, containers, and truck traffic would be the same as Action Alternative 1. There would be no ferry traffic under Action Alternative 3.

For personnel transport under Action Alternative 3, 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 are expected.

2.2.4.3 Diamond Point Port and Lightering Locations

Alternative 3 includes construction of Diamond Point port, marine components, and lightering locations, as described for Action Alternative 2. The Amakdedori port would not be constructed under this alternative.

2.2.4.4 Natural Gas Pipeline Corridor

The natural gas pipeline component would be similar to Action Alternative 2. It would be approximately 1 mile longer than the Action Alternative 2 natural gas pipeline corridor because it would follow the entire north road access route from Diamond Point to the mine site (see Figure 2-61); buried in a trench adjacent to the road bed shoulder. Additionally, the three construction access points described for Action Alternative 2 would not apply to Action Alternative 3, because there would not be stand-alone segments 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 (up to 10 acres) would be required for construction of the stand-alone segment of the Action Alternative 3 pipeline from Ursus Cove to Diamond Point. Appendix K2 provides information for each material site, including the estimated quantities, size, type of material, use of material, and if blasting is required. Figures in Appendix K2 show the location of material sites identified for Alternative 3. 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.

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

2.2.4.5 Alternative 3 – Concentrate Pipeline Variant

Evaluation of an ore concentrate pipeline option was suggested during scoping due to concerns with ferrying ore concentrate across Iliamna Lake. 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 Action 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 Action 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, an electric pump station would be constructed at the mine site and would use a positive displacement pump in the 1,000-horsepower range. See Figure 2-62, which 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.

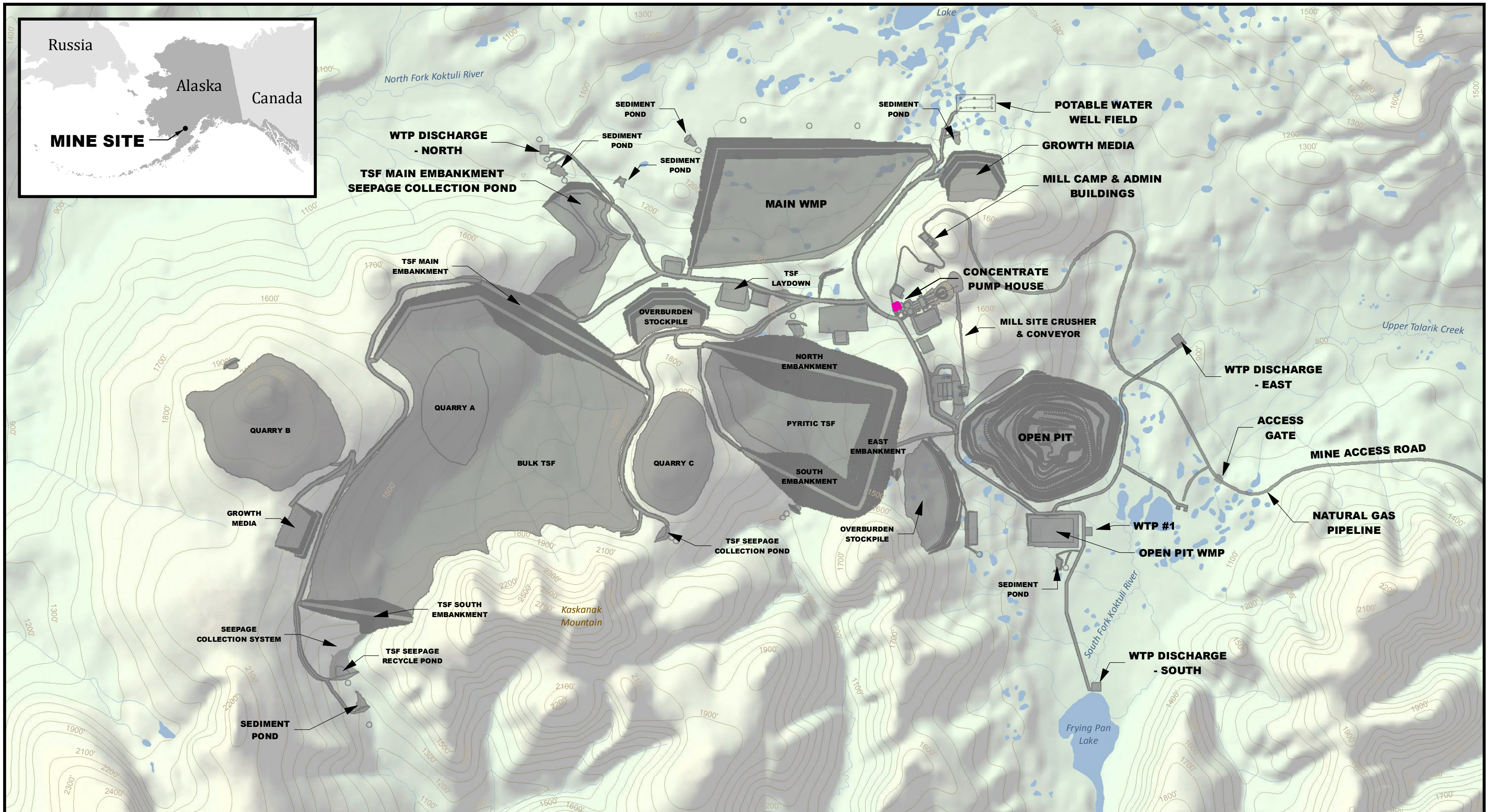
Transportation Corridor

The concentrate pipeline would follow the Action Alternative 3 north access road route and would be co-located in a single trench with the gas pipeline at the toe of the road embankment (see Figure 2-63 and Figure 2-64). The length would be the same as the natural gas pipeline (164 miles). The molybdenum concentrate, which represents approximately 2.5 percent of the total concentrate production, would still be separated at the mine site and transported in containers as proposed for Action Alternative 1.

The 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. An intermediate booster station would be sited along the road/pipeline alignment in the footprint of a proposed material site (see Figure 2-62). This booster station would use a positive displacement pump in the 1,000-horsepower range and would require a power generation facility in the 1- to 2-MW range. Aboveground sections of the pipeline would use heavy-wall pipe or casing as needed for additional protection. Manual isolation and drain valves would be spaced at intervals no greater than 20 miles (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.



Sources: PLP 2018, 2018-RFI-066; 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

Action Alternative 3 Variant
Concentrate Pump House

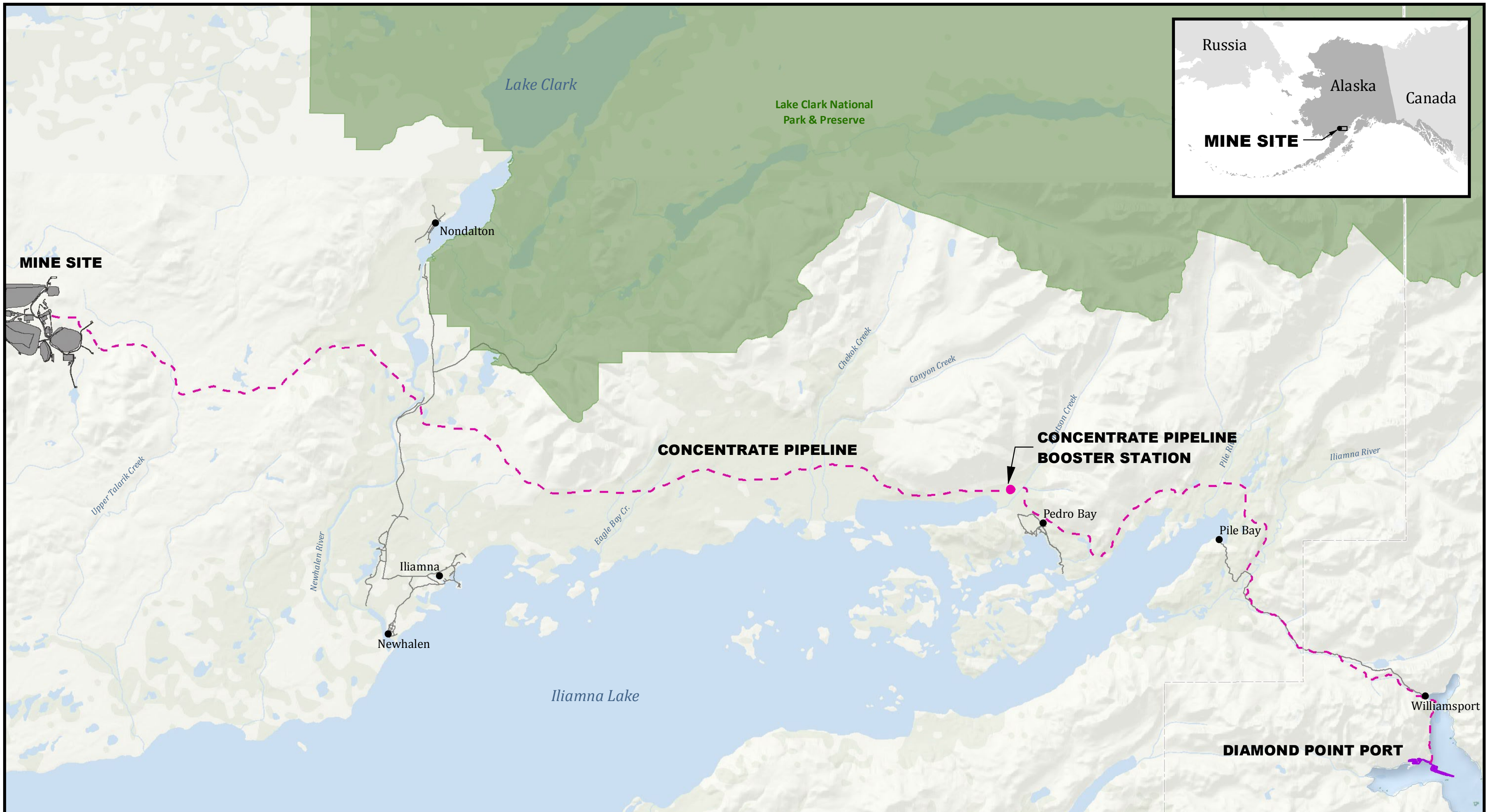
Action Alternative 3
Mine Site Footprint

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

ACTION ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - MINE SITE LAYOUT

PEBBLE PROJECT EIS

FIGURE 2-62



Sources: PLP 2018, 2018-RFI-066; ADNR
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

2 0 2 4
Miles

Action Alternative 3 Variant
- Concentrate Pipeline

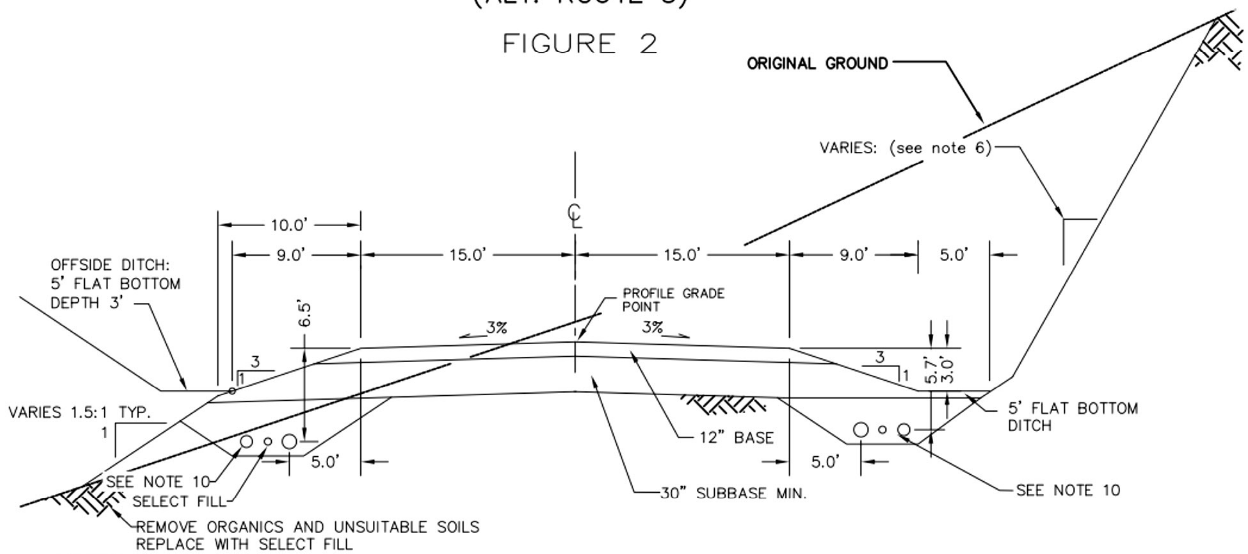
Action Alternative 3
- Mine Site
- Port

Other Features
- Local Roads
- Borough Boundary
- National Park

ACTION ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - CONCENTRATE PIPELINE ROUTE

PEBBLE PROJECT – MINE TO DIAMOND POINT
(ALT. ROUTE 3)

FIGURE 2



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. 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. NATURAL GAS PIPELINE, CONCENTRATE PIPELINE, AND RETURN WATER PIPELINE TO BE INSTALLED EITHER RIGHT OF 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.

ROAD TYPICAL SECTION FOR MODERATE TO ROUGH TERRAIN WITH ROCK CUTS

Sources: PLP 2018

US Army Corps of Engineers®

ACTION ALTERNATIVE 3 - CONCENTRATE PIPELINE VARIANT - TYPICAL ROAD SECTION

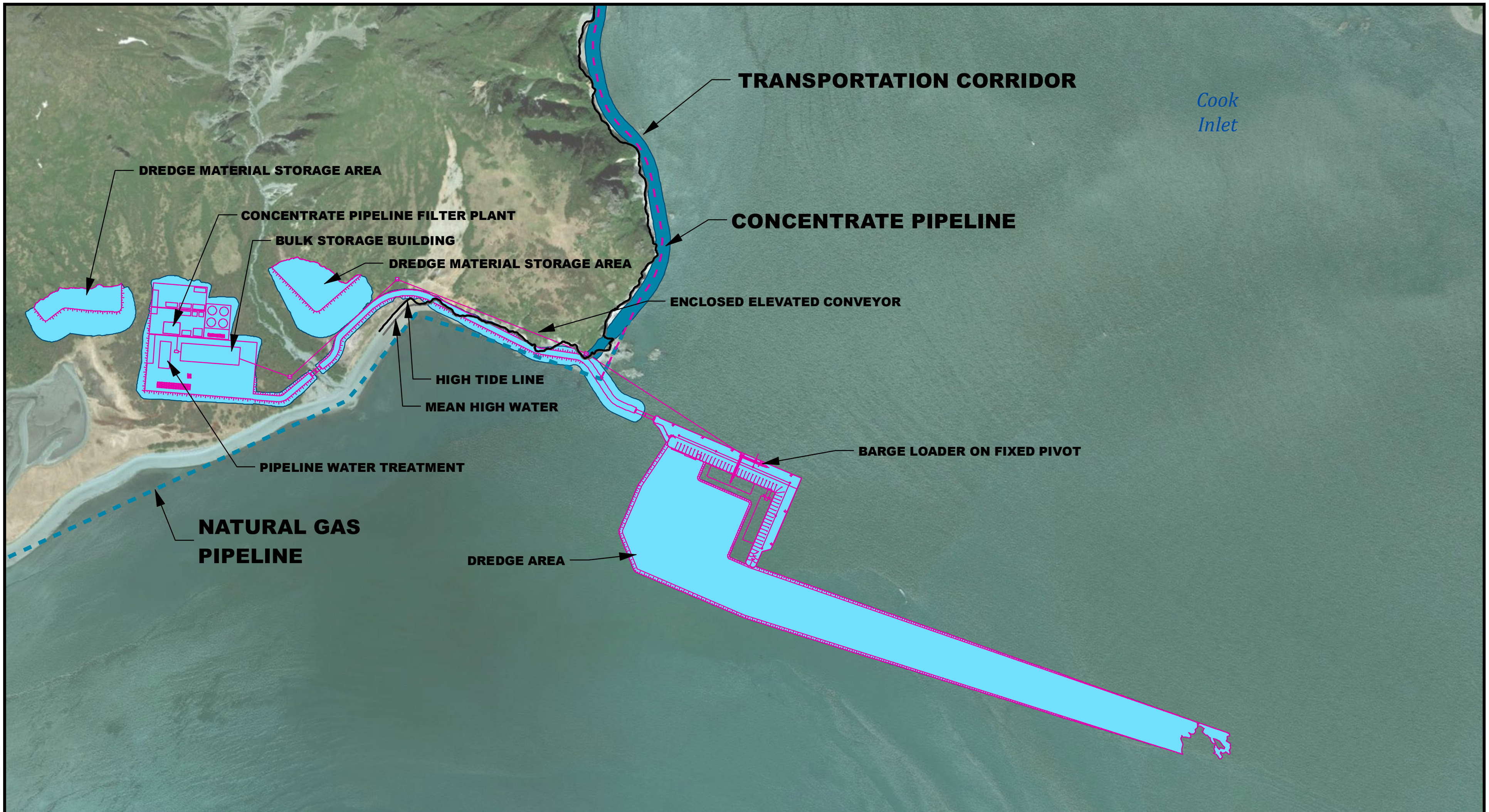
The concentrate pipeline (and the optional return water pipeline) would be buried in the same trench as the gas pipeline, with approximately 36 inches of cover, or deeper in areas where needed to prevent freezing. The trench would be adjacent to the north access road, facilitating access for construction, inspection, and maintenance. Construction of the concentrate pipeline adjacent to the north access road corridor would increase the road corridor width 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). At major stream crossings, the pipeline would be attached to the vehicle bridges. Smaller crossings would use HDD, or trenching if appropriate. Decisions on the appropriate methodology for individual crossings would be made in consultation with ADF&G. Major river crossings would have isolation valves and pressure and temperature monitoring instrumentation installed.

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 2, except the Pedro Bay airport would also be used by inspection crews, approximately once per month. No modifications to the airport are expected.

Diamond Point Port

Use of a concentrate pipeline would require concentrate handling, dewatering, and treatment facilities at Diamond Point port (see Figure 2-65). 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 is not expected to increase. The dewatered concentrate would be stored in bulk in a large storage building. To accommodate the bulk concentrate, the lightering system would use bulk handling (i.e., conveyers) of concentrate to load the bulk carriers, with appropriate controls to address the potential for concentrate dust emissions associated with storage, loading, and unloading.

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. All discharge water would meet appropriate marine discharge criteria. RFI 066 (PLP 2018-RFI 066) presents PLP’s position that the US Environmental Protection Agency’s (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 offsite disposal facility as appropriate.



Sources: PLP 2018-RFI-066
Note: The displayed features are the permanent footprint unless otherwise specified.

US Army Corps of Engineers

500 0 500 1,000
Feet

Action Alternative 3 Variant
- Concentrate Pipeline
- Diamond Point Port Site Variant

Action Alternative 3
- Diamond Point Port
- Transportation Corridor
- Natural Gas Pipeline

- High Tide Line
- Mean High Water

ACTION ALTERNATIVE 3 -CONCENTRATE PIPELINE VARIANT - DIAMOND POINT PORT LAYOUT

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 (see Figure 2-64). 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 appropriate corrosion protection and other controls, as discussed above.
- 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. The return water line would not require an intermediate pump station.

2.2.5 Summary of Differences Between Action Alternatives

Table 2-2 summarizes the primary differences between the action alternatives. The table depicts differences between Action Alternative 1 and the other two action alternatives rather than summarize 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.

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

Project Component/ Facilities	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
		Mine Site Component	
Mine Site	***Action Alternative 1*** • Total Footprint: 8,086 acres • Bulk TSF Main Embankment: Unlined; Centerline Construction o Bulk TSF Footprint[1]: 2,796 acres ***Action Alternative 1 – Kokhanok East Variant*** This variant does not involve changes at the mine site (same as Alternative 1 base case) ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** • Total Footprint: 8,124 acres (differences from Alternative 1 base case detailed below) o Container Yard: 38 acres o Relocation of Sewage Storage Tank Area: Less than 0.5-acre increase ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant does not involve changes at the mine site	***Action Alternative 2*** • Total Footprint: 8,241 acres (increase of approximately 155 acres detailed below) • Bulk TSF Main Embankment: Unlined; Downstream Construction o Bulk TSF Footprint[1]: 2,958 acres ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** • Total Footprint: 8,279 acres (differences from Alternative 2 base case detailed below) o Container Yard: 38 acres o Relocation of Sewage Storage Tank Area: Less than 0.5-acre increase ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant does not involve changes at the mine site	***Action Alternative 3*** • Total Footprint: 8,086 acres (same as Alternative 1) ***Action Alternative 3 – Concentrate Pipeline Variant*** • Total Footprint: 8,087 acres (differences from Alternative 3 base case detailed below) o Concentrate Pump House: 1 acre
		Transportation Component	
Transportation Corridor Traffic	***Action Alternative 1*** • Trucks: Up to 39 round trips per day (PLP 2018-RFI 065) • Ferry: One round trip per day on average ***Action Alternative 1 – Kokhanok East Variant*** This variant would not change truck or ferry trips ***Action Alternative 1 – Summer-Only Ferry***	***Action Alternative 2*** • Same as Alternative 1. ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** • Trucks: Up to 78 round-trip truck moves per day on each side of the ferry (PLP 2018-RFI 065). • Ferry: Larger ferry making two round trips	***Action Alternative 3*** • Same as Alternative 1. ***Action Alternative 3 – Concentrate Pipeline Variant*** • Reduced to 18 round trips per day (PLP 2018-RFI 065)

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

Project Component/ Facilities	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
	Operations Variant • Trucks: Up to 78 round-trip truck moves per day on each side of the ferry (PLP 2018-RFI 065). • Ferry: Larger ferry making two round trips per day on average; or two ferries making one round trip each per day. ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant would not change truck or ferry trips	per day on average; or two ferries making one round trip each per day. ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change truck or ferry trips	
Access Road Lengths and Sizes	***Action Alternative 1*** • Total Road Length/Footprint: 78 miles/ 892 acres o Mine Access Road[2]: 29 miles, 346 acres o Port Access Road: 37 miles, 408 acres o Kokhanok Spur Road: 1 mile, 15 acres o Iliamna Spur Road: 9 miles, 119 acres o Water extraction site access roads: 1 mile, 5 acres ***Action Alternative 1 – Kokhanok East Variant*** • Total Road Length/Footprint: 72 miles/833 acres o Mine Access Road: 29 miles, 346 acres o Port Access Road: 27 miles, 298 acres o Kokhanok Spur Road: 5 miles, 66 acres o Iliamna Spur Road: 9 miles, 119 acres o Water extraction site access roads: 1 mile, 5 acres ***Action Alternative 1 – Summer-Only Ferry***	***Action Alternative 2*** • Total Road Length/Footprint: 53 miles/ 715 acres o Mine Access Road: 35 miles; 505 acres o Port Access Road: 18 miles; 209 acres o Water extraction site access roads: <1 mile, 1 acre ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** • Same length as Alternative 2 • Total Footprint: 737 acres (differences from Alternative 2 base case detailed below) o Container Yard along the Williamsport-Pile Bay Road: 22 acres ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change road lengths	***Action Alternative 3*** • Total Road Length/Footprint: 82 miles; 1,036 acres o North Access Road: 82 miles; 1,036 acres o Water extraction site access roads: <1 mile, 1 acre ***Action Alternative 3 – Concentrate Pipeline Variant*** • Same length as Alternative 3 • Total road footprint would increase (differences from Alternative 3 base case detailed below) o 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%

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

Project Component/ Facilities	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
	Operations Variant This variant would not change road lengths ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant would not change road lengths		compared to Alternative 3 under typical construction conditions). (PLP 2018-RFI 066) o 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).
Ferry Crossing Length	***Action Alternative 1*** • 18 miles ***Action Alternative 1 – Kokhanok East Variant*** • 27 miles ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change the crossing length ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant would not change the crossing length	***Action Alternative 2*** • 29 miles ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change the crossing length ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change the crossing length	***Action Alternative 3*** Not applicable – No ferry ***Action Alternative 3 – Concentrate Pipeline Variant*** This variant would not be changed by absence of a ferry
Material Sites	***Action Alternative 1*** • Total Material Sites: 18 • Material Sites Footprint: 241 acres ***Action Alternative 1 – Kokhanok East Variant*** • Total Material Sites: 18 sites • Material Sites Footprint: 349 acres ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change material sites ***Action Alternative 1 – Pile-Supported Dock Variant***	***Action Alternative 2*** • Total Material Sites: 16 • Material Sites Footprint: 422 acres ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change material sites ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change material sites	***Action Alternative 3*** • Total Material Sites: 26 • Material Sites Footprint: 717 acres ***Action 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	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
	This variant would not change material sites		
Waterbody Crossing Infrastructure	***Action Alternative 1*** • Bridges: 9 • Culverts: 86 (41 fish passage culverts) ***Action Alternative 1 – Kokhanok East Variant*** • Bridges: 7 • Culverts: 78 culverts (33 fish passage culvert) ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change waterbody crossings ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant would not change waterbody crossings	***Action Alternative 2*** • Bridges: 7 • Culverts: 39 (18 fish passage culverts) ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change waterbody crossings ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change waterbody crossings	***Action Alternative 3*** • Bridges: 17 • Culverts: 105 (37 fish passage culverts) ***Action Alternative 3 – Concentrate Pipeline Variant*** This variant would not change waterbody crossings
North Ferry Terminal Location and Size	***Action Alternative 1*** • Location: Southwest of Newhalen • Total Footprint: 4 acres ***Action Alternative 1 – Kokhanok East Variant*** This variant would not change the north ferry terminal ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Action Alternative 2*** • Location: Eagle Bay • Total Footprint: 7 acres ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Action Alternative 3*** Not applicable – No ferry ***Action 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	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
South Ferry Terminal Location and Size	***Action Alternative 1*** • Location: West of Kokhanok • Total Footprint: 23 acres ***Action Alternative 1 – Kokhanok East Variant*** • Location: East of Kokhanok • Total Footprint: 15 acres ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change ferry terminals ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant would not change ferry terminals	***Action Alternative 2*** • Location: Pile Bay • Total Footprint: 18 acres ***Action 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	***Action Alternative 3*** Not applicable – No ferry ***Action Alternative 3 – Concentrate Pipeline Variant*** This variant would not be changed by absence of a ferry or ferry terminals
Port Component			

Port Location and Size	***Action Alternative 1***
	• Location: Amakdedori
	• Dock Design: Earthen causeway and jetty
	• Dredging: None
	• Total Footprint[3]: 30 acres
	  o Airstrip: 6 acres
	  o Shore-based facilities: 14 acres
	  o Marine facilities: 11 acres
	Action Alternative 1 – Kokhanok East Variant
	This variant does not involve changes at the port site
	Action Alternative 1 – Summer-Only Ferry Operations Variant
	• Total Footprint[3]: 58 acres (differences from
		Action Alternative 2
		• Location: Diamond Point
		• Dock Design: Earthen causeway and jetty
		• Dredging: Yes
		• Total Footprint: 112 acres
		  o Shore-based facilities: 25 acres
		  o Marine facilities: 14 acres
		  o Dredge area: 58 acres
		  o Onshore dredge material storage areas: 16 acres
		Action Alternative 2 – Summer-Only Ferry Operations Variant
		This variant does not involve changes at the port site
			Action Alternative 3
			Same as Alternative 2.
			Action Alternative 3 – Concentrate Pipeline Variant
			• Water Treatment Plant: No change in total footprint. Note: the water treatment plant would not be needed with the return water pipeline option.

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

Project Component/ Facilities	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
	Alternative 1 base case detailed below) o Container Yard: 27 acres ***Action Alternative 1 – Pile-Supported Dock Variant*** • Dock Design: Pile-supported dock • Total Footprint[3]: 19 acres (differences from Alternative 1 base case detailed below) o Piling Footprint: Less than 0.1 acre; eliminates in-water fill (reduction of 11 acres)	***Action Alternative 1 – Pile-Supported Dock Variant*** • Dock Design: Pile-supported dock • Total Footprint: 101 acres (differences from Alternative 2 base case detailed below) o Piling Footprint: Less than 0.1 acre; eliminates in-water fill (reduction of 11 acres)	
Lightering Location and Navigational Buoys	***Action Alternative 1*** • 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 located on the reefs framing the entrance to Amakdedori port (~1.5 miles east) ***Action Alternative 1 – Kokhanok East Variant*** This variant would not change lightering locations ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change lightering locations ***Action Alternative 1 – Pile-Supported Dock Variant*** • This variant would not change lightering locations	***Action Alternative 2*** • Primary Lightering Location: Iniskin Bay • Alternate Lightering Location: Same as Alternative 1. • Navigational Buoys: None ***Action Alternative 2 – Summer-Only Ferry Operations Variant*** This variant would not change lightering locations ***Action Alternative 2 – Pile-Supported Dock Variant*** This variant would not change lightering locations	***Action Alternative 3*** Same as Alternative 2. ***Action Alternative 3 – Concentrate Pipeline Variant*** This variant would not change lightering locations
Natural Gas Pipeline Component			

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

Project Component/ Facilities	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
Pipeline Alignment and Length	***Action Alternative 1*** • Total Footprint[3]: 40 acres o Compressor station[4]: 5 acres o Stand-alone onshore pipeline segments[4]: 35 acres • Total Length: 187 miles o Kenai Peninsula Tie-in: less than 1 mile o Cook Inlet Crossing: 104 miles o Amakdedori port to South ferry terminal: 36 miles o Iliamna Lake Crossing: 19 miles o North ferry terminal to Mine Site: 27 miles	***Action Alternative 2*** • Total Footprint[3]: 856 acres o Compressor station[4]: 5 acres o Stand-alone onshore pipeline segments[4]: 516 acres o Material Sites (13 total): 306 acres o Pipeline Construction Access Roads Total: 2.6 miles; 29 acres ▪ Knutson Bay to North Route: 0.2 mile; 2 acres ▪ Lonesome Bay to North Route: 0.9 mile; 9 acres ▪ Pile Bay to North Route: 1.5 miles; 17 acres • Total Length: 164 miles o Kenai Peninsula Tie-in: less than 1 mile o Cook Inlet Crossing: 75 miles o Ursus Cove to Diamond Point Port: 9 miles o Diamond Point port to Mine Site: 80 miles	***Action Alternative 3*** • Total Footprint[3]: 97 acres o Compressor station[4]: 5 acres o Stand-alone onshore pipeline segments[4]: 81 acres o Material Sites (3 total): 10 acres • Total Length: 165 miles o Kenai Peninsula Tie-in: less than 1 mile o Cook Inlet Crossing: 75 miles o Ursus Cove to Diamond Point Port: 9 miles o Diamond Point port to Mine Site: 81 miles
Pipeline Alignment and Length (continued)	***Action Alternative 1 – Kokhanok East Variant*** • Total Length: 185 miles (differences from Alternative 1 base case detailed below) o Amakdedori port to Iliamna Lake: This segment follows the port access road and the spur road into Kokhanok; from there it follows an existing road alignment to the point where it departs the shoreline to tie into the proposed route from Kokhanok	***Action Alternative 2 – Summer-Only Ferry Operations Variant*** This variant does not involve changes to the natural gas pipeline ***Action Alternative 1 – Pile-Supported Dock Variant*** This variant does not involve changes to the natural gas pipeline	***Action 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	Action Alternative 1 – Applicant's Proposed Alternative (Includes 3 Variants)	Action Alternative 2 – North Road and Ferry with Downstream Dams (Includes 2 Variants)	Action Alternative 3 – North Road Only (Includes 1 Variant)
	West (32 miles). o Iliamna Lake Crossing: 20 miles o All other segments are the same as Alternative 1 base case. ***Alternative 1 – Summer-Only Ferry Operations Variant*** This variant would not change this component ***Alternative 1 - Pile-Supported Dock Variant***		
Total Permanent Footprint			
Total Permanent Footprint	***Action Alternative 1*** • 9,317 acres ***Alternative 1 – Kokhanok East Variant*** • 9,395 acres ***Action Alternative 1 – Summer-Only Ferry Operations Variant*** • 9,343 acres ***Action Alternative 1 – Pile-Supported Dock Variant*** • 9,265 acres	***Action Alternative 2*** • 10,341 acres ***Action Alternative 2 – Summer-Only Operations Variant*** • 10,408 acres ***Action Alternative 2 – Pile-Supported Dock Variant*** • 10,330 acres	***Action Alternative 3*** • 10,047 acres ***Action Alternative 3 – Concentrate Pipeline Variant*** • 10,048 acres

Notes:
Dimensions are based on project GIS data (PLP 2018h) 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] Includes access road to compressor station.
[4] Includes onshore stand-alone sections of the natural gas pipeline (e.g., not adjacent to an access road). The footprint assumes a 100-foot-wide impact corridor (40 feet to account for the trench and side-cast material, and 60 feet for construction access); which is being considered a permanent impact at this time, because a restoration plan has yet to be developed. It is likely that much of this area would be restored within 2 years of construction.

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 for the Pebble Project. Appendix B provides 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 evaluated in detail 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, and water treatment. 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 provide no environmental benefit compared to the proposed project.