UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF REGIONAL ADMINISTRATOR

JUL - 1 2019

Shane McCoy, Program Manager
U.S. Army Corps of Engineers, Alaska District
645 G Street, Suite 100-921
Anchorage, Alaska 99501

Dear Mr. McCoy:

In accordance with our responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency has reviewed the U.S. Army Corps of Engineers' February 2019 Draft Environmental Impact Statement for the Pebble Project (CEQ Number 20190018; EPA Region 10 Project Number 18-0002-COE). The EPA is also supporting the Corps in development of specific sections of the EIS as a cooperating agency in accordance with the cooperating agency agreement. As a cooperating agency, we have participated in meetings and provided comments on early drafts of EIS material, including on sections of the Preliminary DEIS in December 2018. We also provided scoping comments to the Corps on June 29, 2018.

Project Background

The Pebble Limited Partnership (PLP) is proposing to develop the Pebble copper, gold, and molybdenum ore deposit in southwest Alaska. The Pebble deposit lies within the Nushagak and Kvichak watersheds, which together account for more than half of the land area in the Bristol Bay watershed.

The proposed project includes an open-pit mine, tailings storage facilities (TSFs), water management ponds, a mill facility, a natural gas-fired power plant, and other mine site facilities. Approximately 1.3 billion tons of ore would be processed at a rate of 180,000 tons of ore per day, over the proposed mine operating life of 20 years. The initial surface disturbance footprint is approximately 8,086 acres and the 608-acre pit would have a maximum pit depth of 1,970 feet. Potentially acid generating (PAG) tailings and non-PAG bulk tailings would be disposed in two tailings facilities that would cover a total of approximately 3,867 acres. Water discharges from the pit lake following mine closure would require water treatment in perpetuity.

The proposed project also includes development of a 188-mile natural gas pipeline across Cook Inlet and Lake Iliamna and two compressor stations used to transport natural gas from the Kenai Peninsula to the mine site. The proposed transportation network would include construction of: 77 miles of new roads, including mine and port access roads and spur roads to communities; ferry terminals on the north and south shores of Lake Iliamna for use by an ice-breaking ferry; and the Amakdedori Port on Cook Inlet.

In addition to the no action alternative and the proposed action (Alternative 1), the DEIS analyzes two additional alternatives and includes variants to the alternatives.

Overview of Comments and Recommendations

We appreciate the progress that the Corps has made and the improvement to the analysis resulting from engagement with the EPA early in the NEPA process. However, the DEIS appears to lack certain critical information about the proposed project and mitigation, and there may be aspects of the environmental modeling and impact analysis which would benefit from being corrected, strengthened, or revised. Because of this, the DEIS likely underestimates impacts and risks to groundwater and surface water flows, water quality, wetlands, aquatic resources, and air quality from the Pebble Project. Inclusion of the additional information and analyses we have identified, or further explanation in the EIS of these issues, is essential to more fully evaluate and disclose the potential project impacts and identify practicable measures to mitigate those impacts. The EPA is committed to working with the Corps to provide our expertise where it can be of assistance.

Our priority comments and recommendations are summarized below. We have enclosed detailed comments explaining these priority comments and recommendations. Our detailed comments also address other issues identified in the EPA's review of the DEIS, including geohazards, environmental justice, and subsistence.

Project Description and Mitigation Details
The DEIS and supporting reference information acknowledge that key aspects of the Pebble Project are at a conceptual level (i.e., early or initial stage) of design and development. Critical but conceptually developed project components include: the open pit mine dewatering system; the dams retaining the mine's tailings and main water management pond; the collection, pumpback, and monitoring systems for managing seepage from the TSFs and main water management pond; and the closure water treatment plant. Critical plans that are yet to be developed or are only conceptually described in the DEIS include plans for: mine reclamation and closure; environmental monitoring; adaptive management; tailings and waste rock characterization and management; fugitive dust control; and strategic timing of water discharges.

More detailed versions of these project components and plans, however, are critical to the evaluation of environmental impacts, alternatives and mitigation. Without more detail, many of the predictions associated with these components and plans in the DEIS do not appear to be fully supported based on the current level of documentation. Given the scale of the project and importance of the aquatic resources in the Bristol Bay watershed, we recommend including more developed designs and plans in the EIS to provide a level of detail that will allow for more meaningful disclosure of the project's potential impacts and the effectiveness of its pollution control infrastructure and plans that are important for environmental protection and mitigation.

Range of Alternatives
The DEIS predicts that groundwater contamination would occur under the bulk TSF. We therefore recommend that the EIS include as an alternative, variant, or mitigation measure the use of a liner under the bulk TSF (with appropriate overdrains to ensure stability). In addition, we recommend that the EIS discuss in detail an alternative or variant that includes the infrastructure elements that would be anticipated under the Pebble Mine Expanded Development Scenario (i.e., diesel pipeline, port site at Iniskin Bay). This would enable consideration of options that would avoid or minimize cumulative impacts that would occur as result of redundant infrastructure associated with expanded development. The EPA recommends that these alternatives or variants be further analyzed in the NEPA analysis as they may be components for the least environmentally damaging practicable alternative (LEDPA) under

Section 404 of the Clean Water Act. We recommend that the alternatives analysis provide the information necessary to support an evaluation of alternatives under the Clean Water Act Section 404(b)(1) Guidelines, including information to support identification of the LEDPA. This issue is further discussed in the EPA's separate comments to the Corps on the Clean Water Act Section 404 Public Notice.

Alternative 3 includes a port site variant that would include a water treatment plant at the port to treat and discharge process wastewater from the concentrate pipeline to Cook Inlet. The discharge of process wastewater alone as defined under this variant likely is not allowed under the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) regulations (see 40 CFR 440 Subparts J and L). Therefore, we recommend that this variant be reconsidered.

Groundwater and Streamflow Impacts
The DEIS relies on watershed, groundwater, and water balance models to predict how mine site activities will change groundwater conditions and impact surface water and aquatic resources. The uncertainty analysis for the groundwater model, however, concludes that the model may significantly underpredict the amount of water produced during mine pit dewatering. The DEIS discloses that this could result in the groundwater zone of influence being larger than predicted and North Fork Koktuli, South Fork Koktuli, Upper Talarik Creek, and tributary stream flows being reduced to a greater extent than is currently predicted in the DEIS. Significant adverse impacts to wetlands and to streams with documented anadromous fish occurrence may result from such stream flow reductions. We recommend that the groundwater model be revised to reduce this uncertainty and provide more accurate predictions associated with open pit dewatering. We have additional recommendations to verify the water balance model and clarify how uncertainties associated with the watershed model effect EIS predictions. We recommend that the EIS fully analyze the potential adverse impacts to groundwater, wetlands, and streams with documented anadromous fish occurrence based on the results of the revised modeling.

Water Quality Impacts
The DEIS may substantially underpredict potentially significant impacts to water quality. Our key comments are:

- The DEIS provides inadequate support for several assumptions regarding the behavior of leachate and relies on very limited sample representativeness for prediction of acid rock drainage and metal leaching. This may result in unanticipated leaching of metals/metalloids at elevated concentrations;
- The DEIS lacks critical details regarding the design and operation of the water treatment plants, particularly at closure. The DEIS reference material states that there is insufficient available information to evaluate the effectiveness of the closure water treatment plant to meet water quality criteria. This prevents meaningful analysis and disclosure of potential water quality impacts related to water treatment;
- As a result of groundwater model uncertainty, the DEIS states that the water treatment plants may need to treat and discharge more mining process water than that for which the plants are currently designed. Significant impacts to water quality could occur if that is the case; and
- Use of conceptual drainage and seepage containment systems for the TSFs and water management pond do not fully support the DEIS assumption that 100% of the seepage would be captured.

The EPA also recommends that the EIS include a data quality assessment for background water quality data, a modeling sensitivity analysis of the water quality modeling and inputs, a reasonably complete analysis of water quality impacts in the closure and post-closure phases, and monitoring and adaptive management plans.

Wetlands Impacts and Compensatory Mitigation

The Pebble Project would result in the permanent loss of approximately 3,560 acres of jurisdictional wetlands and other aquatic resources, including 3,443 acres of wetlands, 55 acres of lakes and ponds, 81 miles (50 acres) of stream channels, and 11 acres of marine waters. An additional 510 acres of streams, wetlands, lakes, ponds, and marine waters would be temporarily filled for construction access, and 2,345 acres would experience secondary impacts due to groundwater drawdown (449 acres) and fugitive dust (1,896 acres). The DEIS, however, does not fully identify and characterize existing aquatic resources and wetland functions to establish the environmental baseline for an impact analysis and mitigation considerations because the analysis area is limited and salient available site-specific data is not utilized. In addition, the EPA recommends a more complete analysis of secondary/indirect effects, which is important to analyze project impacts and compare alternatives.

In terms of compensatory mitigation, the draft Compensatory Mitigation Plan includes only a conceptual discussion, notwithstanding the proposed project's substantial impacts to wetlands and aquatic resources. The plan also does not fully address the types of direct and indirect impacts to waters of the U.S. that may occur and does not identify specific mitigation projects. Therefore, the availability, practicability, and effectiveness of compensatory mitigation to offset unavoidable impacts is unsupported. To ensure disclosure of practicable means to mitigate the direct, indirect, and cumulative impacts of the Pebble Project, the EPA recommends the EIS include a reasonably detailed draft Compensatory Mitigation Plan. This recommendation is further discussed in the EPA's separate comments to the Corps on the CWA Section 404 Public Notice.

Impacts to Fish and Fish Habitat

The impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support should be more fully addressed in the EIS. The EPA recommends significant improvements to: habitat characterization, assessment, quantification, and spatial referencing; assessment of linkages between the loss and/or degradation of habitat and impacts to fish species and life stages (i.e., incubating eggs, spawning fish, and rearing juveniles); groundwater and surface water flow characterization at a scale that is more relevant to fish and fish habitat; and analysis of the potential population-level effects and effects on genetic diversity in the context of the Bristol Bay salmon portfolio. We recommend that the analysis in the DEIS be revised to address these issues.

Air Quality Impacts

Priority issues associated with the air quality analysis include:

- Particulate matter impacts from the mine site may be underpredicted in the EIS based on the modeling parameters used to predict impacts from the mine pit; and
- Assumptions and potential errors in the air quality modeling assessment for the port facilities include lack of evaluation of substantial mobile emissions from vessel traffic, and differences in

meteorological conditions at the Diamond Point port site as compared to the Amakdedori port site.

Our detailed comments provide recommendations to strengthen the air quality analysis.

Tailings Containment and Spill Risk
The DEIS does not fully characterize the stability and performance of the dams containing tailings and contact water in the event of an earthquake. A deformation analysis and seismic safety factor were determined for a past design of the bulk TSF, but this analysis was not provided for the current TSF dam design or for the other dams. The TSFs and main water management pond dams are significant structures that range in height up to 545 feet with combined lengths of 7.2 miles (for the TSF dams) and 3.6 miles (for the WMP dams). We recommend seismic safety factors and potential earthquake induced stability impacts be assessed for these dams so that the EIS discloses how the dams will be impacted by a potential earthquake.

The DEIS, based on conclusions of a Failure Modes Effects Analysis (FMEA), does not evaluate the potential release of tailings from the bulk TSF due to a dam breach or failure. The FMEA risk register, referenced in the DEIS, identifies a number of adverse factors that could occur during engineering, construction, and operations, but assumes that all of these challenges would be overcome. Support for this determination is limited given the simplified conceptual dam designs, lack of operational, monitoring, and closure plans and lack of representative seismic analysis for the bulk TSF. We recommend that a bulk TSF breach or failure scenario be developed, and potential impacts be evaluated and disclosed.

In addition, the spill risk analysis for concentrate and tailings warrants improvement. The current analysis may underpredict impacts of spills due to assumptions and incomplete information related to the role of oxygen in aquatic environments, timing for release of mineral components, and reactivity in porewater. We recommend revising the analysis to address these issues, so that potential adverse impacts to water and sediment quality from leaching of metals are fully disclosed, as well as any associated impacts on fish populations.

Indirect Effects and Cumulative Impacts
The DEIS summarizes potential indirect effects and cumulative impacts in general terms, with limited quantitative analysis of large-scale additional impacts resulting from reasonably foreseeable future actions. We recommend a more robust evaluation of indirect impacts and cumulative effects, particularly in terms of the Pebble Mine Expanded Development Scenario.

Conclusion

The enclosure includes detailed discussion and specific recommendations regarding the key issues summarized above, as well as other issues identified in the EPA's review. Given the substantial potential impacts and risks of the proposed project and weaknesses in the DEIS, the DEIS likely underestimates adverse impacts to groundwater and surface water flows, water quality, wetlands, fish resources, and air quality. Therefore, conclusions that the project will not violate applicable water quality and air quality standards should be further supported. Our detailed comments include recommendations to provide significant additional information about key project components and plans and improve the environmental modeling and other aspects of the impact assessment.[1]

We will continue to work constructively with the Corps as a cooperating agency, providing special expertise in specific areas requested by the Corps, including: alternatives; recreation; aesthetics and visual resources; soils; surface- and groundwater hydrology; water and sediment quality; wetlands and special aquatic sites; vegetation; and mitigation. We also continue to request the ability to assist the Corps in additional areas of the Pebble Project EIS, including fisheries and air quality, where we have special expertise and jurisdiction. In addition, we recommend that resource-specific interagency technical workgroups be developed to work through significant issues. We look forward to working with you and the other cooperating agencies on the next steps in the NEPA process.

If you have questions concerning our comments, please contact Patty McGrath, Mining Advisor and lead for the Pebble Project NEPA/Permitting Team, at mcgrath.patricia@epa.gov or 206-553-6113, or Molly Vaughan, NEPA Reviewer, at vaughan.molly@epa.gov or 907-271-1215.

Sincerely,

Chris Hladick
Regional Administrator

Enclosure: U.S. Environmental Protection Agency Detailed Comments for the Pebble Project Draft Environmental Impact Statement

cc: Colonel Phillip Borders, USACE Alaska District

[1] Effective October 22, 2018, the EPA no longer includes ratings in our comment letters. Information about this change is explained in the Memorandum on Changes to EPA's Environmental Review Rating Process, available at https://www.epa.gov/nepa/policy-and-procedures-review-federal-actions-impacting-environment-under-section-309-clean-air.

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We have reviewed the DEIS and provide detailed comments and recommendations below for improved information and analyses to strengthen disclosure of the impacts of the project and alternatives and potential mitigation measures. This enclosure provides discussion of the key issues summarized in the cover letter to which these comments are attached and also includes additional comments and recommendations.

These comments are organized in the following major sections:

1. Description of the Proposed Project;
2. Alternatives;
3. Comments on specific resource sections of the EIS, including Groundwater and Surface Water Hydrology, Water Quality, Wetlands and Other Waters/Special Aquatic Sites, Fish Values, Commercial and Recreational Fisheries, Geohazards, Air Quality, Environmental Justice, Subsistence;
4. Spill Risk;
5. Indirect and Cumulative Impacts, including the impacts of the Pebble Mine Expanded Development Scenario;
6. Mitigation and monitoring, including compensatory mitigation; and
7. Availability and use of data, including data gaps and data quality.

These comments are generally organized following the structure of the DEIS: project description and alternatives, resource-specific sections, spill risk, and mitigation. For efficiency, we grouped like comments associated with conceptual project features and plans, indirect and cumulative impacts, and availability and use of data. Comments on specific resource sections are ordered by, first, those areas where the Corps has requested our special expertise (hydrology, water quality, wetlands) followed by the other resources areas where we have comments and recommendations (fish, geohazards, air quality, environmental justice, and subsistence). A summary paragraph at the beginning of each of the major sections lists the most significant issues that are discussed further in the section. Additional detailed comments are provided following the discussion of the key issues in each of the major sections, as well as EPA's recommendations. EPA encourages the Corps to further explain why its analysis in the DEIS is sufficient if the Corps, after consideration, disagrees with some or all of the recommendation.

DESCRIPTION OF THE PROPOSED PROJECT

A priority issue related to the description of the Pebble Project is the conceptual (early or initial stage) of design and development of aspects of the Pebble Project that are important to environmental protection. We recommend that the following key project features and plans be further developed to support the assessment of impacts to groundwater and surface water flows, water quality, streams, wetlands, lakes, and ponds and the fishery areas they support; and impacts to air quality:

- Open pit dewatering system;
- Waste rock characterization and management plan;

- Seepage water management system associated with TSFs and water management ponds (WMPs);
- Tailings storage facility (TSF) and main WMP embankment designs and plans;
- Closure water treatment plant;
- Plan for strategic timing of water discharges;
- Reclamation and closure plan;
- Financial assurance cost estimate;
- Monitoring plan;
- Adaptive management plans; and,
- Fugitive dust control plan.

We recommend that Pebble Limited Partnership (PLP) consider developing the Project Description into a more detailed draft plan of operations that includes a tailings and waste management plan, reclamation and closure plan, monitoring plan, and updated water management plan. These plans are typically supplied or required as a basis for development of state of Alaska permit applications and provide more detailed information that is frequently used in the analysis of the impacts of large mining projects in Alaska under NEPA. The development of these plans may efficiently help address several areas where the EPA recommends further information be provided to support the EIS.

Our recommendations regarding these key issues are described below followed by additional comments and recommendations for improvement related to the project description.

Conceptual Level of Design of Key Project Features and Plans

<u>Open Pit Dewatering System</u>: The DEIS states that the pit dewatering design has not been developed (pg 2-16) and that the conceptualized plan for pit dewatering consists of approximately 30 wells (pg. 4.17-3). The extent of the groundwater cone of depression and changes to groundwater and surface water hydrology are dependent upon the pit dewatering system design. We recommend that the pit dewatering system design be developed to provide a basis for the impact assessment, to provide more certainty to the assessment of pit dewatering impacts to groundwater and surface water, including alterations to streamflow. As one component of the design, we recommend clarifying whether the well array will include the entire vertical expanse of the aquifer(s) relevant to the depth of the adjacent pit, to ensure that an inward gradient of groundwater flow with depth is achieved. If more detailed design information is not developed, then we recommend that the EIS summarize the uncertainty associated with the conceptual design and how future design changes could impact groundwater hydrology predictions associated with pit dewatering.

<u>Waste Rock Characterization and Management</u>: The DEIS provides general statements about how PAG/ML (Potentially Acid Generating/ Metal Leaching) and NPAG/non-ML wastes would be managed. We recommend the inclusion of the following additional information, which is typically included in mining EISs, to provide a more specific basis for evaluating the effectiveness of waste management procedures and subsequent environmental impacts to water quality due to acid rock drainage and metals leaching. This information could be provided in a waste management plan as is frequently done for large mining projects in Alaska (see also our comments on Water Quality regarding this information).

1. The specific criteria that would be used to separate PAG from NPAG rock are not described in Chapter 2. Section 4.18 discusses an NP/AP ratio of 1.4, but it is not clear if that is the ratio that

would be used in practice, since it does not appear in the Project Description and a waste management plan has not been developed. We recommend that the DEIS provide the criteria that would be used to separate PAG from NPAG waste.

2. The statement on page 2-16 that, “PAG and ML waste rock would be stored in the pyritic TSF until mine closure” implies that there are two different kinds of rock – PAG rock and ML rock. We recommend that the EIS provide the definition of ML waste rock to support statements made in this Chapter and the Project Description (Appendix N).
3. In addition to identifying the criteria or thresholds that would be used to distinguish PAG from NPAG rock and ML from non-ML rock, we recommend that the EIS include the specific procedures that would be used to separate these materials. Some examples of general procedures are currently provided, such as visual inspection, blast hole sampling, and bench mapping, however, additional detail on the actual procedures would improve support for conclusions regarding potential impacts to water quality.
4. Chapter 2 discusses the segregation of waste rock and overburden and that “NPAG and non-ML waste rock could be used for embankment construction.” On page 4.18-10 the DEIS discusses that some PAG rock would be used at “limited locations” on the northern embankment of the pyritic TSF. We recommend that the EIS clarify these conflicting statements regarding the use of NPAG and non-ML waste rock and PAG waste rock for construction. We recommend that the EIS discuss how the non-acid generating and non-metals leaching material would be determined, where this waste rock will be stored, and how runoff would be managed, if the materials are not used for construction. In addition, we recommend that PAG waste rock not be used for embankment construction due to the possibility of leaching that could impact stability or result in contamination.

TSF and Water Management Pond Seepage Management: The DEIS in Chapter 2 and Section 4.18 provides general descriptions of the seepage management systems and assumes that 100 percent of the seepage from these project features would be captured. We recommend that the EIS include additional information describing the seepage management and collection systems for the Bulk TSF, pyritic TSF, and water management ponds in order to provide a basis for seepage capture estimates and more accurately evaluate impacts.

In regard to the Bulk TSF, the DEIS states that, “[t]he underdrains would enhance the flow-through design concept by providing a preferable seepage path from the tailings mass to the [seepage collection pond (SCP)] downstream of the embankment toe… [D]etails 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.” (pg. 2-22). Without a preliminary design of the underdrain and seepage collection system included for review in the EIS, we were not able to verify that “[a]ll bulk TSF contact water that seeps through the embankment would be hydraulically contained,” (pg 2-24) and that groundwater contaminated by seepage that bypasses the capture system would further be detected by the seepage pumpback monitoring wells at “potential” well locations (Section 4.18.3.1). The DEIS also states that additional seepage collection, cutoff walls, and/or pumpback systems may be installed downgradient, if necessary, as determined by monitored water quality, but locations and design information for these features and a monitoring plan is not currently provided.

The EPA recommends that the Corps provide further detail to support the seepage capture efficiencies for the Pyritic TSF and water management ponds. Liners are currently proposed only under the pyritic TSF and water management ponds. The DEIS states that, "[l]iner materials would be selected during the preliminary and detailed designs in accordance with the [Alaska Dam Safety Program (ADSP)] guidelines…" (pg. 2-21). Liners are an essential component of the seepage management approach and liner characteristics influence predictions made about groundwater quality. We recommend that the EIS include additional information about liner materials and design to support EIS impact predictions that rely upon liner efficiencies.

We recommend that the EIS provide the following information related to seepage management for the TSFs and water management ponds: specific location of the underdrains in relation to project features and seepage and groundwater flow paths; performance criteria and capacity of the underdrain systems; for facilities with liners, specific types of liner and performance criteria; number of groundwater monitoring and pumpback wells and their actual locations and depths in relation to groundwater flow paths; monitoring that would occur to determine if pumpback systems are implemented; analysis of these seepage management design features in relation to Pebble Project features, and; predicted extent of groundwater contamination.

We recommend this level of detail because it supports evaluation of the effectiveness of seepage control, supports seepage rate estimates in groundwater modeling, and assists in determining environmental impacts. If specific detailed seepage collection and pumpback system design is not included in the EIS, we recommend that the EIS further evaluate the efficiency of existing systems in similar environments, to either support and demonstrate that 100 percent capture is possible or any alternative seepage capture efficiencies indicated by that evaluation.

<u>TSF and Main Water Management Pond Embankment Design and Plans</u>: According to Section 4.15 (Geohazards) and DEIS reference materials, the designs of the tailings and water management embankments are early stage and conceptual. We recommend using a more detailed level of design in order to evaluate with more specificity stability and impacts to environmental resources from significant mining structures, such as the TSF and WMP embankments. This is particularly important since the design of the tailings dams was identified as a significant issue during scoping (per Appendix A of the DEIS, tailings dam design ranked in the top five key issues). We recommend that preliminary designs be provided for all the embankments, as they serve as the basis for the impact assessment. See our comments on Section 4.15 for more details.

The DEIS identifies plans that will be developed for the TSFs during the ADSP permitting process including the Operations & Maintenance Manual, Emergency Action Plan, and monitoring (pg. 2-28). We recommend that the main elements of the emergency action plan and monitoring plan be described in more detail so that responsive actions in the event of changes in embankment performance (stability, seepage), accidents, or failures are further explained and effectiveness of these actions at reducing impacts can be better understood.

<u>Pyritic TSF and Tailings Deposition</u>: Page 2-26 states that "[t]he 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." We recommend replacing the word "prevent" with "minimize the likelihood," or alternatively, adding discussion of how complete anoxic conditions would be created and maintained. Further, page 2-28

states that "[t]he 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." These two pages contain conflicting information. We recommend that the EIS clarify these points and describe why the PAG waste around the perimeter would be covered by tailings if the desire is for the tailings to be away from the perimeter to allow water to pool over the tailings without being too close to the embankments, causing risk of embankment failure. Additionally, we recommend that the EIS describe whether the tailings are going to be maintained at a surface level below the PAG waste rock bench, since then the PAG waste rock would not be inundated with water. It also seems that embankment stability would be impacted if water is intended to cover the PAG rock as well as the tailings. Further, if the PAG waste rock is not inundated and therefore anoxic, it will be exposed to the atmosphere, and the resultant acidity and metals from the oxidation of minerals in the PAG rock would runoff with precipitation into the water overlying the tailings. We recommend that the waste rock and tailings management aspects be clarified in an updated project description or waste management plan and that the EIS further clarify both PAG waste and pyritic tailings placement and method for minimization of oxidation of both wastes.

Closure/Post-Closure Water Treatment: Based on our review of Section 4.18, K4.18, and referenced documents, we recommend that the Corps provide additional information to evaluate whether the proposed closure/post-closure water treatment process (WTP #3) would be able to treat water from the open pit to meet applicable water quality standards. In addition, there are significant uncertainties associated with the design of the operations main water treatment plant (WTP #2) due to the potential for the buildup of salts and selenium. We recommend that additional evaluation of water treatment occur as recommended in AECOM's independent review of the WTPs (AECOM 2018i) and that the water management plans be revised to reflect water treatment designs and processes that will treat operations and closure/post-closure water discharges to meet the state standards. Section 4.18 and Appendix K4.18 of the DEIS do not definitively conclude that the closure WTP will meet standards; instead the DEIS states that "water quality of discharge from the open pit WTP is the subject of ongoing engineering analysis" (pg. 4.18-52). See our comments on Water Treatment, below, related to this issue for more information.

Reclamation and Closure: The lack of a detailed reclamation and closure plan is identified as a data gap in Section 3.1 of the DEIS. Reclamation and closure plans are frequently provided in mining EISs and we recommend that a reclamation and closure plan with a reasonable level of detail be provided to support the Pebble Project EIS analysis as this information is important to determine the effectiveness of reclamation and closure actions and resulting environmental impacts. The DEIS states that to accomplish dry closure, the bulk TSF tailings surface "would be covered with soil and/or rock and possibly a geomembrane or other synthetic material" (pg. 2-39). RFI 091 presents advantages and disadvantages of these cover types although it does not state what cover type would be used. We recommend that the EIS describe what specific cover material would be used to close the bulk TSF so that the effectiveness and timing of achieving dry closure can be better determined. Regarding the pyritic TSF, we recommend that the reclamation and closure plan and the EIS more fully assess the ability to adequately remove the pyritic tailings, PAG waste, liner, and any contaminated soil underneath. Further we recommend that the reclamation and closure plan describe plans for restoring any streams, wetlands, and ponds. In addition, we recommend that the EIS describe with more specificity how the cited State of Alaska reclamation standards would be implemented and met.

Financial Assurance: The DEIS states that "[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" (pg. 2-41). We recommend a more specific discussion of the estimated financial assurance amount and mechanism be provided, given that long term water management and treatment would be required in accordance with State of Alaska regulations. This would provide a basis for evaluating whether the reclamation and closure activities would be effective in the event of a bankruptcy or compliance issues. Our scoping comments (pg. 24) provided recommendations on the level of information to include in the financial assurance estimate. Other mining EISs developed by the Corps that that may serve as models for developing financial assurance estimates include the Donlin Gold, Haile Gold, and Northmet Mine EISs.

Plan for Strategic Timing of Water Treatment Plant Discharge: There are statements in the DEIS that the treated water discharges will be managed to optimize downstream fish and aquatic habitats (pg. 4.18-7 and elsewhere). However, the DEIS does not specify how the discharges would "optimize downstream habitat." We recommend adding a discussion and details of the strategy and how effectively it will mitigate project impacts to stream flow, water quality, and fish. We also recommend discussing how the water will be discharged or whether or where water would be stored in the interim between being treated and being discharged to accomplish strategic timing.

Fugitive Dust Control Plan: The project relies on a Fugitive Dust Control Plan to control and mitigate impacts from fugitive dust generated by the project. The DEIS provides examples of control measures that might be included in the fugitive dust control plan but does not provide the plan itself, nor does it state whether the example control measures represent project commitments. We recommend that a draft fugitive dust control plan be included in the EIS that specifies the control measures that would be used in order to more fully explain the extent to which fugitive dust releases would be mitigated and therefore reduce uncertainty regarding the level of potentially significant environmental and human health impacts due to dust releases. Our comments below on Mitigation provide a list of elements that we recommend be included in the Fugitive Dust Control Plan.

Monitoring Plan: The DEIS states that PLP proposes to use monitoring measures through construction, operations, and closure of the proposed project to assess predicted impacts and effectiveness of mitigation and that the monitoring plans would be developed during state permitting. Monitoring plans are typically included or referenced in mining EISs. We recommend that a monitoring plan with a reasonable level of detail be developed for the EIS to better provide a basis for the Corps conclusion that the monitoring plan would be effective at detecting changes. We recommend that the monitoring plan specify resources and locations that would be monitored, monitoring frequencies and parameters, and discussion of how monitoring results would be compared to baseline conditions and trends to determine if project impacts are different than predicted.

Adaptive Management Plan: Adaptive management plans are mentioned in the hydrology, water quality, and fish sections of the DEIS as an approach to respond to site conditions and project impacts that are different than predicted. The DEIS identifies that adaptive management could occur as a result of excess site water, changes to water flows and chemistry, uncontrolled potential seepage from northwest ridge of the bulk TSF, salt and selenium buildup in the water treatment plants, and impacts to water and fish that are greater than predicted. The DEIS provides examples of adaptive management and contingency actions but does not include an adaptive management plan or describe whether these examples represent project commitments. We recommend that PLP develop an adaptive management plan(s) for these elements so that the effectiveness of adaptive management at identifying and responding to changes and mitigation impacts can be assessed in the EIS. We recommend that the adaptive management plan describes which project elements would be subject to adaptive management and, for each of these project elements, identifies the specific monitoring that would occur, thresholds or trigger levels that would result in an adaptive management or contingent actions, and the specific actions that would be taken in the event of the threshold or trigger level being exceeded.

Additional Comments on the Proposed Project

Following are additional comments related to the description of the Proposed Project.

Mine Site Material Sources: The DEIS states that surface runoff from the quarries for mine site material is non-contact water (pg. 2-18). Quarries are classified as gravel pits and subject to the CWA National Pollutant Discharge Elimination System (NPDES) Effluent Limitation Guidelines (ELGs)[1] and any surface runoff is defined as mine drainage. This type of discharge could be covered by an Alaska Pollutant Discharge Elimination System (APDES) general stormwater permit because this is one of the non-stormwater discharges that can be covered. We recommend that the characterization of this type of water be corrected.

Material Management and Supply: Chapter 2 of the DEIS states that "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" (pg. 2-30). Table K2-5 does not include the chemicals required for the water treatment plants during operations and closure. We recommend that the chemicals and estimated quantities that would be required for water treatment be added to Table K2-5 so that both the type and amount of chemicals are included. In addition, since large quantities of specific chemicals would be required, we recommend ensuring that both traffic estimates for materials being brought to the site and onsite storage requirements during operations and closure include the chemicals needed for ongoing water treatment.

Transportation Corridor, Ferry: Regarding bilge water, which would be treated and discharged to Lake Iliamna, the Vessel Incidental Discharge Act (VIDA) requires the EPA to develop performance standards for those discharges and requires the U.S. Coast Guard to develop implementation, compliance, and enforcement regulations. Under VIDA, all provisions of the EPA NPDES Vessel General Permit (VGP) remain in force and effect until the U.S. Coast Guard regulations are finalized. We recommend that Chapter 2 of the EIS be updated to acknowledge the existing and future regulatory requirements for discharges from vessels, such as the ferry across Lake Iliamna. The DEIS also states that there will be office and maintenance buildings at both terminals (pg. 2-50), and we recommend that this section include a description of wastewater disposal for the terminal buildings.

Port Operations and Materials Transport: The DEIS describes the potential for wash water from rinsing the mine/ore concentrate containers to be treated and discharged at the port site (pg. 2-69). This water is mine process water, and as such, it is not an allowable discharge under the CWA. See our additional comments under Alternative 3, below.

Natural Gas Pipeline: The DEIS discusses that "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 natural gas pipeline (pg. 2-75). We recommend that the spacing for off-shore sections also be included.

[1] 40 CFR § 436.

Summary of Project Phases: Table K2-2 (Appendix K2) summarizes the activities that would occur during the project phases. During the closure and post-closure phases, the activity is listed as "Closure" and "Monitoring." We recommend that the need for active long-term water management and treatment be included during each of these project phases, including a specific description of the activities during the closure and post-closure phases.

ALTERNATIVES

Our primary issue and recommendation related to alternatives is that the EIS analyze additional alternatives so that the EIS range of alternatives includes alternatives that may be the Least Environmentally Damaging Practicable Alternative (LEDPA) under Section 404 of the CWA. Our letter on the CWA 404 Public Notice (see Section VI of the letter) also reflects these issues and discusses the CWA 404(b)(1) Guidelines.

Alternative 3 – Concentrate Pipeline Variant: Alternative 3 includes a port site variant that would include a water treatment plant at the port to treat and discharge process wastewater from the concentrate pipeline. That wastewater would consist solely of process wastewater resulting from use of a froth floatation process in the mill. Discharge of that process wastewater is prohibited under the New Source Performance Standards (NSPS) of the Effluent Limitation Guidelines (ELG) which were promulgated under the Clean Water Act by the EPA in 1982 (see 40 CFR 440.104(b)(1)). Discharge of process wastewater should not be included as a variant to an alternative in the EIS because this discharge is not feasible as that term is used under in NEPA (i.e., it cannot be authorized in an NPDES permit).

The New Source Performance Standards (NSPS) found in 40 CFR § 440 Subpart J cover three different types of discharges. Mine drainage and excess precipitation falling on the treatment area are allowable discharges under 40 CFR 440.104(a) while process water is not.

40 CFR 440.104(b), states:

> (b)(1) Except as provided in paragraph (b) of this section, there shall be no discharge of process wastewater to navigable waters from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores or any combination of these ores. . . .

While there are exceptions in the regulation that would allow the discharge of excess precipitation or recycle water, these exceptions do not apply in the case of the treatment system at the port facility as the pipeline would solely transport process wastewater. The exceptions stated in the 1982 NSPS are as follows:

> (b)(2)(i) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

> (b)(2)(ii) In the event there is a buildup of contaminants in the recycle water which significantly interferes with the ore recovery process and this interference cannot be eliminated through appropriate treatment of the recycle water, the permitting authority may allow a discharge of process wastewater in an amount necessary to correct the interference problem after installation of appropriate treatment. This discharge shall be subject to the limitations of paragraph (a) of this section. The facility shall have the burden of demonstrating to the permitting authority that the discharge is necessary to eliminate interference in the ore recovery process and that the interference could not be eliminated through appropriate treatment of the recycle water.

The language of the net precipitation allowance may lead one to the conclusion that any volume of water equivalent to the net precipitation could be discharged, regardless of water composition. The language of 40 CFR 440 Subpart L explains the concept of combined waste streams, which allows for discharge if allowable and nonallowable waste streams are treated together or stored together (as in a tailings impoundment facility):

> "*Combined waste streams.* In the event that waste streams from various subparts or segments of subparts in part 440 are combined for treatment and discharge, the quantity and concentration of each pollutant or pollutant property in the combined discharge that is subject to effluent limitations shall not exceed the quantity and concentration of each pollutant or pollutant property that could have been discharged had each waste stream been treated separately. In addition, the discharge flow from the combined discharge shall not exceed the volume that could have been discharged had each waste stream been treated separately." 40 CFR 440.131(a).

Further, the EPA wishes to correct a misunderstanding stated in the following discussion in the RFI 066:

> From RFI-066: "EPA's regulations do not limit where allowable discharges of process wastewater may occur nor do they restrict the process wastewater to certain processes within the mill or limit process wastewater discharges to those directly from the tailings facility. Rather, EPA's regulations only limit the total volume of process wastewater that may be discharged and leave open questions of "when, where, and how." As provided in EPA's 1982 Guidance document describing application of the net precipitation exception "[t]he volume allowed to be discharge[d] may be apportioned as the operator sees fit." See Development Document for Final Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category, pp. 536 (EPA November 1982). This suggests that the mine operator has significant discretion on discharges of the process wastewater provided the operator does not exceed the volumes allowable under the regulations."

The above quote on apportioning the discharge is from a section of the Development Document that was part of the record for the ELGs discussing the discharge of net precipitation, not process discharges. As stated at 40 CFR 440.104(b), there shall be no discharge of process wastewater to navigable waters from mills that use the froth floatation process alone or in conjunction with other processes. The examples provided in the Development Document discuss the timing of the discharge of excess precipitation (more in wetter months, less in drier) and not the overall composition of the discharge. That analysis found in the Development Document does not address the commingling provisions of the NPDES regulations.

<u>Alternatives 2 and 3 – Transportation and Port Site</u>: Alternatives 2 and 3 include a port at Diamond Point, which is currently being developed as a rock quarry. Development of the Diamond Point rock

quarry involves construction of an access road, breakwater, barge landing, and a solid-fill dock. It also involves 11.42 acres of intertidal fill and dredging in Iliamna Bay. The DEIS does not consider the Diamond Point alternative in light of this rock quarry. Specifically, the DEIS does not explain whether and how the rock quarry and Diamond Point alternative will cause impacts to the same aquatic resources. The DEIS would be strengthened by a discussion of whether and how the dredging for the rock quarry would reduce the 58 acres of dredging and 16 acres of onshore dredge materials storage proposed for Alternatives 2 and 3. In addition, the DEIS does not consider whether and how the two projects will be integrated, if it all. We recommend that the DEIS address this in order to more fully explain whether there is a practicable alternative to the Diamond Port alternative that would have less adverse impact on the aquatic ecosystem. We recommend that the EIS document whether and how the rock quarry and proposed Diamond Point port infrastructure, dredging, and vessel operations will cause impacts to the same aquatic resources. In addition, we recommend that the EIS explain whether and how the two projects will be integrated, if at all. In the alternative, we recommend that the EIS further explain why its existing description of the alternatives analysis for the Diamond Port alternative is sufficient.

<u>Mine Site Component Locations</u>: The DEIS evaluates one location for each of the TSFs, both of which involve a discharge to wetlands or other special aquatic sites. TSFs are not water dependent, and as a result, practicable alternatives that do not involve a discharge to wetlands and other special aquatic sites "are presumed to be available, unless clearly demonstrated otherwise." DEIS Appendix B (TSF-025, pg B-80) indicates that the Corps considered 26 different locations for the TSFs that were not evaluated as alternatives. The DEIS identifies the location of three of these 26 options in Figure B-3 and the locations of the other 23 options are found in RFI 098. RFI 098 identifies TSF location options assessed by PLP that have less impacts to streams with anadromous fish than the proposed action. The DEIS does not fully explain why these 26 options are not practicable. To strengthen the TSF location options screening, we recommend that the Corps should include all 26 TSF options on Figure B-3 and explain why each of the 26 TSF locations are not practicable. Alternatively, we recommend that the Corps further explain why its existing description and analysis of the 26 TSF options is sufficient.

The location proposed for the main WMP involves a discharge to wetlands or other aquatic sites. WMPs are not water dependent, and as a result, practicable alternatives that do not involve a discharge to wetlands and other special aquatic sites "are presumed to be available, unless clearly demonstrated otherwise." The options screening analysis in DEIS Appendix B does not appear to consider any alternative locations for the main WMP. The DEIS does not explain why the main WMP location is the only practicable alternative or explain how the WMP location was optimized to avoid and minimize impacts to aquatic resources. We recommend that the EIS describe why the proposed location for the main WMP is the only practicable alternative and explain the extent to which the proposed WMP location was optimized to avoid and minimize impacts to aquatic resources. In the alternative, EPA recommends that the Corps further explain why its existing description of the main WMP is sufficient.

According to RFI 098, the 26 TSF layouts were compared to several attributes, including minimizing managed water volume, impacts to fish-bearing streams, and impacts to wetlands and stream miles. None of the attributes consider downstream impacts in the event of a tailings dam failure. In light of the value of fisheries resources in the potentially affected watersheds (see Section II), downstream impacts in the event of a tailings dam failure should be one of the attributes included in the comparison. EPA notes that the current best practice for evaluating the different tradeoffs between TSF location, dam type, and impacts is a Multiple Accounts Analysis (MAA). We recommend that the EIS evaluate and document the potential downstream impacts in the event of a tailings dam failure to support its LEDPA determination and conclusions that there are not alternate location(s) that would have less impacts in the event of a tailings dam failure. We recommend that the EIS explain whether a MAA was performed for the TSFs or further explain why its existing description of the alternatives analysis for the TSFs is sufficient.

Transportation Alternatives – Corridors: The DEIS presents alternatives for the proposed transportation corridor, each of which involves discharges to wetlands and other special aquatic sites. The road and pipeline alignments are not water dependent, and as a result, practicable alternatives that do not involve the discharge to wetlands and other special aquatic sites "are presumed to be available, unless clearly demonstrated otherwise." We recommend that the DEIS more fully explain the information it considered when selecting which alternative road alignments to evaluate and in particular how this information relates to impacts on the aquatic ecosystem. In addition, the figures presented in K4.22 only provide information on wetlands and other aquatic resources inside the proposed corridors and do not indicate the status of areas outside the corridors. We recommend that the EIS explain and document the information it considered for the transportation corridor alternatives to demonstrate that there are not practicable alternatives to the transportation corridors analyzed that would have less adverse impact on the aquatic ecosystem, in order to clarify whether impacts to aquatic resources in the proposed transportation corridors could have been avoided and minimized. In addition, we recommend that the EIS include information about how wetlands and other aquatic resources were avoided and minimized to the extent practicable or further explain why its existing description of the alternatives analysis for the transportation corridor is sufficient.

Bulk TSF Liner: The DEIS predicts that groundwater contamination will occur under and beyond the bulk TSF. The DEIS assumes that all contaminated groundwater will be collected by the seepage management system. However, this assumption could be further supported with information about the seepage collection system design in relation to groundwater and geologic characteristics and the predicted contaminant plume (see our comments above and on Section 4.17). We have had discussions with the Corps about the considerations and trade-offs involved with inclusion of a liner. The EPA's letter on the CWA 404 Public Notice explains why the EPA believes this alternative could be part of the LEDPA. A liner is a typical management practice for TSFs that minimizes groundwater contamination, and we note that the Corps has recently permitted two fully lined tailings facilities at the Donlin and Haile mines and that a liner is included for the pyritic TSF. We recommend that the EIS evaluate the use of a liner as an alternative, alternative variant, or mitigation or further explain why a liner is not a practicable alternative to mitigate the predicted groundwater contamination. If a liner alternative or variant is analyzed, we recommend considering the inclusion of overdrains on top of the liner to help mitigate stability problems. Pumping tailings supernatant to the main WMP could be an additional mitigation measure to enhance stability, by further removing water from a lined tailings storage facility.

Potential Additional Alternative - Infrastructure Associated with Expanded Mine Development:
The DEIS indicates that expanded surface mining would require construction of the north access road and concentrate pipeline as described in Action Alternative 3. However, the concentrate pipeline would terminate at a new deepwater port facility constructed in Iniskin Bay[2] rather than at Diamond Point. A diesel pipeline following the road route and a diesel terminal at the Iniskin Bay port would also be required (DEIS Table 4.1-2). The Iniskin Bay port and diesel pipeline are not, however, being evaluated as alternatives for the currently proposed project. These components may be practicable now and it is

[2] The project proponent previously evaluated Iniskin Bay as a potential port site and multiple years of baseline data were collected.

possible that they could be part of the LEDPA. In evaluating whether the Iniskin Bay Port and diesel pipeline are part of the LEDPA, the Corps must evaluate the direct, secondary/indirect, and cumulative impacts to jurisdictional waters resulting from each alternative considered. One potential advantage of the Iniskin Bay port and diesel pipeline is that constructing this infrastructure now may avoid redundant infrastructure for expanded surface mining. Specifically, when the cumulative impacts of expanded mine development are considered, infrastructure such as the southern access route and ferry would appear to be redundant and therefore involve avoidable impacts. The Council on Environmental Quality (CEQ) cumulative effects guidance (CEQ 1997) states that lead agencies can "[m]odify or add alternatives to avoid, minimize, or mitigate significant cumulative effects." The cumulative effects of an additional port site and pipeline to accommodate future mine expansion could be significant. We recommend that the EIS evaluate this additional transportation corridor alternative terminating in Iniskin Bay or further explain why it is not practicable.

GROUNDWATER AND SURFACE WATER HYDROLOGY

Priority issues related to groundwater and surface water hydrology include potential inaccuracies and uncertainties associated with the hydrologic modeling and conceptual level of pit dewatering design, seepage management system design, and adaptive management which may result in underpredictions of the magnitude and extent of impacts to groundwater and surface water hydrology. The following detailed comments describe these key issues and provide recommendations for additional analysis to fully explain potential impacts to hydrology; comments related to open pit dewatering, seepage management, and adaptive management are also found in "Conceptual Level of Design and Development of Key Project Features and Plans". Additional comments on groundwater and surface water hydrology are provided following our key comments.

Hydrologic Modeling

Verification of Water Balance Model: Section 3.16 states that the water balance model incorporates three modules (watershed, groundwater, and mine plan modules) and that "the watershed module is a semi-distributed spreadsheet-based precipitation-runoff model" (pg. 3.16-18). However, there is no detailed explanation of the model and its application included in the DEIS. Most applied models are reviewed for accuracy and validity by analyzing inputs, model components, equations of those component relationships, and comparison of model outputs with measured/observed data at different study watersheds. We recommend that the Corps provide documentation to address these important components of model application. We recommend that the Corps consider EPA guidance on evaluation, application, and reporting of environmental models for impact prediction,[3] and include further information regarding water balance model accuracy and validity and verification of the merits and limitations of the model. In addition, we recommend that the NEPA document include: a description of the input parameters, including which hydrologic cycle components are included in the model; what water balance equations are used to determine the relationships of different water balance components; whether the spreadsheet method of water balance approach has been tested at different watersheds for its applicability; and how calibration and validation years were determined.

Groundwater Model Calibration and Sensitivity Analysis: The DEIS states that the groundwater model is still in the process of being updated and has not been fully calibrated and that "[c]ompletion of a model calibration report demonstrating adequate calibration of the model and including a more robust

[3] Guidance Document on the Development, Evaluation, and Application of Environmental Models, EPA/100/K-09/003.

sensitivity analysis would enhance the reliability of the model findings" (pg. K4.17-2). Because groundwater model findings are essential to the evaluation of groundwater impacts and input into the water balance model, we recommend completing the groundwater model calibration and sensitivity report to better demonstrate the adequacy of the groundwater model and water balance model results used for the EIS analysis of impacts.

Appendix K3.17 states that Monte Carlo analysis was used to assess groundwater model uncertainty and that "[t]his methodology differs from standard sensitivity analyses in which model realizations frequently exceed calibration criteria, meaning that the scenarios simulated may not be physically credible compared to existing field data." (pg. K3.17-33). We recommend that the Corps further explain this discrepancy in methodology regarding the differences of the two methods (Monte Carlo vs. standard sensitivity analysis) in a quantifiable way, or further explain why quantification is not necessary in this regard. We also recommend that the groundwater model be revised to improve accuracy or that the EIS discuss how these potential inaccuracies with the model affect the impact predictions.

<u>Groundwater Model and Extent of Groundwater Hydrology Impacts</u>: The DEIS uses the groundwater model to predict changes in groundwater conditions resulting from mine site activities. The DEIS states that the model may underpredict the impacts of pit dewatering as "the range of capture zones shown on Figure 4.17-2 are based on evaluating a modest range of variability in hydrogeologic properties assigned to the different layers and zones in the model to estimate the effect of uncertainty in these parameters." Considering the model uncertainties, the actual results of dewatering the pit may differ from projections described above. The DEIS states that "[i]t is expected that the amount of water produced during pit dewatering could be larger than simulated, and the capture zone and zone of influence could be larger" (pg. 4.17-6).

We recommend revising the groundwater model to reduce this level of uncertainty and provide more accurate and conservative predictions relevant to the amount of water produced during pit dewatering, capture zone, zone of influence and changes in groundwater conditions. We recommend that the Corps evaluate the model's hydrogeological input parameters that have the most influence on groundwater model results and adjust these input parameters, as needed, to develop more accurate predictions of the capture zone and open pit dewatering amounts. We recommend that groundwater model results be provided for expected conditions and conditions that could occur during dry and wet years and that the EIS explain the range of conditions modeled.

The groundwater flow model results provide the basis for other estimates and models. Therefore, we recommend that impact analyses based on the groundwater flow model results be revised based on the revised groundwater modeling, including the water balance estimates and stream flow reduction estimates, in order to reduce the likelihood that the severity of effects on groundwater and surface water flows and the ecologically important wetlands, lakes, and ponds and the fishery areas they support be underpredicted.

<u>Watershed Module</u>: In the calibration and validation plots for the North Fork of the Koktuli River and the South Fork of the Koktuli River provided in RFI-104, the model underestimates streamflow during higher flows and overestimates streamflow during lower flows, but it doesn't appear that there is consistency within or between years. The differences are evident also for the Upper Talarik Creek sites but appear less dramatic. There is a statement in RFI-104 that the model may not be able to predict the lowest flows. Low streamflows are associated with groundwater base flow in systems where there is interaction between surface water and groundwater. Because it is important to ensure that the Watershed

Module and Water Balance Model calibration accounts for the seasonal and annual variability of streamflow to address low, average, and peak flow periods or dry, average, and wet years and because of the apparent differences in model predictability based on seasonal flows (peak months and baseflow months), we recommend considering running models for separate flow seasons to see if there were closer fits to the actual data that would more fully capture the seasonal and annual variability. Alternately, we recommend discussing in the EIS how the potential inability to predict the lowest streamflows influences interpretation and use of model results and groundwater and streamflow estimates. We also recommend discussing whether the use of seasonally-separated flow models would better predict actual conditions.

Discussion of the calibration in RFI-104, Watershed Model Documentation, states that, "[i]n general, modeled flows replicate the winter low flows and the peaks created by freshet and fall rains. The cumulative plots show that the total water passing the gage over the calibration period matches well; however, the model over predicts the cumulative volume of water over the first two years of the calibration period and under predicts the cumulative flow for the remaining 3 years for most gage sites. The maximum discrepancy between calculated and measured cumulative flows is up to about 20 percent across the sites." However, the plots in RFI-104 indicate that some of the absolute differences between measured and calculated streamflows differ by more than 20 percent. We recommend that the EIS discuss how the 20 percent discrepancy in cumulative flows is considered in the Watershed Model output and what influence those results have on the output of other modules, such as the Water Balance Module, utilizing the same data.

Watershed Model inputs are based on monthly averages. Extreme precipitation events can have significant impacts in the affected environment, which cannot be simulated using the month-to-month approach. We recommend consideration of modeling the maximum and minimum values, or following a daily or event-based approach, to capture the variability in conditions, or that the EIS demonstrate how the current approach represents the range of flows that occurs over each month and takes into account extreme events on the water balance components in the watershed. We recommend that the EIS discuss how variability in input data for the Watershed Module (and other modules) is accounted for in model output. This is especially important if outputs from one module are used as inputs to another module. If the uncertainty in the model output (from both the assumptions used to develop the model and from the variability in each component of input data) is not carried forward with any use of model outputs as inputs for another module, we recommend that the EIS describe how this practice affects the mine site water balance.

We also recommend that the EIS more fully explain how the baseline data set does or does not consider extreme climate conditions. Long-term historical hydrologic assessment helps to understand how the watersheds in the area respond to natural events, especially extreme events related to drought and flooding. The baseline surface hydrology data used in this analysis spans a period of approximately 10 years or less (primarily from 2004 to 2012). Because the data set does not appear to capture historical conditions, we recommend using models to assess historical conditions by incorporating modelled weather and climate parameters. We understand that synthetic precipitation and temperature records were developed as part of the analysis for the DEIS. We recommend that the EIS discuss how the synthetic weather variables were developed by describing the equations or methods used for development, the objective criteria to assess the synthetic variables, the uncertainty analysis used to evaluate the accuracy of synthetic products, and how the peak flows were estimated from those parameters.

Spatial variability of hydrologic components over the geographic area is notable, and we recommend that the modeling address this variability. Without accounting for spatial variability, it is difficult to conclude that the model applied is a semi-distributed model. We recommend that the EIS include whether any interpolation of weather parameters at gaging stations was conducted for the model to cover spatial variability of watersheds.

Finally, we recommend that the Corps further consider addressing the magnitude and extent of increase/or decrease of the surface water flow in streams within the project study boundaries and beyond. Quantifying the watershed's response as a system, rather than solely looking at changes at gaging points, can help to assess the environmental consequences. We recommend including predictions of possible consequences on surface water magnitude and timing from the full implementation of the mining project using different scenarios, for example minimum, average, and maximum impacts.

Hydrology Impacts

Bulk TSF Groundwater Hydrology Impacts at Closure: The DEIS (Section 4.17.3.1) discusses changes in groundwater hydrology due to the presence of the bulk TSF during operation, but not during closure and post-closure. The bulk TSF will remain as a permanent site feature at closure and post-closure and therefore we recommend that the EIS describe expected impacts to groundwater hydrology during these phases.

Bulk TSF Seepage Estimates and Environmental Consequences: The DEIS includes inconsistent statements regarding the amounts of bulk TSF seepage that would flow through the embankment and the amount of seepage that would flow vertically into bedrock fractures.

Regarding flow into fractures, the DEIS states that seepage from the bulk TSF will flow laterally to the SCP and that some could also flow vertically downwards into deeper bedrock fractures (pg 4.17-4). Table 4.17-1 states that diverted groundwater would be "largely captured, treated, and discharged." Other sections of the DEIS imply that 100 percent of the seepage would be captured. We recommend resolving these conflicting statements and that the EIS describe how much seepage could flow into deeper bedrock fractures, where these fractures are located, and the extent to which these fractures could contaminate groundwater and transmit it beyond the mine site during operations, closure and post-closure.

The DEIS states that seepage through the embankment would be about nine cubic feet per second and seepage to groundwater would be 0.1 cfs (Section 4.17.3.1). The DEIS Geohazards Section (Section K4.15.1.4) states that seepage would be from 3 to 14 cfs and up to 20 cfs. The water quality section (Section 4.18.3.1) states that seepage would contribute 0.2 cfs to underlying groundwater (assumed to be accurate within a factor of 5) as compared to 9 cfs through the embankment. To resolve inconsistent estimates provided in the DEIS of seepage from the bulk TSF, we recommend that the EIS consistently describe the estimates of seepage through the embankment, to shallow groundwater, and to deeper bedrock fractures and that the EIS describe the uncertainty associated with these estimates.

Bulk TSF Seepage Adaptive Management and Contingencies: The DEIS states that "because tailings along the northwestern ridge of the bulk TSF would be built up higher than the two saddles along this ridge, it is possible that there would be a potential for groundwater flow paths through these saddles in late operations" (pg. 4.17-14). According to the document, "contingencies such as relief wells and/or seepage recovery wells would be implemented" if seepage through the ridge is detected by piezometers along the ridge and downstream. However, no details are provided regarding the adaptive management strategy that would be used to monitor, detect, and respond to any uncontrolled potential seepage. Nor does the referenced technical report (Knight Piésold 2018n) provide this detailed information. We recommend providing a detailed plan to detect and respond to uncontrolled potential seepage through the saddles and elsewhere as a reference document and summarizing the findings in the EIS.

Water Balance and WTP Capacity: The DEIS (Section 4.16.3.1) states that the water balance estimates may be subject to significant uncertainty since the predictions of groundwater flow to the pit are more likely to be low than high, and therefore the WTPs may need to process and discharge more water than currently anticipated (during both operations and closure). The DEIS does not include whether the WTPs are currently designed to treat higher flows and significant impacts to water quality could occur if the water treatment plant designs are based on an underestimate of the volume of water that will need to be treated. As noted above, we recommend revising the groundwater model and the water balance model to reflect higher pit inflow and also comparing the updated water balance results to WTP capacities so that the ability of the WTPs to treat the expected volume of wastewater is evaluated and included.

Excess Water Adaptive Water Management: The DEIS describes conceptual and general strategies for managing excess water at the mine site (pg 4.16-8). Given the uncertainty associated with the water balance estimates and the real potential for excess site water, we recommend that the EIS further examine the strategies and discuss their implementation and effectiveness to manage excess water. One of the strategies includes directing excess water to the open pit; we recommend that the EIS explain how this strategy could be implemented in practice, since the open pit is to be kept dry during mining. Another strategy is to direct excess water to the bulk TSF; we recommend that the EIS explain how this strategy could impact the freeboard and stability of the TSF. Conceptual adaptive strategies are listed, but an adaptive management plan is not provided. We recommend providing an adaptive management plan that describes the monitoring, trigger levels, and actions that would be taken in the event of water flows or chemistry that is greater than predicted, to enable determination of how adaptive management would be implemented and whether it would be effective.

Additional Hydrology Comments & Recommendations

Following are additional comments related to groundwater and surface water hydrology.

Groundwater Hydrology

Characterization of Aquifers and Confining Units: The DEIS displays cross-sections developed from borehole data to illustrate the subsurface distribution of aquifers and confining units in the mine vicinity. While the document states that the cross-sections illustrate lateral variability in surficial geology, this conclusion does not appear to be drawn from the figures. We recommend showing the extent of the aquifers on a plan view figure and providing additional information to clarify whether the aquifers and confining units in the mine vicinity are considered continuous or discontinuous.

Figures are also included to illustrate shallow groundwater flow patterns in the surficial aquifer at seasonal low and seasonal high-water levels (Figure 3.17-9a and Figure 3.17-9b). We recommend providing data points and representative elevation measurements utilized to generate the flow contours to show how the measured data support the contours. (Pg 3.17-4/3.17-6)

Characterization of Groundwater and Surface Water Interaction: We recommend providing additional information regarding how surface and groundwater interact across the mine site area, including an assessment/quantitative estimates of discharge from and recharge to groundwater (e.g., locations, forecasted volumes, seasonal variations, etc.) to indicate the extent of surface/groundwater interaction. This information could be provided in the EIS as a range of the minimum, average, and maximum discharge/recharge values. The DEIS concludes that the majority of stream reaches in the region are “gaining” reaches, that is, they receive groundwater discharge from the underlying aquifer. Losing stream segments are shown in Figure 3.17-11, however, a limited number of data points are displayed on this figure. We recommend that the EIS describe how determinations regarding which reaches are gaining versus losing were made, and that the Corps provide additional data points and representative elevation measurements where needed to support such determinations (i.e., relevant surface water and groundwater measuring points and values). We also recommend providing additional figures in the EIS that show representative gaining and losing scenarios based on existing data. (Pg 3.17-21/3.17.1.7)

Characterization of Flood Hazards: The DEIS states that because the project area watersheds “… are essentially undeveloped, a pre-mine flood hazard does not exist.” This statement appears to neglect other potential factors contributing to flood hazard, such as soil moisture content and extreme precipitation events. We recommend including additional discussion in the EIS to support the conclusion that baseline conditions throughout the project area include zero risk of flood hazard.

Water Management Pond Impacts to Groundwater: The DEIS acknowledges that “impacts to groundwater from the main WMP and open pit WMP would occur” (pg. 4.17-12) but provides little detail regarding the extent and magnitude of the impacts to groundwater elevations and flow. We recommend that the EIS include additional information regarding the potential impacts to groundwater from the WMPs. In addition, we recommend clarifying the statement in the DEIS that “effects could slightly exceed historic seasonal variation but would not extend beyond project component areas” with regard to magnitude and extent of impacts to groundwater elevations, as well as clarifying how the extent of impacts will be assessed beyond the component areas.

Private Groundwater Wells: The DEIS discloses the presence of 11 private groundwater wells within 0.5 miles of the pipeline infrastructure on the eastern side of Cook Inlet and provides a figure showing the location of those wells. While Section 4.17 acknowledges that the horizontal directional drilling (HDD)-installed pipeline would be expected to intersect aquifers used by these private wells, it does not address the potential for impacts to water quality or quantity. We recommend that the EIS evaluate and explain whether any hydrologic impacts are expected to affect private wells in the project vicinity and the plans for adaptive management as well as community outreach and support for safe drinking water should a pipeline failure occur.

Key Issues Summary, Table 4.17-1: We recommend that the uncertainty associated with the estimates to changes in groundwater be included in the table or as a footnote, particularly since they may be underestimated due to significant uncertainty identified in the groundwater model.

Surface Water Hydrology

Streamflow Changes: The DEIS (Section 4.16.3.1) states that streamflow predictions during operations and closure may be subject to significant uncertainties due to underestimates of groundwater flow into the pit. This could result in stream reaches that are not currently predicted to be impacted to be impacted, due to the underestimation of groundwater flow to the pit. As discussed above (see our recommendations for the groundwater model), we recommend that the groundwater modeling be revised based on higher inflows and that predicted changes to water balance, discharge volumes, and streamflows be subsequently revised such that the EIS more accurately predicts the magnitude and extent of streamflow impacts during mine operations, closure and post-closure.

Tables 4.16-2 and 4.16-4 provide estimates of the changes in average monthly streamflow during operations at a 50th percentile probability. We recommend providing summary tables in the EIS that show the changes associated with low and high flows. The 5-year low, 10-year low, 5-year high, and 10-year high flow information is provided in the cited reference, AECOM 2019b. The extent and magnitude of changes in streamflow are important to characterize in Section 4.16 and are also important for the subsequent sections that describe impacts to wetlands and aquatic resources (due, in part to these streamflow changes). Because of the importance of this information, we recommend including the low and high flow tables from AECOM 2019b in the EIS and/or Appendix K4.16 rather than in a reference document. In addition, we recommend adding figures to the EIS that show the locations of the stream reaches shown in Table 4.16-2, so that the geographic extent of streamflow changes are more fully explained.

<u>Operations Water Management</u>: According to the DEIS, the average annual process water surplus treated and discharged during maximum operations is estimated to be 29 cfs. We recommend further discussing the uncertainty around this estimate, particularly given the significant uncertainty in open pit water inflows (see Hydrologic Modelling comments, above). There are statements in the DEIS that the treated water discharges will be managed to optimize downstream fish and aquatic habitats. We recommend that the EIS provide a description of the system for managing treated water discharge and assess its effectiveness at optimizing downstream habitats.

<u>Design Criteria (Freeboard) for Water Management Structures</u>: We recommend that the DEIS provide numerical values related to the inflow design flood and freeboard in feet for the WMPs, SCPs and TSFs (see Table 4.16-1) or otherwise show that these facilities are designed with adequate freeboard and factors of safety, pertinent to both the Surface Water Hydrology and Geohazards (Section 4.15) environmental consequences sections.

<u>Water Extraction Impacts Along Transportation Corridor</u>: The EIS would be strengthened by additional evaluation of the potential effects from water extraction during construction and operation along the transportation corridor. Both temporary and long-term water extraction has the potential to reduce streamflow, alter wetland hydrology, and affect fish habitat. The DEIS, Chapter 2, provides a summary of water extraction sites and estimated annual water use, along with the length and area of access roads that would be constructed to extract the water. The specific locations of water extraction, the anticipated rate of extraction, and years of use are provided in Appendix K2. Many water extraction sites are stated to operate throughout the “life of mine” in Appendix K2, including four stream locations and five lake locations under Alternative 1. We recommend that the EIS provide additional information and analysis to further explain the amount of water available at each extraction site, in order to better support conclusions regarding the effects of these water withdrawals on streamflow and fish habitat. Furthermore, the discussion of effects resulting from water extraction is limited to those on waters that contain anadromous fish. The DEIS states that “[p]ermit compliance would avoid the potential for impacts from water withdrawal at streams” (pg. 4.16-30). We recommend that the EIS explain whether anadromous fish are located at every water extraction site, and therefore whether this conclusion is appropriate for every water extraction site. We further recommend that the EIS discuss the types of measures that the permit would require to protect fish generally, including anadromous fish, and how

impacts would be reduced using those measures. We recommend that for each extraction site, the DEIS explain how much water, wetlands, and habitat are currently present (the baseline), and the potential for impacts to streamflow, wetland hydrology, and fish habitat. We recommend that the analysis include information about the specific water bodies where water extraction will occur, including more information than a simple water resource categorization of "stream," "lake," or "pond," and that the analysis include a comparison of proposed water extraction to streamflow data collected from stream gaging stations (Figures 3.16-4 and 3.16-15).

<u>Amakdedori Port Design and Analysis of Nearshore Sediment Transport</u>: The DEIS provides a cursory discussion and analysis of coastal processes and does not include a coastal engineering assessment for the Amakdedori Port location, nor an assessment of the prevailing littoral drift direction along the shoreline in that area. The drivers and magnitude of shoreline sediment transport processes and sediment sources are not discussed, nor are the long-term changes (erosion, accretion, substrate characteristics) to the shoreline and associated resources (e.g., at the mouth of Amakdedori Creek). Statements in the DEIS that no predominant littoral sediment transport nor alongshore currents exist at Amakdedori Port are based on "historical and current photos of the coastline," though the details, scope, and sufficiency of this analysis are not provided. In addition, the document states that the shoreline is currently "in equilibrium," and that while some accumulation at the base of the causeway is inevitable, there are no signs that such accumulation would be large or persistent. We recommend that the EIS more fully explain the details and analysis supporting this statement.

Proposed construction of the Amakdedori Port marine facility (11 acres) includes an earthen access causeway (500 feet wide x 1200 feet long) extending out to a marine jetty, located in water depth -15' below mean lower low water (MLLW). The marine jetty (120 feet wide x 700 feet long) would continue to extend into the Bay from there and would be a sheet pile cell structure filled with granular material. Thus, the overall structure would extend perpendicular to the shoreline, almost 2000 feet into Cook Inlet (see Figures 2-28 and 2-33), and would affect coastal processes in this area. Therefore, we recommend conducting a coastal engineering analysis specific to the two marine port alternative locations to assess the effects of the alternative port causeway/jetty structures on adjacent shorelines, sediment transport processes, and associated resources. We recommend including the information in the EIS to further support conclusions regarding potential impacts to nearshore sediment transport.

The Amakdedori Port description states that "dredging of the port site would not be required." Required navigable depths for fully loaded lightering barges and marine traffic other than tugs (12-foot draft) are not provided, and there is currently no analysis to support the statement that maintenance dredging would never be required at this site. The previously recommended coastal engineering analysis would also provide a prediction of the frequency and potential volumes of sediment associated with any maintenance dredging required for each alternative for decision makers and the public to consider. We additionally recommend evaluating and disclosing the impacts to the immediate and adjacent shoreline from the pile-supported causeway and jetty variant (Section 2.2.2.7 Action Alternative 1 – Pile-Supported Dock Variant), as dense piling structures affect sediment transport.

<u>Diamond Point Port Design and Analysis of Nearshore Sediment Transport</u>: The DEIS lacks a sediment transport assessment, and we have the same recommendations on this topic for the Diamond Point alternative as for Amakdedori, although we note that the marine footprint is larger (14 acres), so impacts may be greater. In addition, the DEIS analysis anticipates dredging a -20' MLLW channel (58 acres), producing 650,000 cubic yards of dredged material. A portion of the material would be used for dock construction, with the remainder of the material placed upland for disposal (see figures 2-52 and 2-53).

The DEIS states that “[t]he frequency of required maintenance dredging is unknown but could be every 5 years.” There is no supporting documentation for this statement, nor for the size of upland disposal areas anticipated to take initial and future volumes of maintenance dredged material. We reiterate our recommendation for a more complete coastal engineering analysis to support these dredging and disposal predictions. We also recommend evaluating and disclosing impacts to the immediate and adjacent shoreline from the pile-supported causeway and jetty alternative (Section 2.2.3.6 Action Alternative 2 – Pile-Supported Dock Variant), as dense piling structures affect sediment transport.

Alternative 3 – Concentrate Pipeline Variant: The DEIS (Section 4.16.5.5) concludes that the reduced discharge from WTPs associated with this alternative could result in greater reduction in stream flows than those described under Alternative 1. The significance of this reduction is not described. We recommend that the magnitude, duration, and extent of this reduction in stream flows be described in the EIS so that this alternative can be better compared to Alternative 1 and the other alternatives.

Summary of Key Surface Water Hydrology Issues: The key issues summary table (Table 4.16-5) provides summaries of mean annual streamflow changes. We recommend also providing a summary of changes due to extreme conditions (high and low flows) so that the magnitude and extent of streamflow changes is fully summarized. In addition, some of the differences among the alternatives described in the text are not provided in the key issues table (such as streamflow changes for the Alternative 3 concentrate pipeline variant) and we recommend that these be added to the table. We also recommend summarizing the uncertainty associated with these flow estimates in the table.

Impacts of Future Potential Changes in Climate: In our scoping comments, the EPA recommended that the EIS include a discussion of reasonably foreseeable effects that changes in the climate may have on the proposed project and the project area, including its long-term infrastructure. To complement the general discussion of climate change and its potential effects on aquatic resources in the DEIS, we recommend projected changes in the type (e.g., snow vs. rain) and timing of precipitation be addressed. Given the long closure and post-closure time periods that include management of the open pit and water discharges in perpetuity, the Corps should consider whether projected changes in climate should be evaluated for longer time frames than the few decades during which the mine is proposed to be operational. The DEIS refers to Knight Piésold 2009, which summarized relevant literature regarding likely changes to the climate in the mine region; we recommend that the relevant conclusions of that study, updated by recent national assessments, be discussed in the EIS. Where projected changes could notably exacerbate the environmental impacts of the project, we recommend that the EIS include more robust discussion of those potential effects. This would include the EIS assessing the impacts on the water balance and hydrology impacts of increased extreme precipitation events due to climate change. The project appears to rely on water management pond freeboards and adaptive management to respond to changes; however, an adaptive management plan is not provided, which makes it difficult to assess the effectiveness of adaptive management. We recommend that an adaptive management plan be prepared and provided in the EIS, and that it include the monitoring and specific measures to manage and mitigate impacts that could result from changes in the climate around the mine region.

WATER QUALITY

Key issues with the analysis of impacts to water quality include: poor representativeness of the geochemical dataset, lack of supporting information for many assumptions regarding the behavior of leachate, need for additional information to assess the effectiveness of water treatment at closure, incomplete detail to evaluate the effectiveness of seepage management, incomplete data quality assessment for background water quality data, lack of a modeling sensitivity and uncertainty analysis, and incomplete analysis of water quality impacts in closure/post-closure phases. These issues may result in underpredictions of the magnitude and extent of impacts to groundwater and surface water quality which could result in exceedances of water quality standards. The following detailed comments describe these key issues and provide recommendations for additional analysis to fully explain potential impacts to water qualtiy. Additional comments on water quality are provided following our key comments.

Geochemical Sample Representativeness

The comments below describe the key issues with the representativeness of the geochemical dataset, which include: the lack of a quantitative analysis to support representativeness; the limited geochemical testing performed on tailings representative of the current metallurgical process; and the fact that geochemical data utilized to characterize ore and waste rock includes many samples that were collected from outside of the area of the proposed mine. Because this dataset forms the basis for the predicted water and sediment quality impacts, bias in the geochemical dataset could result in water and sediment quality predictions that are not representative of conditions during and after mining at the Pebble Project site. We recommend that only ore and waste rock samples from within the current footprint of the proposed mine and that only tailings samples that are representative of the current metallurgical process be included in the geochemical dataset to support EIS water quality predictions.

<u>Ore and Waste Rock Representativeness</u>: In several locations, the DEIS mentions that the geochemical dataset is representative of the different types of materials associated with the mine (e.g., Ch 3.18, pg. 3.18-2). However, quantitative analysis to support the conclusion regarding representativeness is not included. We recommend that this be addressed by providing a table in the EIS that shows the percentage of each ore type for the proposed mine and the percentage of samples that were used to characterize each ore type. We also recommend that the number of samples used in the characterization be similar to the percent abundance of the particular ore-type in order to more fully support the conclusion regarding representativeness.

In Appendix K3.18, Table K3.18-3 shows a summary of the rock and tailings used in the geochemical testing program. The above information could also be added to this table to support the conclusion. In addition, we recommend that this table include information regarding the sedimentary and volcanic origins of the materials associated with the mine, as well as the presence of hydrothermal alterations zones within the different types of materials, since this information is important to understand the acid generation potential of the different materials.

The geochemical data utilized in the DEIS includes many samples that were collected from outside of the area of the proposed mine. The DEIS states that "data from both the PEZ and PWZ are used, and when appropriate, combined to create a more robust dataset (SRK 2018f)" (pg. 3.18-3). The proposed project includes mining only the west pit (PWZ); therefore, data obtained from outside the PWZ are not representative of the conditions encountered in proposed project. As a result, the water and sediment quality predictions (which utilized the data from both the PWZ and PEZ) are not representative of the impacts associated with the proposed mine project.

The rationale for combining the PEZ and PWZ data is provided in the SRK 2018f reference, a draft memorandum, which had the objective of performing a "high-level analysis comparing data from Pebble East and West." The draft memorandum uses five lines of evidence to support using the combined dataset:

1. The draft memorandum provides a general description of how the PWZ and PEZ have similar geology. However, this analysis is non-quantitative and focuses on broad similarities as opposed to discussing lateral variability in the geological units, variations in the depth of oxidation, variations in the coverage of tertiary rocks, and variability in the sulfur and trace metals concentrations. In the SRK 2011a document, Table 11-1 shows the Pebble Deposit Rock types for the PEZ and PWZ. While this table shows that there are many similarities between the PWZ and PEZ geology, there are also notable differences. For example, the PWZ has the following rock types that are not present in PEZ: Quarternary Ferricrete, Pre-tertiary quartz monzonite monzodiorite, gabbro, pyroxenite, igneous breccia, skarn, and felsite. Also, the PEZ has the following rock types not present in PWZ: Tertiary Latite, siltstone, and volcaniclastic rocks. Overall, despite high-level similarities in the geology of the PWZ and PEZ, there remain significant differences when looking at more specific rock types and characteristics.
2. The draft memorandum states that the HCTs had 10 more samples from the PWZ than the PEZ (36 compared to 26). However, there is no discussion of whether the results from the humidity cell tests (HCTs) showed any significant differences.
3. The draft memorandum refers to Figure 11-27 in Chapter 11 of the SEBD which shows that there is overlap in the graph of sulfide versus sulfate release in the PEZ and PWZ. However, this analysis is based on a small dataset (n=36 samples) and only focuses on a single geochemical parameter, sulfur.
4. The draft memorandum mentions that the barrel tests had more PWZ than PEZ rock in them. However, this does not provide evidence that the leaching chemistry was not biased by the addition of the PEZ material. In addition, the data from the barrel tests was not used to develop the source term concentrations used for water quality modeling, and therefore these results are disconnected to the predicted water quality impacts from the mine.
5. The draft memorandum mentions that the shake flask tests were from the PWZ. However, this is a relatively small part of the geochemistry dataset, and, as with the barrel tests, the shake flask data were not used directly in any of the water quality predictions models.

Overall, the SRK 2018f memo makes the case for combining the PEZ and PWZ data based on the comparisons of very small datasets. Because there is a lot of variability in the geochemistry data, comparisons of small datasets will be biased towards not being able to identify significant differences between the two sample populations (i.e., the PWZ and the PEZ).

However, there is a much larger dataset of acid base accounting (ABA) results for both the PEZ and PWZ in Appendix 11B of the PLP 2018a document (>1,000 samples). Due to its larger sample size, this dataset is more well suited for addressing questions of similarities between the PEZ and PWZ. We performed statistical t-test analyses on some of this data to determine if there were statistically different concentrations between the PWZ and PEZ. Our results show that the PWZ samples had a significantly lower pH than the PEZ (t-test assuming equal variance, $t=7.76$, $df=1082$, $p<0.001$: PWZ pH: 7.4±1.2; PEZ: 8.0±1.5). The higher pH in the PEZ dataset suggests that combined PEZ and PWZ dataset would underestimate the acid rock drainage (ARD) risk relative to using just the PWZ data. Similarly, analysis of this dataset showed that the percent total sulfur and the percent sulfate were both <u>significantly higher</u> in the PWZ than the PEZ (Sulfur PWZ: 2.6 ± 1.9%; PEZ: 1.5 ±3%; $p<0.001$, $df=1082$; Sulfate: PWZ: 0.06 ±0.01%; PEZ: 0.04 ±0.01%; $df=1082$, $p<0.001$). Again, these results show that the combined PEZ and PWZ dataset would <u>underestimate</u> the ARD risk relative to using just the PWZ data. In addition, the concentration of arsenic in waste rock was significantly higher in the PWZ than the PEZ (PWS As: 45 ±94 ppm, PEZ: 25±35 ppm; $p=0.004$, $df=554$). These results indicate that the combined dataset would predict lower arsenic concentration than if using just the PWZ. It is also worth noting that many of the statistical tests between other metals/metalloids did not indicate that the PWZ samples were associated with higher metal leaching or ARD risk. However, in the above examples, using the combined dataset has the potential to underpredict the environmental impacts of the proposed mine for some parameters. We recommend that the dataset most representative of the project (i.e., the PWZ data only) be used as a basis for the impact assessment rather than the combined data set.

The DEIS and supporting documents focus on explaining the similarities in the PEZ and PWZ dataset (which is not entirely supportable based on the given information); however, the specific benefit of including many samples collected from outside of the proposed mine area is not established. We recommend that all PEZ data be removed from the analysis and the characterization of the impacts of the mine include only data from the PWZ, which is a more scientifically accurate approach. Alternatively, the Corps should further explain why this approach was adequate.

If the EIS analysis continues to rely on the combined dataset, we recommend providing a statistical analysis that supports this approach and that the EIS describe any limitations or influences on modeling and the conclusions made in the EIS based on use of this combined data. We also recommend that the EIS discuss limitations on statements and conclusions associated with variability in the data analysis (i.e., how variability affects modeling output and how that affects water quality predictions and conclusions).

Tailings Representativeness: The DEIS states that "limited geochemical testing has been performed on the representative concentrate because possible designs for metallurgical processes are still at an investigative stage" (pg. 3.18-3). Because the characteristics of the tailings appear to be different from the ones used in the geochemical testing, the predictions may not be representative of the actual water quality. The tailings supernatant data used to represent tailings water quality is based on tailings produced via flotation and "gold plant tails" (Appendix K4.18). We assume "gold plant tails" means cyanide leach tailings, although we recommend that this be clarified in the EIS. Since the current project processing flowsheet does not include a gold plant, these samples may not be representative of the tailings at the mine site. We recommend that metallurgical processes be established prior to conducting the geochemical analysis, such that representative information can be included in the EIS. We recommend that gold plant tails samples be removed from the data used to represent tailings water quality or that further discussion be provided in the EIS that explains the variability and uncertainty around the tailings water quality estimates due to inclusion of this data. In addition, there should be information included on how the grain size of the tailings relates to the grain size of the material used in the HCTs because this can be an important variable affecting the release of metals/metalloids.

Metal/Metalloid Mobilization and Behavior of Leachate

We recommend that the DEIS expand its consideration of several important aspects of leachate behavior, including the potential for metal/metalloid mobilization. The distinctions between PAG and non-PAG materials in the DEIS do not appear to be conservative estimates, metal/metalloid mobilization under neutral pH conditions has not been fully considered, the DEIS appears to underestimate metal/metalloid whole water concentrations, and differences in selenium, mercury, and chromium speciation are not fully considered. These issues impact the accuracy of the impact analysis and appears to underestimate those impacts. Our detailed technical comments regarding these key water quality issues and recommendations follow.

Distinctions Between PAG and Non-PAG Materials: It appears that the distinctions between PAG and non-PAG materials are not conservative and could result in unanticipated water quality impacts. This is important because mine materials are managed differently depending on whether they are PAG or are non-PAG. Material determined in the DEIS to be non-PAG could leach metals/metalloids at elevated concentrations and impact water quality. The DEIS states: "During mining, rock materials will be assessed using the block model to determine whether the mined rocks are PAG or non-PAG, and whether the mined material would be processed and disposed as tailings, or not processed and set aside as waste rock" (pg. 3.18-5); and, "The ABA and humidity cell data indicate that PAG and non-PAG rocks can be distinguished using an NP/AP ratio of 1.4 (PLP 2018a), and are applicable to pre-Tertiary, Tertiary, and overburden materials." (pg. 3.18-3)

Although not specifically stated in the main text of the DEIS, we assume that the site-specific value of neutralizing potential to acid producing (NP/AP) ratio value of 1.4 would be used to segregate PAG from non-PAG materials. We reviewed the referenced document (PLP 2018a), specifically Section 11.7.1.3.1, and the derivation of the 1.4 value is not explained. The text references Figure 11-28, which shows a plot of NP/AP versus sulfate release, but this plot does not show specifically how the 1.4 value was derived. We recommend that the rationale for the 1.4 ratio and description of how it was calculated be described in the EIS.

Elsewhere in the supporting documents of the DEIS, a more conservative ratio value of 2 is used to indicate where the materials have uncertain acid generating potential (e.g., Figure K3.18-2 and pg. 11-9 of the EBD). Ratio values larger than 2 have also been proposed for other mine sites to provide a more conservative approach to distinguishing PAG from non-PAG. For example, the EPA's 1994 document, Acid Mine Drainage Prediction, states that, "[W]hen the ratio of a sample's neutralization potential and acid production potential is greater than 3:1, experience indicates that there is lower risk for acid drainage to develop (Brodie et al. 1991). For ratios between 3:1 and 1:1, referred to as the zone of uncertainty, additional kinetic testing is usually recommended."

There are several factors that can affect the calculation of NP/AP ratios and result in biased calculations. Uncertainties associated with these different variables is one reason why more conservative ratios (such as 2 or 3) are often used to differentiate PAG from non-PAG. Because the DEIS is using a relatively low NP/AP ratio of 1.4, we recommend that it is important that the EIS address the multiple factors that can potentially result in biased ratios. For example, in the discussion of NP/AP ratios, we recommend that the EIS provide information on the presence of non-pyrite sulfide minerals, the presence of acid-producing minerals other than sulfides, the presence of carbonate minerals that do not produce alkalinity, and the presence of non-carbonate minerals that can buffer acidity (e.g., chlorite, biotite). In addition, the PLP 2011 supporting document indicates that both the Sobek and the modified Sobek methods were used for the estimation of the neutralizing potential (NP). The modified Sobek method is preferred for the determination of PAG material because it is less likely to overestimate neutralizing capacity. We recommend that the EIS clarify whether data from both these types of tests were used in the calculations or just the more conservative modifided Sobek data were used.

Distinctions Between Metal Leaching and Non-Metal Leaching Materials: The DEIS assumes that mine materials with NP/AP ratios >1.4 are non-PAG, have less risk of metal leaching and will be handled differently at the mine site compared to PAG materials. We recommend that the Corps evaluate whether the NP/AP ratio of 1.4 is a good predictor of lower metal concentrations and explain the determination in the EIS. To address this, we analyzed the data in SRK 2011a, Table 11-10, to determine whether there were significantly lower metal concentrations associated with samples with NP/AP ratios of >1.4 for several elements (As, Cu, Hg, Pb, Se, and Zn). For As, Hg, Pb and Zn, there was no significant difference in concentrations depending on whether the ratio was greater or less than 1.4:

- Arsenic NP/AP >1.4: 63 ±63 mg/kg; As NP/AP <1.4: 140 ±241mg/kg, t-test p-value: 0.34, df=28;
- Mercury NP/AP >1.4: 0.10 ±.26 mg/kg; Hg NP/AP <1.4: 0.20 ±0.07 mg/kg, t-test p-value: 0.25, df=28;
- Lead NP/AP >1.4: 17 ±.11 mg/kg; Pb NP/AP <1.4: 11 ±12 mg/kg, t-test p-value: 0.24, df=28; and,
- Zinc NP/AP >1.4: 4.4 ±2.9 mg/kg; Zn NP/AP <1.4: 4.3 ±3.3 mg/kg, t-test p-value: 0.94, df=28;

Only copper and selenium showed significantly higher concentrations when the NP/AP ratio was <1.4. Our analysis shows that the NP/AP ratio of 1.4 is not a good predictor of metal concentrations and may not correctly identify materials that have the potential for elevated metal leaching. We recommend that either a more conservative ratio value (such as 2 or 3) be used to differentiate PAG from non-PAG material or that the rationale for the 1.4 ratio value be better explained in the EIS to demonstrate protection of water quality.

Use of Dissolved/Filtered Water Concentrations: The water quality predictions in the DEIS are based on dissolved/filtered water concentrations for metals parameters and these lower numbers are compared to State of Alaska water quality standards that are based on whole water concentrations. Our assessment of the information provided in the DEIS and supporting technical documentation indicates that the water quality predictions that are based only on dissolved metals concentrations can result in an underestimation of the metal/metalloid whole water concentrations and a biased comparison to WQS. We recommend that whole water concentrations be used instead or that the EIS further explain why the current analysis is sufficient as discussed below.

Chapter 3.18 p 3.18-4 of the DEIS states that “[e]lement release rates determined from kinetic tests, which were performed on both filtered and unfiltered samples, were mainly a function of leachate pH rather than the element content of the samples (SRK 2011a).” While it is correct that the barrel tests analyzed dissolved and whole water fractions, the other kinetic tests (HCTs, the saturated column tests, and the stored bag tests) did not perform that analysis. Most importantly, the HCTs release rates were used in generating the source term element releases rates that were incorporated into the water quality modeling. The results from the barrel tests do not appear to be directly used in the water quality modeling and the distinctions between the dissolved and whole water concentrations obtained from these tests is not discussed or analyzed in the DEIS or supporting documents.

The SRK 2018 document, Geochemical Source Terms for Water Treatment Planning, (SRK 2018a) states that the modeling source terms were developed based on dissolved concentrations and that this is a limitation of their use in predictive water quality modeling. SRK 2011a, Appendix 11J includes a table that provides whole water and filtered water concentrations from the barrel tests. Doing a statistical paired t-test for the whole water and filtered water shows that for some metals the whole water values are significantly higher. For example, the whole water aluminum concentrations were 29 percent higher than the filtered concentrations (p<0.001); the whole water iron concentrations were 17 percent higher (p=0.001) and the whole water mercury concentrations were 79 percent higher (p<0.001). These results indicate that water quality predictions included in the DEIS based only on dissolved metals concentrations are underestimating the whole water concentrations. We recommend that the ratios of whole water to filtered water from the barrel tests be used in the EIS to estimate the whole water concentrations from the dissolved values that are provided by the model.

Metal/Metalloid Mobilization Under Neutral pH Conditions: We recommend that the EIS analyze the potential impacts from metal/metalloid mobilization under neutral pH conditions. As stated in the DEIS: "metalloids such as arsenic, molybdenum, and selenium, and salts such as sulfate, can be released into the environment even if the water draining the rock has a neutral or basic pH" (pg. 3.18-3); and, "[F]or some elements (arsenic, molybdenum, and selenium), release can be environmentally significant under neutral pH conditions, as described in SRK (2011a)" (3.18-4). Because determinations regarding how a material will be handled (i.e., whether it can be used for road construction, etc.) will be based on whether it is PAG or non-PAG, there is the potential that non-PAG materials could become sources of some metals/metalloids leached under neutral pH conditions. We recommend that the EIS consider this potential when discussing non-PAG material to determine if there are elevated concentrations of metals/metalloids that could be mobilized under neutral pH conditions. This is particularly important for areas where the runoff from these materials would not be captured by any water treatment facility.

Influence of Bulk Metal Concentrations Versus pH on Leaching Rates: Statements in the DEIS indicate that the leachate pH is a more important variable than the element content of the mine material for predicting water quality impacts. This assumption does not appear to be supported by statistical analysis and could result in an underestimation of water quality impacts from materials with elevated metal/metalloid concentrations but lower acid generating potential. The DEIS states, "Element release rates determined from kinetic tests, which were performed on both filtered and unfiltered samples, were mainly a function of leachate pH rather than the element content of the samples (SRK 2011a). Leaching of copper accelerated as pH decreased; therefore, the potential for metal release is linked to the potential for acid generation, and ABA data can be used to assess the potential for copper leaching." (pg. 3.18-4)

A review of SRK 2011a shows that this statement is based on information in Figure 11-55 and 11-56 as well as Table 11-43, each of which are discussed in more detail below:

- Figure 11-55: This figure shows the copper (Cu) release rate plotted as a function of the total Cu content. In the figure, the highest release rates are associated with samples with pH<6; however, these samples are also associated with the highest bulk phase Cu concentrations. The figure and associated text do not provide any statistical analysis to support the statement that the pH is a larger driver of the Cu in leachate compared to the Cu content of the bulk material;
- The DEIS, and supporting document SRK 2011a, do not provide a table where the pH values associated with the element release rates are provided, and as such, it is not possible for reviewers of the EIS to perform the statistical analysis necessary to determine the relative importance of pH versus bulk phase element concentrations. In lieu of having that information, the EPA extracted/estimated data from Figure 11-55 using a web plot digitizer and performed a simple linear regression analysis between the bulk Cu concentration and the release rate. The results of this analysis showed a highly significant relationship (p=0.00001). While this analysis does not show that the bulk concentrations are a larger driver than pH in the Cu release rates (that would require multivariate analysis), it clearly shows that the bulk concentrations are an important factor affecting the Cu release rates;

- Figure 11-56: This figure provides similar information as 11-55 mentioned above, but instead focuses on Arsenic (As). Based on our visual assessment of the information included in this graph, the figure does not provide enough information to support the original statement in the DEIS regarding the importance of pH;
- Table 11-43. This table provides the summary information on the relationship between bulk concentrations and leaching rates. In the table, the correlation coefficients are presented for specific pH ranges (pH<3, pH<6 and pH>6). When the DEIS discusses leaching rates at neutral pH conditions, we presume that the discussion refers to leaching at pH>6, although we recommend that this point be clarified. Because rainwater pH is ~5, we recommend that the data be consolidated into categories of pH values less than and greater than 5, as this split is more relevant to field conditions at the mine site. Because the analysis in the DEIS relies on the assumption that non-acid generating conditions would occur at a pH of 6, the DEIS might be underestimating element leaching when exposed to rain water;
- Table 11-43 does not provide information on whether the correlations are significant, or the sample size associated with the analysis. These are both important pieces of information to include for the interpretation of the data in the table; and
- In Table 11-43, most elements have higher correlation coefficients at higher pH values (<6) relative to lower pH values (<3). Examples of this include the following elements: Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Fe, Mn, Ni, Pb, Sb, and Se. Examples showing that the best correlation occurred at pH<3 include: Cu, Hg, K, Mg, Mo, and Zn. The text in SRK 2011a states, "For the acid leachates, some stronger correlations were observed, particularly in the case of the very acidic leachates (pH less than 3)." However, there were 15 elements that had higher correlations at pH<6 than at pH<3, and there were only six elements where the correlation was stronger when pH<3. As such, we recommend that the EIS include additional data to support this statement, as well as to support the statement in the DEIS regarding the importance of pH over bulk element concentrations in driving element leaching.

The multivariate component to element release rates is acknowledged on pg. 11-55 in the SRK 2011a document, which states that "[i]t is possible that the pH effect is masking any relationship that might have been present between the metal release rates and the bulk composition." In summary, we recommend that multivariate statistical analysis be used to determine the relative influence of bulk metal concentrations versus pH on leaching rates. Alternatively, the Corps should further explain why its existing analysis is sufficient.

<u>Timeframe for the Development of Acidic Conditions</u>: The timeframe predicted for the development of acidic conditions may be underestimated and future mine expansion activities may delay the aqueous storage of PAG materials and result in some materials becoming acid generating and having higher metal/metalloid leaching rates than are predicted in the DEIS. The DEIS states that "[p]aste pH results for aged rock cores stored at the site suggest that acidification may be delayed up to 40 years for 95 percent of the pre-Tertiary mineralized rock (SRK 2011a). Given differences in the test conditions, laboratory and field tests suggest that oxidized pre-Tertiary mineralized rock may take up to several decades for acidification to occur." (pg. 3.18-3). In reviewing the SRK 2011a document, it is not clear whether the rock cores were aged intact or crushed. If they were relatively intact, the greatly reduced surface area would limit the oxidation rate and these rates/time frames would be much longer than if the test was performed on crushed material, which may be more representative of actual site conditions. We

recommend that the EIS provide additional information regarding the grain size of the aged rock cores and how this would impact the acid rock drainage ARD timeframe.

The SRK 2011a reference also states that, "ARD generation under site conditions is at least a decade to several decades," and PLP 2018a states that, "Under field conditions, onset of acid generation is expected to be delayed by at least two decades." We recommend verifying which reference accurately reflects anticipated onset of acidic conditions in the waste storage areas and updating the information in the EIS.

<u>Metal/Metalloid Speciation</u>: Differences in selenium, mercury, and chromium speciation are not discussed in the DEIS. These metal/metalloids have different toxicological properties depending on their speciation, which we recommend be taken into consideration when determining the impacts of releases into the environment.

- For selenium, there is potential for the WTP to alter selenium speciation and potentially increase its toxicity. This is particularly important because the Se levels leaving the WTP are expected to be 5 µg/L, which is the concentration value of the water quality standard (Table B1.3 in Knight Piésold 2018a). From the dust deposition estimates, the Se concentrations in water are expected to increase by 0.65 percent (considered to be an underprediction and specifically discussed elsewhere in our comments). While this increase is relatively small, if the increase in Se concentration is added to the 5µg/L Se that is leaving the treatment plant, this could result in an exceedance of the 5µg/L surface water quality standard for Se; though there would be dilution occurring downstream which could lower this concentration. We recommend that the Se in the effluent from the WTP be further reduced through treatment methods available, to ensure that surface water quality standards are met when taking into consideration the additional Se inputs from fugitive dust deposition. Otherwise, the combined impacts of the project could result in an exceedance of water quality standards and violations of the CWA. If the WTP design and treatment process is not reconsidered, then we recommend that the EIS explain that it is known that the water quality standards for selenium could be exceeded.

- For mercury, there is potential for the formation of methylmercury (MeHg). MeHg is the more toxic and bioaccumulative form of Hg that can be produced under anoxic conditions and is associated with the activity of sulfate reducing bacteria. Appendix K4.18 states that, "PitMod predicts that the pit lake will become thermally and chemically stratified after about closure years 25 to 30 (Lorax Environmental 2018)" (pg. K4.18-40). The anoxic water in the stratified pit lake would provide good conditions for Hg methylation, and MeHg production could be quite large because of the high Hg concentrations in the pit lake (median concentrations predicted to be 113 ng/L) and sulfate concentrations >1,000 mg/L. While the pit lake water will be treated to meet water quality standards prior to discharge, the water treatment focuses on reducing inorganic Hg ion concentrations which have a +2 charge, whereas MeHg has a +1 charge. This difference in speciation may decrease the efficiency of the treatment facility to reduce its Hg concentrations. We recommend that information be added to the EIS that addresses Hg speciation, specifically as it applies to MeHg production.

  Table B1.3, in Knight Piésold 2018a, shows that the predicted WTP outflow concentration of sulfate would be 151 mg/L. While this concentration is below the sulfate water quality standard, at 250 mg/L, it is an order of magnitude above the existing condition concentrations in the receiving water bodies. This large addition of sulfate could stimulate Hg methylation downstream of the mine. Studies have shown that the addition of sulfate can increase MeHg production rates, even when the inorganic Hg concentrations have remained constant (Branfireun et al., 2001; Wasik et al., 2012). We recommend that the EIS address the potential for downstream MeHg production as a result of increased sulfate loading and also identify options to further reduce sulfate releases from the WTP.

The temperature corrections applied to the HCT release rates may underestimate leaching rates encountered at the mine site. For example, SRK 2018a states that, “The rate of accumulation of this load is indicated by weathering rates (on a mass basis) determined in humidity cells corrected for lower site temperatures and lower particle surface areas.” Use of an annual average air temperature could underestimate the weathering rates because the subsurface temperature within the waste rock/tailings and under snow cover will be significantly warmer than the air temperature. We recommend that the EIS include information on the site temperature that was used for this correction to confirm accuracy of the leaching rate estimates.

Water Quality Modeling

Our key issues related to the accuracy of the water quality modeling are detailed in the comments below.

Sensitivity and Uncertainty Analysis: A sensitivity and uncertainty analysis is the standard practice in the majority of major mine project EISs. This is important for identifying which input parameters are the most influential on the model outputs, in identifying the impact of how uncertainties in model input parameters would affect the outputs, and in establishing confidence in the model results. We recommend that a sensitivity and uncertainty analysis of the water quality modeling be conducted consistent with EPA guidance on environmental modeling (see reference under “Hydrologic Modeling” above). One particularly important area to be addressed by the uncertainty analysis is the related unknowns associated with the geochemical sample representativeness (see our comments on that topic, above). We recommend that uncertainty related to geochemical information be included in the modeling analysis by applying a range of values that could be the upper and lower end of potential concentrations.

For the source term chemistry, the upper 95th percentile of the data are utilized to provide a conservative estimate of water quality concentrations (Appendix K4.18, pg. 4.18-40). However, there are model components that are not based on source term concentrations that can also impact the model outputs (e.g., temperatures, infiltration rates, porosity, etc.). We recommend that the variability in these other model components be included in a sensitivity and uncertainty analysis and the information included in the EIS.

The water quality modeling included several assumptions, such as steady state, complete mixing, and no reactivity or degradation occurring. We recommend that the EIS include a discussion of the limitations of the model predictions and limitations of the subsequent use of the predicted data (pit, water treatment, etc.) during operations and closure, resulting from these assumptions.

Use of 95th Percentile of the Source Term Concentrations: As mentioned above, in lieu of performing sensitivity and uncertainty analysis, the DEIS states that model results are expected to be conservative/protective because they utilize the 95th percentile of the source term concentrations (Appendix K4.18, pg. K4.18-14). However, SRK 2018a, the document that describes the source term calculations, states that “[w]here the mean would be considered the best representation of the most likely condition and extreme low and high values will offset each other, the input was calculated as the upper

95% confidence limit on the mean (i.e., representing the statistical uncertainty on the mean).” There is an important difference between using the 95th percentile of all the data versus using the 95% confidence limit of the mean, with the latter being significantly less conservative. If the model is going to rely on using 95th percentile data, we recommend that this be used on the entire dataset, i.e., not only on the mean value, to provide a more conservative estimate of the potential water quality impacts from the Pebble Project.

The SRK 2018a source term document states that, “[r]elease rates per week (mg/kg/week) are calculated for each parameter for each week, based on the concentration (mg/L), leachate volume recovered (L/week) and mass of the sample (kg). 95th percentile rates are calculated separately for each major rock type category and grouped by pH of the leachate.” We note that separate source terms were developed for ~15 different types of material based on data from ~100 HCTs. If we understand correctly how these calculations were made, that would mean that, on average, seven HCT results would be available for each of the different types of material tested. Seven results represent a small sample size from which to develop a 95% confidence interval. We understand that the 95th percentile is used in the DEIS to infer a degree of conservativism in the dataset, however, we do not recommend basing an EIS impact analysis on the 95% confidence intervals of datasets with very small sample sizes. The variability in the data from a few samples may not be representative of the full range of variability encountered at the mine site, and therefore, the 95% confidence interval may not provide estimates with a high level of certainty to support the water quality predictions.

<u>Source Term Concentrations</u>: It appears that the source term concentrations used in the water quality model predictions underestimate the magnitude of the water quality impacts. For example, SRK 2018a states that “[t]he average rate following the end of the flush is calculated for each test.” By excluding the first flush of elevated metal/metalloid concentrations in the source term calculations, the modeled water quality concentrations during mine operations are underestimated. While the first flush effect may be temporally isolated for a given sample of rock, at an active mine site, fresh rock/ore is being generated daily. As such, the first flush effect considered to be a temporally isolated event in the HCTs will continue throughout mining operations, as new material is regularly exposed to water. While the percentage of material experiencing the first flush effect at the mine site decreases over the course of the mine life, the complete removal of these initial elevated concentrations from the modeling exercises likely will result in an underestimation of the actual water quality impacts. Therefore, we recommend that water quality modeling include the first flush effect in the source term calculations. Alternatively, the Corps should explain why its existing analysis is sufficient.

<u>Use of Predicted pH</u>: The pH was not modeled for any of the water sources previously modeled by GoldSim, however the DEIS pH is reported as “predicted” in the DEIS. Pg. K4.18-45: “PHREEQC predicts that the pit lake surface water would have slightly basic pH (7.6 to 8.2) within discharge limits.” Lorax Environmental 2018 states that, “Source terms used in the pit lake model were obtained from KP (2018) [Knight Piésold 2018d, closure water management plan], SRK (2018) [SRK 2018a, source term memo] and HDR (2018) [HDR 2018a, Pebble Base-Case Water Treatment Plant Engineering Revision].” It also states that input data were from the Year 15 data from KP, which corresponds to Closure Phase 1. Knight Piésold 2018d states that, “pH was not modeled”, and there are no entries for pH in Table B2.1 for Closure Phase 1. HDR 2018a includes a footnote on the results table that input came from the Knight Piésold 2018a (operations water management plan), which provides pH values of “7 to 8” for all sources, but has a footnote that, “pH was not modeled and pH values are based on the range of pH source terms provided by SRK (dated 20 June 2018).” Additionally, the SRK source term document (the input for the GoldSim modeling that gave output used by PitMod) states that pyritic

tailings were considered non-reactive due to saturated conditions. We note that those are not the conditions that would exist at the start of the pit filling with water, since material would be moved over several years and be exposed to atmospheric oxygen before the pit would reach saturated conditions. Finally, pit lake water quality predictions for all metals are summarized in Table K4.18-7 and Table K4.18-8 for Closure Phases 1 and 2, respectively. These tables also have footnotes stating that pH was not modeled. If the pit lake modeling (PitMod) used the seven to eight values from Knight Piésold 2018a (via HDR 2018a) for pH as input to the model, the pH output may be invalid because pH was not modeled to be used as input to PitMod. On page 4.18-12, the DEIS states that the pit water is expected to initially be acidic, so it is important to explain what pH value was used as input to PitMod.

We recommend removing the word “predicted” from the EIS discussion on pH, where modeling did not occur, and/or that the EIS clarify that pH was not predicted based on modeling. We also recommend explaining why pH was not modeled in GoldSim, since pH is a parameter that controls geochemical reactions. It may be that pH is not as important for the water treatment plant influents, since the pH likely would be assessed at the time of treatment to ensure proper dosing of chemicals; however, we recommend that it is important to understand the actual pH and speciation of metals/metalloids/non-metals in the mine site water reporting to the TSFs and the concentrations that might be expected to occur in the overlying pit water and tailings pore water that may be released accidentally through a failure or through seepage that escapes capture.

We recommend that the EIS also provide the value of pH used for input to the pit model, include support for statements regarding pH of the pit water, and discuss limitations on discussions and conclusions made based on use of the non-modeled pH. We also recommend that the EIS discuss limitations of using an assumed pH instead of a modeled pH, with respect to water treatment and water quality in seepage or from potential releases from storage facilities (TSFs and ponds) and on potential impacts from releases and management of materials.

Water Management and Treatment and Water Quality Impacts

<u>Operations Water Treatment Plant Performance and Impacts</u>: Regarding the operations WTPs (WTP #1 and #2), the DEIS states, “Based on an independent review of the WTP source terms and processes (Appendix K4.18, AECOM 2018i), discharge water from both WTPs is currently expected to meet ADEC criteria…” (pg 4.18-4). However, the independent review (AECOM 2018i) specifically did not conclude that WTP #2 is expected to meet the State of Alaska water quality standards. Instead it recommended additional investigation and mitigation measures and/or development of improved management processes to provide confidence that salt and selenium are properly sequestered and stabilized for long-term management in the solid form, and to ensure that WTP performance will meet treatment goals.

We recommend including a full discussion of the issues identified in AECOM 2018i regarding the potential for salt and selenium build up. The DEIS indicates that these issues “may” require further investigation as design progresses and/or as a long-term adaptive management strategy (pg 4.18-5). We recommend that language in the EIS accurately represent the AECOM 2018i reference document and the importance of the issues and recommendations of the independent review by deleting the term “may” and discussing the previously recommended additional investigation and appropriate up-front WTP design.

We recommend that PLP conduct the additional investigation recommended in AECOM's independent review and, based on the investigation, provide a revised design plan for WTP #2 that acknowledges and responds to the potential for salt and selenium buildup by describing what specifically will be done to either prevent it or to treat the higher total dissolved solids (TDS) and selenium levels in order to meet surface water quality standards. Whereas the DEIS states that more treatment units would be added, the EIS would be strengthened by describing the specific water treatment processes proposed, the flows and concentrations for which they would be designed to manage and the predicted effluent quality under average and high flow conditions. If this information is not provided in an updated project description and water management plan, then we recommend that the EIS base its water quality impact analysis on what is proposed, which is a WTP (WTP #2) with uncertain effectiveness, based on AECOMs independent review.

Closure Water Treatment Plant Performance and Impacts: It appears that the DEIS mischaracterizes the results of an independent review conducted by AECOM of the closure WTP process and the ability of the water treatment plant to meet water treatment goals and water quality standards and we recommend that the EIS clarify this issue, as discussed below.

Regarding closure WTP #3, AECOM's independent review referenced in the DEIS concluded that, "Insufficient information on WTP #3 design and process is currently available to assess effectiveness." The DEIS Appendix K4.18 states, "Water quality of the discharge from the open pit WTP is the subject of ongoing engineering analysis (PLP 2061-RFI 106)" (pg. K4.18-52). The DEIS concludes in Chapter 4.18 that "[i]n terms of magnitude and extent, the treated water would be discharged to the environment downstream of the mine site in Frying Pan Lake" (pg 4.18-13), and "[p]it lake water quality would exceed standards but would be pumped to maintain operational levels and treated prior to being discharged to the environment." (pg. 4.18-32). The DEIS does not specifically state that the treated water discharge would meet surface water quality standards, and does not reflect the conclusion of the independent analysis that information is currently insufficient to assess the effectiveness of the WTP #3 design and process.

We recommend that the Corps further supplement the information available in the DEIS to assess the effectiveness of water treatment at closure, because at present it appears to be a data gap. Currently, the impacts to surface water quality at closure from the WTP discharges cannot be assessed. We recommend that: 1) PLP develop a robust design for WTP #3 that will ensure that the discharge of the treated open pit water meets water quality criteria under the CWA and the State of Alaska water quality standards, and that PLP include the revised WTP #3 design and process in an updated project description, plan of operations or water management plan; and, 2) the Corps independently review, analyze and explain in the EIS that the revised WTP #3 design will result in discharges such that surface water quality standards will be met at mine closure. The DEIS does not currently include a flowsheet of the closure water treatment process and we recommend that be provided. Alternatively, we recommend that the EIS explain why its existing analysis is sufficient to support a conclusion that treated water discharged from WTP #3 will meet water quality standards at closure.

Bulk TSF Seepage Closure Water Treatment: The DEIS states that seepage water from the bulk tailings TSF embankment would be collected and treated until treatment is no longer necessary, anticipated after closure year 50 (Section 4.18.3.1). However, the reference for this statement (Knight Piésold 2018d) indicates that TSF seepage will require treatment over the long term. We recommend that the conflicting statements regarding how long seepage water will require treatment be addressed in the EIS to clarify the Pebble Project impacts on water quality.

Characterization of the Extent of Groundwater Contamination: As mentioned previously in this enclosure, the DEIS states that all seepage would be captured, however, there is no design information supplied regarding the seepage collection and monitoring well/pumpback system to support this conclusion. We recommend that such design information be analyzed in the EIS.

In addition, we recommend that the EIS include additional details to support the characterization of the lateral and vertical extent of groundwater contamination to both shallow and deep groundwater from the mine site features during mine operations, closure and post-closure. The groundwater model predicts that contact water that leaks through the WMP liner to shallow groundwater would migrate about two miles, unless it is captured by foundation drains and the monitoring well/pumpback system (Appendix K4.17). We recommend that figures be added that depict the lateral and vertical extent of groundwater contamination for constituents that exceed standards in shallow and deep groundwater from the bulk TSF, pyritic TSF, and WMP so that the extent of groundwater impacts are more fully explained. This information is routinely provided in mining EISs to show the magnitude and extent of groundwater impacts

The DEIS states that "groundwater quality beneath the NFK west and NFK east drainages in the immediate vicinity of the mine site would be impacted during operations but would be expected to improve in the decades after mine closure" (pg. 4.18-18). To support this statement, we recommend that the EIS include additional information on the magnitude of potential groundwater quality impacts at closure (including a figure that depicts geographic extent of the impacts, see our earlier comment above) and how groundwater quality is expected to improve over time.

Bulk TSF Seepage Closure Water Treatment: The DEIS states that seepage water from the bulk tailings TSF embankment would be collected and treated until treatment is no longer necessary, anticipated after closure year 50 (Section 4.18.3.1). However, the reference for this statement (Knight Piésold 2018d) indicates that TSF seepage will require treatment over the long term. We recommend that the conflicting statements regarding how long seepage water will require treatment be addressed in the EIS to clarify the Pebble Project impacts on water quality.

Adaptive Management and Monitoring at Closure: The DEIS states that "[i]f monitoring shows that water quality is not improving during the post-closure period, additional remedies would be implemented to treat the impacted groundwater, as needed." (pg 4.18-18). However, since monitoring and adaptive management plans have not been provided for review, we currently cannot determine whether the monitoring and additional remedies would be successful. We recommend that monitoring and adaptive management plans be provided so that potential environmental impacts can be more fully analyzed and explained.

Characterization of Existing Water Quality Conditions

Characterization of Existing Water Quality Variability and Trends: Approaches used in the DEIS for combining baseline water and sediment quality data over space and time do not appear to accurately represent the variability in baseline conditions. This may lead to inaccuracies in predicting the magnitude of potential impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support from the Pebble Project. In the DEIS, mean surface water concentrations are presented as the means for all samples taken over all years within a given water body; the mean groundwater concentrations are presented as all samples taken over time in all wells within a given area;

and sediment concentrations are stated as being means of each sampling location's means, also appearing to be over all time. This approach does not appear to account for seasonal and spatial trends expected in surface water and sediment concentration data. Surface water concentration trends are especially important for fish because their life-cycles are dependent on time, space and water quality within the watersheds. Trends in concentration data also may exist in groundwater (especially shallow groundwater) and in sediment in deeper water bodies, but may be of a lesser magnitude than in riverine systems.

We recommend that the EIS provide an assessment (i.e., quantitative results of statistical testing) that further supports the approach taken of combining data over space and time to calculate means (for groundwater, surface water, and sediment) and demonstrates that it is a scientifically valid approach. If this approach to calculating means is not supported by the assessment results, we recommend that the affected environment analyses be revised to better represent the temporal (seasonal) and spatial water and sediment chemistry. In addition, we recommend that the environmental consequences analysis be revised to more accurately predict potential changes to those conditions. We also recommend providing a discussion of the limitations on conclusions made regarding background water and sediment quality and impacts (and associated resources) based on the data analysis and variabilities associated with the mean concentrations provided.

Because background water and sediment quality data were not collected from January through March of each year, we recommend that the EIS discuss the limitations of conclusions in the DEIS based on the limited winter data available.

Additional Comments on Water Quality Analysis

Following are additional comments and recommendations on the water quality analysis.

<u>Water Treatment Plant Operations</u>: We recommend the following information be added to the EIS to strengthen the analysis and disclosure of potential water quality impacts related to water treatment:

The DEIS raises the possible need for increasing the temperature of the discharge to enhance selenium removal (Section 4.18.3.1, Mine Site - Water Treatment during Operations) but does not analyze the potential need for cooling the discharge to meet surface water quality standards for temperature. If cooling will be necessary to meet temperature standards, we recommend that this be included in the EIS.

The DEIS indicates that the waste stream would be split in Step 6 for the Main Water Treatment Plant (K4.18.2.2 Main Water Treatment Plant (WTP #2), Step 6). The text discusses reverse osmosis (RO) treatment and the possibility of evaporation; however, RO treatment and evaporation are not included in any step of the process identified in the DEIS. We recommend that the EIS clarify whether RO treatment and evaporation are a 7th step in the process;

<u>Water Treatment Plant Residuals</u>: We recommend that the following information be added to the EIS to strengthen the analysis of potential water quality impacts related to management of the water treatment plant residuals.

The DEIS discusses the placement of the precipitated calcium sulfate solids into the pyritic TSF and explains that modeling indicates that the conditions in this TSF should prevent re-dissolution of the solids (K4.18.2.2, Main Water Treatment Plant (WTP #2), Step 5). At least one other mine in Alaska has issues with total dissolved solids chemistry, where the conditions indicate that calcium sulfate precipitate should form but that has not actually occurred. We recommend that the EIS include monitoring and specific adaptive management plans to address how issues with precipitate would be detected and remedied as necessary.

The DEIS states that rejected selenium solids from the Main Water Treatment Plant would be placed in the Bulk TSF (Section K4.18.2.2, WTP #2, Step 6), but that selenium solids from the Open Pit Water Treatment Plant would be transferred to the pyritic TSF (Section K4.18.2.1, WTP#1, Step 7). We recommend that the EIS clarify the difference between rejected selenium solids from WTP #2 and selenium solids from WTP #1 and explain why they would be directed to two different storage facilities.

The oxygen level in the open pit is anticipated to be above 2 mg/L for all depths and closure years (DEIS Figure K4.18-13, Pages 4.18-13 and 17). Considering that as little as 0.2 mg/L implies an oxidizing environment, it seems likely that there could be oxidation of the PAG material directly underlying the water column. Dissolved ferric iron will oxidize pyritic minerals as well as dissolved oxygen (DO) faster in the presence of microorganisms that oxidize the pyrite, and the cycle will continue. Precipitation of ferric oxyhydroxides releases protons that decrease solution pH. Addition of treatment plant wastes (e.g., alkaline sludge) to the bottom part of the water column, as discussed in this section, may aid in minimizing creation of acidic conditions; however, the potential for acidic conditions to occur should be discussed in the EIS, especially since the pH input to the pit lake water quality model was not based on chemical reactions that could be occurring in the pyritic TSF over the 20 years of material storage. We recommend that the EIS include further discussion regarding disposal of water treatment residuals into the open pit, including how those residuals are expected to influence water quality to be treated over extended time and the influence of sludge volumes disposed over extended time. We also recommend discussing limitations on data and concluding statements from assuming a "fully mixed pit lake during the four closure phases" when PitMod predicts that there would be thermal and chemical stratification after closure years 25-30, seasonal extension of well-oxygenated waters would reach a depth of about 50 feet (K4.18-10), and that oxic conditions also would exist in the lowermost 130 feet of the pit.

Fugitive Dust Impacts on Water Quality: The fugitive dust deposition calculations appear to underestimate the impacts to streams, wetlands, lakes, and ponds. The DEIS states that "[t]he equation used [in the analysis] conservatively assumes all of the metals from air deposition partition to sediment" (pg. K4.18-57). While we concur that this approach is conservative from the perspective of sediment concentrations, it results in an underestimation of surface water concentrations. Based on our understanding of the calculations, the metals deposited in water partition further into the sediment and then a small fraction of that concentration leaches back into the water from the sediment. Given the small particle sizes associated with fugitive dust deposition, we would anticipate that most of these particles could be entrained within the water column and would not immediately deposit to the sediment. Furthermore, we would also expect some metals partitioning directly from the entrained particles into the dissolved phase in the water. We recommend a more conservative approach be taken in the EIS impacts analysis from the perspective of water concentrations, i.e., if 100 percent of the fugitive dust deposited remains in surface water rather than partition into the sediment.

In addition, the DEIS (Section 4.18.3.1 Mine Site - Effects from Deposition of Fugitive Dust) states that the expected increase in the concentration of metals in surface water would not result in any exceedances of the most stringent water quality standards. Because this statement does not acknowledge that, based on baseline water quality monitoring, some of the waterbodies in the project area currently exceed the most stringent criteria for metals concentrations more information is needed. We recommend that the analysis of fugitive dust impact on water quality consider the existing water quality conditions of potentially impacted waterbodies and that the EIS include locations and waterbodies where fugitive dust impacts will result in exceedances of water quality standards, if any. In addition, see our earlier water quality comment related to consideration of the additive impacts of selenium in fugitive dust and treated water discharges.

Impacts Due to Road Construction: The DEIS (Pg. 4.18-21) states that "[t]he extent of effects during road construction would likely be limited to stream crossing locations within the construction right-of-way (ROW)." We recommend providing supporting analysis for this conclusion.

Impacts Due to TSS From Ferry Operation: The DEIS (Pg. 4.18-21) states that " . . . if fine bottom sediments were resuspended by ferry operations, it is expected that TSS concentrations would be expected to return to background levels within a short distance (less than 100 feet) from the ferry." We recommend providing additional information in the EIS to support this statement.

Impacts to Water Quality at Port Locations: The DEIS Section 4.18.4.3, Diamond Point Port, discusses the effect of marine water from the dredged material seeping into groundwater from the initial dredging when at least half of the dredged material would be used in the causeway. During future dredging events all the dredged material would be placed in the disposal area as it will no longer be needed for causeway construction. We recommend that the EIS further analyze potential groundwater impacts from disposal of material from future maintenance dredging.

DEIS Section 4.18.3.3, Amakdedori Port - Substrate/Sediment Quality, states that runoff would be treated and discharged to Amakdedori Creek, while Section 2.2.2.3, Amakdedori Port and Lightering Locations – Water Management, states that the runoff would be treated and discharged through an outfall at the end of the dock, presumably to Cook Inlet (more specifically, Kamishak Bay). We recommend that this apparent discrepancy in runoff discharge locations be clarified or corrected in the EIS.

DEIS Section 4.18.3.3, Amakdedori Port - Substrate/Sediment Quality, states that "[p]otential contaminants from marine vessels accessing Amakdedori Port would be diluted and flushed into the North Pacific Ocean and would not be expected to contribute a negligible amount of contamination to existing low background levels" (4.18-25). However, Section 3.18.3.3, Substrate/Sediment Quality, describes Kamishak Bay as a natural depositional area for hydrocarbons. Based on this information, while the rest of Cook Inlet is well flushed by high tidal exchanges, the same may not be true for Kamishak Bay. We recommend that the apparent discrepancy in the characterization of Kamishak Bay between Chapters 3 and 4 be addressed or clarified, and that the EIS further analyze the potential for hydrocarbon impacts in Kamishak Bay.

Impacts of Future Potential Changes in Climate: The modeling of water quality impacts was performed under a range of historic climate conditions, using long-term historical air temperature trends, but predictions are not included regarding future climate scenarios. The DEIS states that there is no long-term data for water temperatures, which influences dissolution of minerals, and discusses that there is an expected increase in trends. Currently, the DEIS does not address how any changes in air temperature may influence changes in water temperature (or whether they are relatable) or how changes in climate may affect precipitation patterns and subsequent influences on water chemistry. We recommend that the EIS include a discussion of how the water quality impacts might change under different climate scenarios, including an explanation of the link between air temperature and water temperature. We recommend that the analysis address how water quality (and quantity, with respect to size of storage ponds and the amount of water released to streams) will change with projected temperature and precipitation changes and the influence of these changes on resources.

Additional Comments on Geochemistry: We recommend the additional technical comments on geochemistry below be addressed in the EIS.

The statements made in the DEIS regarding the tailings material suggest that the potential for metal leaching and acid generation is lower than is indicated in some of the supporting documents. For example, Chapter 3.18 states that, "Geochemical testing of 64 tailings samples indicates that the most volumetrically abundant product, bulk tailings, which would be produced under most of the processing approaches being considered, typically contains low to moderate total sulfur" (pg. 3.18-4). However, Table K3.18-3 shows that the tailings have an average NP/AP of 0.29. A ratio this low suggests that the tailings would be acid generating (Ch. 3.18 states that NP/AP values of less than 1.4 are potentially acid generating). Given the very low NP/AP value in Table K3.18-3, the geochemical ABA testing results show the tailings to be acid generating. We recommend that this be reflected in the main text of Chapter 3.18.

Chapter 3.18 of the DEIS states that "[d]ata analysis from the various geochemical tests performed yielded consistent results. Leaching data from humidity cell tests, barrel tests, and shake flask tests performed on samples collected in both the PWZ and PEZ were used to develop geochemical source terms for predictive water quality (SRK 2018c, 2018f). Additional information regarding how the data were used in water quality modeling is provided in Section 4.18, Water and Sediment Quality" (pg. 3.18-4). The reference SRK 2018c, Geotechnical Stability Assessment of the Pebble West Pit Memorandum, does not appear to contain information needed to support these statements. Similarly, SRK 2018f, Response to PLP Action Item from Water-Focused Technical Meeting, provides information on how the data from the east and west zones are similar, but does not provide supporting analysis to directly address the statement that there were consistent results between the humidity cell tests, the barrel tests, and the shake flask tests. We recommend that Section 4.18 of the EIS provide a summary of the information in the reference documents and that the EIS provide a statistical evaluation of the release rates from these different tests showing that there were no significant differences between the various geochemical test methods.

The second sentence in the quote above suggests that data from all three methods were used to develop the source terms used to predict water quality. Information from other supporting documents suggests that only the HCT data was used for this purpose. We recommend that this be clarified in the EIS; if the data were all used to develop the geochemical source terms, we also recommend including a discussion regarding how this data was combined/averaged in the EIS.

Chapter 3.18 states that "[b]ulk tailings can be categorized as non-PAG if the total sulfur remains below 0.2 percent" (pg. 3.18-4). However, this information is not supported by data presented in Table 11-29 in the reference document, PLP 2018a. Table 11-29 presents the NP/AP values and the percent total sulfur for different samples. Earlier in the DEIS, PAG is defined by a NP/AP ratio of 1.4 and there are several examples where the NP/AP is below this level and yet the %S is lower than 0.2. For example, sample number LCT-35 had a %S of 0.13 and an NP/AP ratio of 1.2; LCT-31 had a %S of 0.15 and a NP/AP of 1.2; LCT-42 had %S of 0.16 and NP/AP of 1.4; KS-LCT1 had %S of 0.15 and NP/AP of 1.4; LCT 50 had a %S of 0.18 and NP/AP of 0.3; and LCT 58 had %S of 0.18 and NP/AP of 0.4. While these examples may be exceptions to the general trend of non-PAG generally having a low %S, we recommend that it is important that the EIS acknowledge that exceptions to this general trend exist.

In addition, PLP 2018a states, "Figure 11-35 shows the NP/AP ratio plotted as a function of sample sulfide content. As observed previously (EBD, 2010), sulfide content appears a strong control on NP/AP – where NP/AP values below 2 are coincident with sulfide contents above 0.2%." However, this information is reported in the DEIS with sulfide changed to total sulfur. While sulfide is often a major percentage of the total sulfur, these two measurements are not equivalent, due to the presence of sulfate. The total sulfur numbers will be larger than the sulfide numbers, consequently, there is a potential to underpredict water quality impacts, and we recommend that this be addressed in the EIS.

Chapter 3.18 states that, "Element leaching from the rougher tailings occurred at low rates, and unfiltered process supernatants were found to contain low levels of potential constituents relative to water quality standards" (pg. 3.18-4). We recommend that the EIS provide information to clarify whether this statement is referring to the analysis of fresh, aged, or the combination of both supernatants. The reference, SRK 2011a, shows that the copper concentrations increased by an order of magnitude between the fresh and the aged supernatants. For example, when comparing fresh and aged supernatants, pg. 11-59 of SRK2011a states that cooper concentrations increased from 2 to 17 µg/L for one sample, and from 6 to 16 µg/L for another sample. Presumably the aged supernatant results are more representative of actual conditions that will occur in the field. Additionally, based on the values presented in Table K3.18-1, the copper criterion is 2.19 µg/L, so both the fresh and aged samples appear to exceed this criterion. Therefore, we recommend that the discussion of the supernatant concentrations focus on the aged analysis instead of the fresh analysis

Figure K3.18-2: We recommend that the EIS provide additional context for the figure displaying neutralizing potential as a function of acid generating potential, including the type of tailings for the previous data (2004, 2005, and 2008) and the type of tailings examined in the barrel test in 2012. Tailings in the EIS are discussed in terms of bulk and pyritic; bulk tailings are described as non-PAG and pyritic tailings are described as PAG. It appears that a majority of 2011 samples of rougher tailings have a NP/AP < 1, which would suggest they are PAG. We recommend clarifying Figure K3.18-2 and the associated text to specify data representing the mine material that will be stored in the bulk TSF and data representing what will be stored in the pyritic TSF.

<u>Additional Comments Related to Existing Water Quality</u>:

Description of Existing Water Quality Exceedances: The DEIS states that "[w]ater quality data occasionally exceeded the maximum criteria for concentrations of various trace elements in some individual sample measurements" (pg. 3.18-7). We recommend that the EIS provide information on the specific locations where criteria is exceeded to strengthen the characterization of the affected environment. We recommend that hydrological conditions associated with the exceedances; for example, whether they mostly occur during baseflow or high flow conditions, also be provided. The hydrological conditions are an important factor affecting metal/metalloid concentrations.
Transportation Corridor Groundwater Quality: Chapter 3.18 (pg. 3.18-2) states that "[g]roundwater quality beneath the proposed 84-mile transportation corridor under Alternative 1 and the additional segments under Alternatives 2 and 3 can be characterized as similar to that of the mine site and port" (pg. 3.18-20). No supporting data is provided in the DEIS to support this statement, and the DEIS later states that the northern access road crosses a variety of surficial deposits, which can influence

groundwater quality and characteristics. We recommend that the EIS provide additional information to support characterization of groundwater quality beneath the transportation corridor for all alternatives.

Figure 3.18-1: The figure displaying surface water quality sampling locations appears to be missing many seep sites that are identified in Figures 9.1-4 and 9.1-5 of the Environmental Baseline Document. Further, the stream sites shown in Figure 3.18-1 do not match the stream sites shown in Figure 9.1-3 in the EBD (e.g., NK100B does not appear in the same location, NK100D in not included). We recommend verifying and correcting the information in Figure 3.18-1 to provide a more accurate disclosure of existing water quality conditions.

Pg. 3.18-8: The DEIS states that, "Recorded pH values ranged from 3.31 to 9.33 with the lowest pH recorded in the NFK and the highest recorded in UTC. The frequency of this trend in seeps was at least double that of streams, depending on the watershed." We recommend that the EIS provide additional information to clarify the trend being discussed.

Pg. 3.18-8: The DEIS text states that mean dissolved oxygen concentrations "ranged from 10.2 to 10.5 mg/L;" however, according to Tables K3.18-7 through K3.18-9, mean DO concentrations did not exceed 9.89 in the NFK, SFK, or UTC watersheds. We recommend that the dissolved oxygen concentrations be verified and corrected, or further explained, as appropriate.

Tables K3.18-8 and K3.18-9: The "Range of Detects" for dissolved oxygen in the tables summarizing surface water for the mine site provides a maximum of 18.2 and 18.6 mg/l, respectively. These values appear higher than saturation concentrations, even at zero degrees. We recommend verifying the values and correcting the data assessment and discussions if they are anomalous.

Table K3.18-7 through Table K3.18-12: Appendix K3.18 states that, "Table K3.18-7 through Table K3.18-12 provide the range of detected results, along with the mean and standard deviation" (pg. K3.18-42). The standard deviation is not reported in these tables and we therefore recommend that it be added to the tables. We recommend that the EIS discuss what data are and are not included and why, including why the numbers of samples reported for total and dissolved concentrations vary for many of the elements.

Background surface water quality: We recommend explaining the selection of sites NK119A and SK100F for characterizing background water quality. NF119A is located within the mine footprint, but SK100F is located downstream from Frying Pan Lake, which is outside of the mine footprint. We recommend clarifying in the EIS how these two sites selected for characterizing background will achieve the stated goal of providing predicted concentrations from sources "at the mine site that would be captured onsite, such as waste rock, pit wall runoff, railings, existing streams, and groundwater", since one of them is not located within the mine site.

Impacts on Sediment Quality

Metals Accumulation: The DEIS states that chemical components in water (such as metals and sulfate) would be absorbed by sediment or adsorbed onto sediment surfaces, and that conversely sediment would be expected to retain chemical constituents and slowly release them back into water. We recommend including a discussion of this cycle of metals accumulation with enough information to clarify the magnitude and extent of these changes, particularly for metals, such as selenium and mercury, that tend to accumulate in sediments and adversely impact sediment and water quality.

Sediment Monitoring for Operational Impacts: The DEIS states that trace elements were detected in the baseline sediment samples, and the highest detected concentrations of arsenic, chromium, copper, and nickel exceeded concentrations that may have an adverse effect on benthic organisms, both the threshold effects level and higher probable effects level (PEL). The mean concentration of arsenic also exceeded the threshold effects level across the study area (Section 3.18.1.3, Substrate/Sediment Quality). We recommend that a monitoring plan be provided in the EIS that explains how these sediment baseline concentrations will be utilized when compared to operational and closure monitoring data to assess whether sediments have been impacted by the mine.

Sediment Quality at Port Locations: The DEIS uses NOAA's freshwater sediment quality guidelines for comparison to baseline freshwater sediment quality information. In the absence of sediment quality guidelines for the State of Alaska, the NOAA values appear to be an appropriately conservative measure to use here and in future freshwater sediment quality monitoring. We recommend also considering Washington State's freshwater standards for selenium (11,000 ppb) and silver (570 ppb), which can be integrated into future sediment monitoring comparisons.

We recommend that marine sediment quality comparison values be provided. The schedule in Geoengineers 2018b indicates that additional sediment fieldwork was to be conducted in 2018 near the marine port proposals. We recommend that sediment characterization from the port locations (especially from Diamond Point Port) be provided in the EIS, as an important component of characterizing the existing environment. We recommend that the EIS also provide appropriate marine sediment quality guidelines, such as those published by NOAA or Washington State. Any future marine dredging and disposal would require additional sediment physical and chemical characterization/review specific to the proposed project at that time.

WETLANDS, AND OTHER WATERS / SPECIAL AQUATIC SITES

The Pebble Project Draft EIS (DEIS) discloses the permanent loss of approximately 3,443 acres of wetlands, 81 miles (50 acres) of stream, 11 acres of marine waters, and 55 acres of lakes and ponds. There are additional temporary and indirect impacts. The key issues regarding impacts to streams, wetlands, lakes, and ponds is that the DEIS likely underestimates the extent, magnitude, and permanence of the adverse effects of the Pebble Project's discharges of dredged or fill material to streams, wetlands, lakes, ponds, and marine waters, and the fisheries resources they support. The DEIS does not fully identify and characterize existing aquatic resources and wetland functions to establish the environmental baseline for the analysis, because the analysis area is limited and the DEIS does not use salient available site-specific data. In addition, the analysis does not fully assess secondary/indirect effects, which is important to compare alternatives and analyze project impacts. These comments and recommendations are described below. Our letter on the CWA 404 Public Notice (see Sections V.A. and V.B.) also reflects these issues and discusses the CWA 404(b)(1) Guidelines.

Baseline Characterization - Defining Extent of Potentially Affected Aquatic Resources

Wetland Mapping: The DEIS (3.22-4-5) identifies that all Action Alternatives include areas that lack field-verified wetland mapping. Action Alternatives 2 and 3 include approximately 3,126 acres where existing National Wetland Inventory (NWI) coverage was used to map wetlands instead of field-verified wetland mapping. In addition, Action Alternative 1 includes approximately 1,300 acres where satellite data was used to map wetlands at 100-meter resolution instead of field-verified wetland mapping. Based on the EPA's review of the preliminary jurisdictional determination, NWI coverage and satellite data substantially under-identify wetland area relative to field-verified mapping. In addition, the current disparity in the wetland mapping for different alternatives makes it difficult to compare the wetland impacts between the alternatives. According to the Corps, supplemental wetland mapping to fill these gaps is planned for the 2019 field season and this information would be included in the final EIS. Where high resolution information is not currently available, the EPA supports the Corps' decision to conduct additional data collection as greater precision mapping is necessary to accurately identify the impacts in light of the significant and complex nature of the discharge activities in this case.

Geographic Extent of Analysis: The DEIS defines an analysis area that is a fixed width area around the mine site. The DEIS analyzes impacts within this area and does not analyze impacts that are outside it. Section 230.11(h) requires an evaluation of the secondary effects of the discharges of dredged or fill material on the aquatic ecosystem, which include effects of the proposed discharge on the downstream ecosystem. However, the analysis area in the DEIS excludes areas downstream of the mine site where secondary/indirect impacts would occur. In addition, sections 230.11(b), (e), and (g) require an evaluation of the cumulative effects of the discharge of dredged or fill material on the aquatic ecosystem. However, the analysis area in the DEIS does not include the headwaters of UTC where future mining expansion would occur (i.e., the expanded mine scenario evaluated as part of the cumulative effects analysis in the DEIS). The aquatic resources in these additional areas were mapped at high resolution and field-verified between 2004 and 2008 during the collection of the environmental baseline data.[4] We recommend that the Corps use complete and accurate mapping of the extent of potentially affected aquatic resources (including direct, secondary/indirect and cumulative effects), taking advantage of available field-verified aquatic resource mapping information. Alternatively, the Corps should explain why its existing approach is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Stream Mapping: Regarding streams, the DEIS relies on the National Hydrography Dataset (NHD) mapping of stream networks to identify the streams that will potentially be impacted by the proposed project. The NHD does not capture all stream courses and may underestimate channel sinuosity, resulting in underestimates of affected stream length. We recommend that the EIS acknowledge uncertainties in the use of NHD and, to the extent possible, provide an estimate of the additional stream length for reaches that are not captured by the NHD.

In the DEIS, maps that depict the same areas show different stream channels (Figures 4.16-1, 4.22-2, 4.24-1, relative to NHD coverages for the same area). The DEIS does not explain these discrepancies. We recommend that the EIS: 1) use a consistent, thorough, and transparent "baseline" estimate of stream channel extent throughout the analysis area (i.e., for the mine site, transportation corridor, and all other project components); and 2) ensure that these stream channels are visible on all maps.

Assessing Impacts to Functions Provided by Potentially Affected Aquatic Resources

As discussed below, the DEIS does not assess the functions provided by the potentially affected streams, wetlands, lakes, ponds, and marine waters or the impacts to those functions in sufficient detail to evaluate impacts.

[4] The 2004-2008 mapping effort assessed over 100,000 acres just in the proposed mine area. The environmental baseline mapping was augmented in 2013 and 2017 to map the newly-proposed southern access route and the Amakdedori Creek and Diamond Point port sites.

Available High-Resolution Data: The DEIS identifies the aquatic resources that will potentially be impacted by the proposed project, including lakes, ponds, and streams, using eight condensed classes. Earlier mapping work conducted by the project proponent used 27 enhanced NWI classes of aquatic resources, including for lakes, ponds, and streams. This kind of enhanced NWI mapping and differentiation among the aquatic resources allows for more accurate assessments of the functions that the potentially affected aquatic resources perform as compared to an approach that uses more general, condensed classed like those used in the DEIS.[5] The DEIS (Section 3.22.1) does not rely on this more detailed aquatic resource data and does not explain why the greater precision information already existing in the GIS database was not used for analysis. We recommend that the Corps use the greater precision information that was collected to determine the nature and degree of effect that the proposed project discharge will have on the structure and function of the aquatic ecosystem and organisms in light of the significance and complexity of the discharge activities associated with this project. Alternatively, the Corps should explain why this more detailed information was not used and fully explain how a condensed approach allows for a complete and accurate assessment of the functions provided by the resources at issue.

Wetlands Functions: For wetlands, the Corps provides what it calls “a qualitative overview of wetland functions in the EIS analysis area.” (pg 3.22-7). This qualitative overview does not describe the level at which potentially affected wetlands are currently performing each function. This information is important to determine the nature and degree of effect that the proposed discharge will have…on the structure and function of the aquatic ecosystem. In this case, not only are the functional assessment methods available but extensive data was collected, particularly at the mine site, to apply the methods.[6] We recommend that the EIS characterize the level at which potentially affected wetlands are currently performing each function, taking advantage of available site-specific functional assessment data and where necessary supplementing that data. Alternatively, we recommend that the DEIS explain why its “qualitative overview” of wetland functions is sufficient to assess the nature and degree of effect that the proposed discharge will have on the structure and function of the aquatic ecosystem in light of the significance and complexity of the discharge activities associated with this project.

Scrub and herbaceous wetlands[7] constitute most of the wetland losses and degradation anticipated by the proposed project.[8] However, the DEIS does not include the full set of functions provided by these two types of wetlands. Scrub and herbaceous wetlands, depending on their position in the landscape and water regime, provide high-quality habitat for numerous fish species and contribute water, nutrients, organic material, macroinvertebrates, algae, and bacteria downstream to higher-order streams in the

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[5] The additional aquatic resource classes provided by the enhanced NWI reduce within-class variability and make attributing function easier and more meaningful, supporting a more precise and accurate functional assessment.

[6] During the 2004-2008 mapping/delineation work, wetlands were identified by both enhanced NWI and Hyrdogeomorphic (HGM) class, and data was collected to assess wetland function using the Rapid Procedure for Assessing Wetland Functional Capacity, Based on Hydrogeomorphic Classification (Magee, 1998). The performance of eight wetland functions was quantitatively assessed. These are: 1) modification of ground water discharge; 2) modification of ground water recharge; 3) storm and flood water storage; 4) modification of stream flow; 5) modification of water quality; 6) export of detritus; 7) contribution to abundance and diversity of wetland vegetation; and 8) contribution to abundance and diversity of wetland fauna. Two hundred and twenty-eight wetland functional assessments were conducted in the mine area during the 2004 field season alone. The ENWI water regime modifiers and functional data from the earlier mapping were not used for attributing function and evaluating project-related functional loss and is not referenced in the DEIS.

[7] Classified using NWI.

[8] This comment also applies to wetlands classified as slope wetlands under the HGM classification because there is extensive overlap between HGM slope wetlands and the wetlands classified as scrub or herbaceous under NWI.

watershed. They also moderate groundwater discharge and surface and subsurface flows to other wetlands and support stream base flows, which all act to support fish habitat, including thermally diverse habitats. The scrub and herbaceous wetlands in the NFK, SFK, and UTC watersheds preform these functions due to the high level of hydrologic connection between streams, wetlands, lakes, and ponds in the area. The DEIS does not attribute these functions to scrub and herbaceous wetlands potentially affected by this project. Without this information, the Corps record would underestimate the anticipated aquatic resource functional losses. We recommend that the EIS characterize the full array of functions currently performed by the potentially affected wetlands. Alternatively, the Corps should explain why its existing description of the potentially affected wetlands is sufficient to analyze the nature and degree of effect that the proposed project discharge will have on the structure and function of the aquatic ecosystem and organisms in light of the significance and complexity of the discharge activities associated with this project.

<u>Regionally Important Wetlands:</u> The DEIS (pg. 3.22-8) identifies certain wetlands as "regionally important"[9] based on a few general characteristics including whether they provide habitat for regionally important fish (without identification of any specific fish species). The DEIS appears to give more weight to losses of aquatic resources that it identifies as "regionally important." This list of regionally important wetlands appears to omit the wetland types that are estimated to sustain the greatest level of project induced impacts (i.e., scrub and herbaceous wetlands).[10] In addition, due to the strong hydrologic and ecologic connection, virtually all wetlands in the analysis area appear to meet the Corps' definition of a "regionally important" wetland because they, either directly or indirectly, support habitat for anadromous and resident fish through flow contribution or moderation, water quality benefit, or organic matter or nutrient contribution. Similarly, the DEIS does not explicitly identify streams as "regionally important," although all fish-bearing streams (and their tributaries), lakes, and ponds provide habitat support for anadromous and resident fish species. As a result, the DEIS' approach to filter resources based on a determination of whether they are "regionally important" does not account for the full functions of these resources and results in an underestimation of anticipated aquatic resource functional losses. The EPA recommends that the DEIS not use this "regionally important" approach because the DEIS does not explain how the few characteristics it considered support a conclusion that some aquatic resources are regionally important, and others are not. In addition, the DEIS does not explain how its criteria as applied results in identifying resources that are more "important" than others. The EPA recommends that the Corps conduct a detailed analysis of the functions provided by each of the aquatic resource types as a basis for determining the value of what would be lost due to impacts from the project in light of the significance and complexity of the discharge activities associated with this project.

<u>Streams, Lakes, and Ponds Functions</u>: No functions are attributed to the specific stream reaches, lakes, or ponds that would be lost or degraded by the project. The DEIS does not identify what functions these specific aquatic resources perform or the degree to which they are currently performing each function. This information is important in determining the nature and extent of impacts on the structure and function of the aquatic ecosystem and organisms. We recommend that the Corps characterize the full array of functions currently performed by the potentially affected streams, lakes, and ponds as well as the degree to which they are currently performing each function. Alternatively, we recommend that the EIS explain why the current approach is sufficient in light of the significance and complexity of the

[9] This is not a term relevant to compliance with NEPA or the Guidelines, and it is unclear how and why the Corps is making this determination.
[10] As previously noted, many of these wetlands were also classified as slope wetlands using HGM.

discharge activities associated with this project. Characterization of fish habitat functions and potential impacts to those functions is discussed in more detail below.

Impacts to Aquatic Resources Functions: The DEIS does not characterize how performance of each function would change as a result of the direct, secondary/indirect, and cumulative effects of the discharge of dredged or fill material associated with the project. Instead, the DEIS only includes general statements such as "[e]xcavation, filling, and clearing of wetlands and other waters would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions" (pg. 4.22-8). We recommend that the EIS characterize the degree to which each of the functions provided by each of the potentially affected aquatic resources will change as a result of the direct, secondary/indirect, and cumulative effects of the project. Alternatively, we recommend that the EIS explain why the current general approach is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Secondary/Indirect Effects: The scale and location of the direct impacts associated with the Pebble Project's discharges of dredged or fill material likely will result in numerous secondary/indirect effects. The DEIS (pg. 4.22-4) identifies seven general types of secondary/indirect effects associated with the project: disruption of wetland hydrology; conversion of wetland type; habitat degradation downstream of the mine site; fragmentation of habitats; water quality and quantity changes; erosion and sedimentation; and fugitive dust. However, the DEIS estimates the acreage of wetlands and other waters potentially impacted by three of these types of secondary/indirect effects: habitat fragmentation, fugitive dust, and dewatering. We recommend that the Corps estimate the geographic extent (i.e., area, and for impacts to streams, linear miles also) of all of the types of secondary/indirect effects identified in the DEIS. We recommend that this include the estimated amount (in linear miles and area) of habitat degradation downstream of the mine site, and its potential implications for fish (discussed in more detail in Fish Values comments, below). Alternatively, the EIS explain why the current evaluation of the secondary/indirect effects of the proposed discharges on the aquatic ecosystem is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The attribution of fugitive dust impacts is based on a fixed-width buffer rather than the dust dispersion model developed for the project, which would likely be more accurate than an assumed buffer. We recommend that the EIS explain which method is expected to provide more accurate results for determining the geographic extent of fugitive dust impacts on aquatic resources and utilize that method.

The DEIS indicates that there is uncertainty regarding the extent of the cone of depression and the predicted changes to groundwater and surface water hydrology (pg. 2.2.2.1-2-16 and 4.17.3). Thus, the volume of water produced during pit dewatering could be greater than predicted by the groundwater model, and the capture zone and zone of influence could be larger (4.17.3.1) meaning that additional aquatic resources could be impacted by the groundwater drawdown. We recommend that the EIS explain the uncertainty in the estimates of the geographic extent of dewatering impacts.

Characterization of Impacts: The DEIS does not fully identify the severity or significance of impacts to aquatic resources. For example, the DEIS (4.22-11) identifies that roughly 12 percent of the shrub wetlands and 17 percent of all stream channel length in the 171,000-acre watershed would be directly impacted (i.e., permanently lost), but it does not identify the loss of functions and the severity or significance for those effects (i.e., the relative importance of that loss). Similarly, the DEIS discloses that the proposed natural gas pipeline may impact two weathervane scallop beds, potentially affecting the sustainability of the Kamishak Bay weathervane scallop fishery. The DEIS also discloses that the

Pacific herring sac roe fishery in Kamishak Bay could experience direct or cumulative effects. The specific ecological or economic consequences of these impacts are not evaluated. We recommend that the EIS identify the nature and degree of effect of the proposed project on the aquatic ecosystem, including the severity or significance of those effects.

The DEIS considers impacts to streams, wetlands, lakes, and ponds in terms of Hydrological Unit Code (HUC)-10 watersheds, whereas impacts to fish resources (discussed in more detail below) are considered at a different scale (i.e., the NFK, SFK, and UTC watersheds), even though streams, wetlands, lakes, ponds, and fish are highly inter-related aquatic resources. We recommend that the EIS evaluate effects to streams, wetlands, lakes, ponds and fish at the same scale (i.e., the NFK, SFK, and UTC watersheds). Alternatively, we recommend that the EIS explain why it is appropriate to use different evaluation scales for these inter-related aquatic resources.

FISH VALUES

The physical, chemical, and biological impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support should be more fully addressed in the EIS. The EPA recommends significant improvements to: habitat characterization, assessment, quantification, and spatial referencing; assessment of linkages between the loss and/or degradation of habitat and impacts to fish species and life stages (i.e., incubating eggs, spawning fish, and rearing juveniles); groundwater and surface water flow characterization at a scale that is more relevant to fish and fish habitat; and analysis of the potential population-level effects and effects on genetic diversity in the context of the Bristol Bay salmon portfolio. Our detailed comments and recommendations are provided in the following subsections and include comments on the draft Essential Fish Habitat (EFH) Assessment (Appendix I) since it is a supporting document to the DEIS. Our letter on the CWA 404 Public Notice (see Section V.C. of the letter) also reflects these comments and discusses the CWA 404(b)(1) Guidelines.

Fish Habitat

The abundance and distribution of different fish species are dictated by availability of the diverse, ecologically important habitats—wetlands, streams, lakes, ponds, off-channel areas, and other habitat types—that each species requires. The sufficiency, spatial arrangement, and proximity of the habitats each species requires throughout its life cycle (e.g., for spawning, rearing, overwintering, feeding) are key factors determining productivity and sustainability of fish populations. For this reason, the Corps should analyze how the project will affect both the amount and the accessibility of the full complement of habitats that each fish species requires to complete their life histories. If spawning and rearing habitats no longer exist at sufficient levels (in terms of quantity or quality), or no longer exist in proximity to each other, the abundance, productivity, and sustainability of fish populations will be compromised. These habitats would need to remain both sufficiently represented and connected, throughout the project area, in order to sustain resiliency and persistence of fish populations.

<u>Habitat Characterization</u>: Table 3.24-1 presents different types of habitats: mainstem reach, riffle, run/glide, pool, beaver pond, and other off-channel habitat types. The DEIS does not explain or provide evidence to support (1) how these habitats were selected and sampled; (2) whether these habitats represent all fish habitats that may be impacted by the project; and (3) how and when these habitats are used by fish [e.g., in terms of species, season, and life history stage (e.g., spawning vs. rearing vs. overwintering habitats)]. The DEIS also does not explain how this habitat information is used to evaluate effects of the project on fish (i.e., DEIS Section 4.24). We recommend that the EIS include

information regarding how and when fish habitats were defined, identified, and sampled; whether they represent all relevant fish habitats in the project area; how and when different fish species use these (and any other) habitats; and how these habitats will be affected by this project. Alternatively, we recommend that the EIS explain why its existing description of fish habitats is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The Draft EFH Assessment discloses that areas of spawning, migration, and rearing are delineated based on the available ADF&G Anadromous Waters Catalog and observations PLP made during project studies. However, it does not explain the repeatable process framework by which habitats were identified or characterized. Representative habitat characterization provides the foundation on which interrelated studies (e.g., fish distribution and abundance studies) can be overlain. A consistent project framework that clearly states criteria used to classify or characterize different habitat types should be a precursor to quantifying pre-existing and post-project fish habitat. We recommend that the EIS include additional information used to support baseline habitat characterizations, including references to baseline habitat studies and the framework used to characterize fish habitats. Alternatively, we recommend that the EIS explain why its existing analysis of fish habitat is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not provide a comprehensive analysis of environmental factors associated with distributions and abundances of fish species throughout the project area watersheds, which is needed to evaluate project-related changes in fish habitat. We recommend that the Corps ensure its analysis is comprehensive, which would include summaries of seasonal fish species' distributions and abundances (with uncertainty estimates), associated environmental conditions, and an assessment of factors potentially limiting distributions and abundances of fish species found within the project area watersheds. We recommend that the EIS discuss how habitat was assessed at both sites where fish were observed and sites where fish were not observed, to evaluate what characteristics (e.g., groundwater upwelling or downwelling, water temperature) were significant predictors of fish occurrence. We recommend that the EIS also include areas that were assessed as overwintering habitat. Inclusion of such information will help validate and support inferred relationships between fish distribution, abundance, and habitat selection. Alternatively, we recommend that the Corps explain why its existing analysis of fish habitat and relevant environmental factors is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS (pg 4.24-8) states that, "[s]pecies diversity and abundance data indicate there is sufficient available habitat for relocation without impacts to existing populations." The DEIS does not appear to provide support for this statement, and it does not present information on how available relocation habitats were assessed or what constitutes fish habitat. We recommend that the EIS explain what is meant by "sufficient available habitat that would allow for relocation without impacts to existing populations" and provide information and analyses to support this statement. Alternatively, we recommend that the Corps explain why its existing assessment of fish habitat and population-level effects of the project is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Table 4.24-2, entitled "Average precipitation year spawning habitat for all streams and species in the mine site area pre-mine, during operations, and post-closure," does not include all species documented to occur at the mine site area.[11] Values are reported in terms of stream area for all watersheds combined,

[11] Woody and O'Neal 2010.

but both stream area and stream length and breakdowns by watershed are necessary for evaluation purposes. We recommend that the table be revised to include (1) all anadromous and resident fish species (including lamprey) documented to occur in the project area watersheds and (2) values in terms of stream miles in each of the three project area watersheds, in addition to stream acreage. Alternatively, the Corps should explain why its existing analysis is sufficient.

Habitat Function and Connectivity: The DEIS and the Draft EFH Assessment do not analyze habitat function (i.e., how fish species are using the different habitats at risk from project impacts during all life stages). Fish species and populations use different habitats for different functions (e.g., spawning, egg incubation, rearing, refugia, feeding, overwintering, and migration), and this habitat use varies both seasonally and from year to year.[12] We recommend that the EIS describe fish habitat functions and their spatial and temporal variability and explain the consequences of project-related changes to each of those habitats in terms of the different habitat functions (i.e., spawning, egg incubation, rearing, refugia, feeding, overwintering, and migration). This would allow for estimation of the amount of habitat loss (in acres and linear miles) related to different habitat functions, for different fish species. Alternatively, we recommend that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not analyze the spatial arrangement or connectivity of different habitat types used by anadromous and resident fish species throughout their life cycles within the project area. We recommend that the EIS analyze the spatial arrangement and connectivity of different fish habitats or explain why the existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS (pg. 4.24-6) states that "[f]ree passage of resident and anadromous fish may be temporarily interrupted but would continue unimpeded after construction is complete. Habitat at the immediate location of culverts would be altered, but fish would continue to use the streams." The DEIS does not cite evidence to support these statements. We recommend that the EIS include further analysis and explanation to support these statements, or explain why its existing statement is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Habitat Quantification: The DEIS and Draft EFH Assessment lack basic habitat quantifications for streams, lakes, ponds, and marine habitats: stream loss of channel length is not quantified by linear feet and/or miles; habitats assessed to be spawning, incubation, rearing, overwintering, and feeding areas are not quantified in acreage; migratory habitats are not quantified as linear stream miles and acreage; and, there is not sufficient quantification of habitat types and fish usage. We recommend that EIS quantify the geographic extent of potentially affected fish habitats, or explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project. Specific recommendations are included for each of the instances listed below:

1. The Draft EFH Assessment (Table 5-1 p. 68) presents a summary of essential fish habitat for managed fish species that will be lost/destroyed during mine site development. We recommend including a table which quantifies potential habitat losses for all species (including resident and non-managed anadromous species) found in the project impact area. This information will enable

[12] Brennan et al. 2019.

the Corps to quantify impacts to fish species from the current proposal as well as from the potential future expanded mine scenario.

2. The DEIS asserts that "[t]he percentage reductions in habitat would generally decrease in a downstream direction until reaching the confluence of the NFK and the SFK (with a few exceptions). In terms of extent, rainbow trout, chum, sockeye, Dolly Varden, and Arctic grayling would have habitat decreases only in the headwater tributaries" (pg. 4.24-13). We recommend that the EIS include evidence to support this statement.

3. The Draft EFH Assessment and DEIS present miles of spawning and rearing habitats for Chinook, coho, chum, and sockeye salmon, but do not quantify overwintering, incubation, or migratory habitat. The EFH Assessment uses the Anadromous Waters Catalog to calculate spawning and rearing habitat in linear feet and miles. The Anadromous Waters Catalog covers fish spawning or presence (and less frequently migration and rearing), and it does not differentiate other critical habitats, such as overwintering habitat. Therefore, the DEIS provides an incomplete picture of fish habitat use. There is no data provided to verify the accounting of habitat miles (or acreage, by fish species) that will be impacted by the Pebble Project. We recommend that the EIS include a complete table of quantified habitat classifications by fish species documented to occur in the project impact area, to understand the amount of habitat that will be lost because of the project and the functions those habitats provide to each fish species.

Habitat Quality: The DEIS and the Draft EFH Assessment make unsupported conclusions related to habitat quality (see list below). In particular, conclusions related to "low use" and "low quality" fish habitat are not supported by the information provided in the DEIS. As discussed in the recommendations above, we recommend that the EIS conduct additional analyses of habitat characterization, function, quantification, spatial arrangement and connectivity, and the full seasonal distribution of fish species and life stages across multiple years. Once these analyses are done, we recommend that this additional information be supplied to support its conclusions. Alternatively, we recommend that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project. The following are specific recommendations:

1. The Draft EFH Assessment (pg. 66) states that construction of the mine site "would discharge fill material into 46,836 linear feet (14,276 linear miles)[13] of EFH catalogued as anadromous streams in the [Anadromous Waters Catalog] and/or identified by PLP research as EFH" and concludes that impacted reaches "support primarily low levels of use by rearing Chinook salmon and rearing and spawning coho salmon." The Draft EFH Assessment further states that "the NFK and SFK reaches that would be removed have a low Pacific salmon presence compared to downstream reaches indicating that these habitats are of lower quality EFH." We recommend detailed analyses or references be provided to support these conclusions regarding "low levels of use" or "low Pacific salmon presence." This supporting information is particularly important given recent research highlighting the importance of temporally and spatially shifting habitat mosaics for Pacific salmon populations in this region.[14]

[13] There also appears to be a conversion error in these number which come from the Draft EFH Assessment.
[14] Brennan et al. 2019.

2. The Draft EFH Assessment (pg. 67) states that habitats that would be removed exhibited some of the “lowest density use by both coho and sockeye salmon juveniles” within the SFK drainage, suggesting “low overall quality EFH or abundance of quality habitat in unaffected areas.” We recommend that additional information be provided to support these conclusions. Specifically, we recommend that the Corps present fish sampling data as catch-per-unit effort values, rather than as density use; present data on seasonal fish distributions; present data on habitat quality within the project waters; and discuss whether the DEIS and the Draft EFH Assessment evaluated and compared habitat characteristics at sites where fish were and were not observed.

3. The Draft EFH Assessment (pg. 67) asserts that, considering the low use of EFH and direct habitat losses in the SFK-E reach and the NFK 1.190 tributary, “drainage-wide impacts to Pacific salmon populations from these direct habitat losses would be unlikely.” We recommend that evidence be provided that supports this conclusion.

4. The Draft EFH Assessment concludes that the Pebble Project may adversely affect EFH. However, the Assessment also concludes that “…mortalities are unlikely and EFH characteristics would return to normal shortly after the activity ceases, or in the short term” (pg. 120) and that “habitat removed is generally of low biological importance.” We recommend that the Corps should either explain or resolve this apparent discrepancy and include references or documentation to support these assertions.

<u>Geospatial Mapping of Habitat</u>: The DEIS does not include geospatial representation (i.e., the location and spatial arrangement) of assessed baseline fish habitats. Such geo-location of classified habitats, analyzed by their functions for individual species, is needed to understand how the project will affect habitat availability, spatial arrangement, and connectivity, which in turn will determine impacts to fish populations. We recommend that the EIS document the location of existing baseline fish habitats, their proximity to other similar or dissimilar habitats required by those fish, and how the spatial arrangement of these habitats will change as a result of the proposed mine project. Alternatively, we recommend that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

<u>Headwater Streams</u>: The DEIS and the Draft EFH Assessment do not address the effects of decreased inputs from headwater streams on downstream waters. Headwater streams support numerous fish species and habitats, and the disruption to headwater streams from the mine site has the potential to result in large environmental consequences to fish and aquatic resources at a scale beyond that included in the Mine Site EIS Analysis Area (Figure 3.24-1). We recommend that the EIS include discussion of the extensive body of scientific evidence demonstrating that headwaters are critical aquatic habitats,[15] and evaluate the role and importance of headwater streams in the project area in terms of both direct use of these habitats and their inputs to downstream waters. Alternatively, the Corps should explain why its existing consideration of headwater streams is sufficient in light of the significance and complexity of the discharge activities associated with this project.

<u>Intermittent Stream Reaches</u>: The DEIS does not analyze intermittent stream surface and groundwater flow pathways relevant to fish and fish habitat. Intermittent streams may lack flow during critical summer low flow periods and are often viewed as having limited ecological function for fish habitat or

[15] For example, Section 7.2.3.2 in EPA 2014.

water quality when surface flow ceases. However, hyporheic flow composed of mixed shallow groundwater and surface water under and along the channel bed can continue in these intermittent channels after surface flow has ceased. This hyporheic flow can be thermally moderated (i.e., buffered from the effects of solar heating by the channel substrate),[16] and thus can create thermally distinct fish habitat in isolated pools in intermittent streams.[17] The literature supports the idea that intermittent streams can provide high quality habitat. Subsurface flow can also increase thermal heterogeneity where it emerges at confluence zones with perennial water bodies, such as lakes[18] or streams and rivers,[19] providing patches of cold-water habitat in otherwise warm downstream waters. The functional role of colder tributaries in providing thermally distinct water that supports cold water fish species is a clear example of an ecosystem service provided by the tributaries,[20] potentially even after surface flow has ceased in an intermittent stream reach. We recommend that the EIS evaluate the potential importance of intermittent stream reaches, which are seasonally important for fish migration, spawning, and rearing as part of stream-lake networks, in the project impact area or the Corps should explain why its existing consideration of intermittent streams is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS states that the mainstem SFK has a 10-mile reach, from two miles below Frying Pan Lake to the SFK Tributary 1.19, that frequently exhibits zero or intermittent flow during winter and summer months. The DEIS states that the loss of surface water in this reach transfers an average of 22 cfs from the SFK (Nushagak River headwaters) into the UTC (Kvichak River headwaters) via groundwater exchange, indicating complex hydrological connections. Groundwater remaining in the SFK basin reemerges at the downstream end of the intermittent reach, 20 miles above the NFK confluence. The DEIS states that this reach is not considered “quality” habitat for purposes of environmental review (pg. 3.24-9), but this conclusion is not supported within the DEIS. As discussed above, the scientific literature supports the conclusion that intermittent stream reaches can be seasonally important for fish migration, spawning, and rearing[21] as part of stream-lake networks. Furthermore, the DEIS states that the highest densities of chum salmon redds occurred in the reach immediately downstream of the dry channel (SFK-C), where accretion of groundwater is most evident.[22] The DEIS does not present the data or other information on stream habitat that were analyzed to reach the conclusion that the intermittent stream reach does not represent quality habitat. We recommend that the EIS evaluate the intermittent reach on the mainstem SFK, between SFK Tributary 1.19 and the outlet of Frying Pan Lake, as potential habitat for Chinook, sockeye, and chum salmon and resident fish. Alternatively, we recommend that the Corps explain why its analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

<u>Off-Channel Habitat</u>: The DEIS does not quantify off-channel floodplain habitats or disclose models that will be used to account for off-channel habitats, even though off-channel habitats can be an extremely important factor in salmonid distribution.[23] Tables 4.24.2 and 4.24.3 assert that there will be an increase in downstream spawning and rearing habitats, but the DEIS does not provide scientific evidence supporting this claim. We recommend that the EIS document and quantify pre-existing off-

[16] May and Lee 2004, Arrigoni et al. 2008.
[17] Bilby 1984, May and Lee 2004.
[18] Buttle et al. 2001.
[19] Ebersole et al. 2015.
[20] Torgersen et al. 2012.
[21] *Id.*
[22] R2 et al 2011a.
[23] For example, Swales and Levins 1989.

channel habitats that may be affected by the project, analyze potential losses of off-channel habitats due to the project, and address the consequences of these habitat losses to fish populations. We recommend that results from the Pebble Project Draft Environmental Baseline Studies 2006 Study Plan be used to help illustrate the mechanics of flow connectivity to the channel from surface flow, groundwater flow, or both combined. For example, Figure 11.1-3 of PLP 2006 includes a map of off-channel habitat transects from the SFK River. Alternatively, the Corps should explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Fish

Distribution and Abundance: The DEIS and the Draft EFH Assessment do not characterize the full seasonal distribution and abundance of resident and anadromous fish or capture interannual variability in these parameters. Because the distribution and abundance of fish can vary substantially both seasonally and interannually, and because the project will affect the area in perpetuity, long-term data on fish distributions and abundances are needed to evaluate impacts of the project. We recommend that the EIS analyze the full seasonal and interannual variability in distributions and abundances of fish species and assemblages that are supported by the diversity of habitats in the Nushagak and Kvichak River watersheds, including habitats in the headwater streams of the SFK, NFK, and UTC over multiple years. Alternatively, the Corps should explain why its existing analysis of spatial and temporal variability in fish abundances and distributions is sufficient in light of the significance and complexity of the discharge activities associated with this project. Specific recommendations include:

1. Fish may be absent from a site during some years or some portions of a single year, but present in high abundances at other times. Low abundance at one point in time does not necessarily equate to low abundance at another point in time, nor does it mean that the habitat is not ecologically important. We recommend that the EIS explain the seasonal and interannual distributions and abundances of fish species in terms of migration, spawning, incubation, rearing, and overwintering habitat within streams affected by the Pebble Project, including those affected by the withdrawal, storage, and discharge of water. When abundance and distribution data are presented, we recommend that the Corps specify how that data was generated (e.g., in terms of sampling frequency).
2. The DEIS includes little data on fish densities (see DEIS Sections 3.24 and 4.24), although density data is available.[24] The statements that are included in the DEIS are qualitative and unsupported. We recommend that the Corps include relevant data collected by PLP and supplement their analysis with relevant data collected by others.[25]
3. The DEIS states (pg. 4.24-3) that rearing Chinook salmon have been documented in the 2.9 miles of NFK Tributary 1.19 in lower densities (0.11 fish/100m^2) compared to the mainstem NFK (4.99 fish/100m^2) but does not include a citation to support this statement. These estimates appear to conflict with research conducted by ADF&G in the Nushagak River watershed that concludes that juvenile salmon are likely more abundant in the tributaries and headwaters of the

[24] For example, Tables 7.1-7.3 in EPA 2014, which show data from PLP’s Environmental Baseline Document.
[25] For example, Woody and O’Neal 2010.

drainage, where finer scale habitat such as riffles and woody debris are more common.[26] We recommend that the EIS consider this ADF&G report and provide supporting information for the above referenced statement.

4. The Draft EFH Assessment states that no adult Pacific salmon were observed within the headwater reach of the SFK River that would be eliminated by the Pebble Project during the 2004-2008 aerial surveys to document adult salmon distribution (pg. 67). Aerial surveys can substantially underestimate salmon abundances in narrow, deep, highly vegetated, or tannic waters.[27] Inclusion of supplemental survey methods such as mark-recapture can help identify error and bias in estimates.[28] We recommend that the EIS include discussion of the limitations of aerial surveys and how these limitations could impact conclusions made in the EFH Assessment and in the EIS (i.e., by underestimating salmon counts in headwater streams).
5. Fish abundance estimates from the Environmental Baseline Document (Figure 15-1-96; PLP 2011) suggest that over 80,000 returning sockeye salmon were counted during one aerial survey in UTC and Tributary 1.60. This estimate, combined with remaining adult aerial counts, suggest that over 100,000 spawning sockeye salmon were counted in UTC alone in 2008, but this information is not included in the DEIS. We recommend that the EIS include these and other existing project-specific fish abundance estimates in the record

<u>Bristol Bay Salmon Portfolio</u>: The DEIS and the Draft EFH Assessment do not fully analyze population level effects from the potential loss of genetic diversity of the Bristol Bay salmon portfolio.[29] The Pebble Project could result in population-level effects on the genetic diversity of salmon stocks in the Nushagak and Kvichak River watersheds, which in turn could impact the salmon portfolio and overall resilience of salmon populations within the Bristol Bay watershed. Thus, additional information on the genetically distinct fish populations in the project area is needed. We recommend that the EIS analyze the relative contribution of genetically distinct spawning populations to determine the significance of population losses or reductions that may result in impacts beyond recovery thresholds of species.[30] We recommend that the EIS also analyze and discuss existing scientific information on the Bristol Bay salmon portfolio and the consequences of genetic biodiversity losses for salmon populations. Alternatively, the Corps should explain why its existing discussion of genetic diversity and the portfolio effect in the Bristol Bay region is sufficient in light of the significance and complexity of the discharge activities associated with this project. Specific topics that we recommend the EIS discuss and evaluate include:

1. There are several hundred discrete sockeye salmon populations in Bristol Bay.[31] It is possible that as many as 200 to 300 discrete sockeye salmon spawning aggregates occupy the Kvichak River system alone.[32] The heterogeneity of these Kvichak River populations reduces the

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[26] For more information about this research see: http://www.adfg.alaska.gov/index.cfm?adfg=chinookinitiative_nushagak.main#juvenileabundance
[27] Bevan 1961.
[28] For example, Parken et al. 2003.
[29] Schindler et al. 2010.
[30] *Id.*
[31] *Id.*
[32] Habicht et al. 2004; Ramsted et al. 2004; Ramstad et al 2009.

variability of sockeye salmon returns in the Bristol Bay region and contributes to the stability and robustness of the resource.

2. ADF&G has built and tested the Bristol Bay salmon genetic baseline over the past 17 years.[33]

3. Recent research indicates that sockeye and Chinook salmon productivity vary over space and time in the Nushagak River drainage, and that shifting habitat mosaics throughout the drainage, including streams draining the project area, help stabilize interannual salmon production.[34]

Population Level Effects: The DEIS Summary for Habitat Loss (Section 4.24.2.1) concludes that modeling indicates that "indirect impacts associated with mine operations would occur at the individual level and be attenuated upstream of the confluence of the NFK and SFK with no measurable impacts to salmon populations" (p. 4.24-6). Standard fisheries management techniques are applied at the population level, not the individual level, and the approach mentioned in the DEIS is inconsistent with ADF&G population/stock management approaches. The DEIS also does not provide fish population estimates or the models used to support the determination that impacts would occur at the individual level rather than at the population level. We recommend the EIS clarify the distinction between individual-level and population-level effects and include supporting information for the conclusion that there would be no measurable impacts to salmon populations. Alternatively, we recommend the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Temporal Availability of Salmon: The Pebble Project proposes to eliminate, dewater, block, and fragment headwater streams, which could result in the loss of habitats that support headwater spawning and rearing salmonid populations. Headwater stream populations arrive later to their spawning grounds than those downstream in the mainstem and lower tributaries. Later arriving salmon populations are important because they extend the seasonal availability of salmon to terrestrial wildlife (e.g., bears, wolves) and other aquatic biota (e.g., fish and invertebrates) in the NFK, SFK, and UTC, and the overall Nushagak and Kvichak watersheds. Predators and scavengers roam from lakes to mainstems to tributaries in search of food subsidies offered by asynchronous salmon run timings across the landscape. The DEIS does not evaluate the importance of late arriving salmon to the ecology of headwater and downstream areas or of the potential consequences of losses due to the project. We recommend the EIS evaluate the importance of late arriving salmon to the ecology of headwater and downstream areas and the potential consequences of losses of these asynchronous subsidies due to the project or the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Age Structure: The DEIS acknowledges the presence of multiple age classes of Chinook, coho, and sockeye salmon in the Nushagak and Kvichak River watersheds. As a result, project impacts may result in losses of multiple age classes of multiple species. This loss of age class representation could significantly impact annual production or returns within a few generations. This issue is currently not evaluated in the DEIS. We recommend that the EIS analyze the potential for losses of multiple age classes, including across multiple species, and the potential resulting depletion of annual returns or that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

[33] For more information see: http://www.adfg.alaska.gov/index.cfm?adfg=fishinggeneconservationlab.bbaysockeye_baseline
[34] Brennan et al. 2019.

Egg Incubation: The DEIS and the Draft EFH Assessment do not fully address egg incubation or potential impacts to incubating fish eggs from habitat alterations. While the DEIS analyzes timing of spawning, egg incubation is a different life stage that occurs during a different time period. Table 3.24-4 does not include egg incubation, and thus this table presents an incomplete picture of life-stage periodicities of fish species in the NFK, SFK, and UTC watersheds. In addition, egg incubation could be affected by several project induced physical and chemical alterations, including changes in water temperature, groundwater inputs/flow pathways, surface flows, dissolved oxygen, pH, conductivity, and other water quality parameters. We recommend the EIS add egg incubation to Table 3.24-4, between spawning and emergence periods and that the EIS evaluate potential impacts to incubating eggs from changes in flow (e.g., scour) and other physical and chemical project induced alterations, as well as the consequences of the potential impacts to incubating eggs for fish species and populations. DEIS Table 4.24-1, which presents “Priority species and life stages used to determine habitat flow needs in the mine site area,” should be revised to include the incubation life stage for all species documented to occur in potentially affected waters, including lamprey (resident and anadromous). The analysis of impacts to lamprey are important because lamprey eggs hatch into larvae (ammocoetes) in about two weeks’ time and drift downstream to slow velocity areas, where they reside in the substrate from three to seven years, resulting in multiple age classes in the substrate at once. Lamprey eggs and ammocoetes, as well as eggs of other nest-building fish species, can be impacted by high flows that scour redds during sensitive life stages. We recommend that Table 4.24-3, entitled “Average precipitation year juvenile habitat for all streams and species in the mine site area pre-mine, during operations, and post-closure,” be revised to include all species documented at the mine site area.[35] Alternatively, we recommend that the Corps explain why its existing consideration of egg incubation is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Resident and Anadromous Fish: The DEIS discloses that potential direct and indirect (i.e., secondary) effects for aquatic resources are assessed according to the magnitude of impact from the project depending on the specific species sensitivity to the type of disturbance (p. 4-24-1). However, only select species are mentioned and several species that would be impacted are not included. As a result, the DEIS presents an incomplete picture of the number of impacted fish species and underestimates direct, secondary/indirect and cumulative impacts to the diversity of species and assemblages that provide ecological sustainability to the NFK, SFK, and UTC watersheds. We recommend that the EIS analyze impacts for the full diversity of resident and anadromous fish species known to occur in the Nushagak and Kvichak River watersheds or explain why its existing focus on selected species is sufficient in light of the significance and complexity of the discharge activities associated with this project.

DEIS Table 3.24-4 presents periodicity information only for select species. This table is incomplete and does not sufficiently represent periodicity because the length of time between spawning and fry emergence varies with species, population, and water temperature.[36] We recommend that the EIS include the complete periodicity of critical life stages of all anadromous and resident species known to occur in the mainstem and tributaries of the Nushagak and Kvichak River watersheds in Table 3.24-4 or explain why its existing focus on selected species is sufficient.

[35] Woody and O’Neal 2010.
[36] Murray and McPhail 1988, Quinn 2004.

DEIS Figures 3.24-2 and 3.24-3 present the fish distribution and relative contribution of "anadromous salmonids," "resident salmonids," "non-salmonid fish," and "no fish observed." The DEIS does not clearly define these terms, which differ from the regulatory language of the ADF&G Anadromous Waters Catalog. We recommend that the EIS define the categories used in Figures 3.24-2 and 3.24-3. For comparative purposes, we recommend that the EIS refer to life history strategies as either "anadromous" or "resident," consistent with the ADF&G Anadromous Waters Catalog. We also recommend that the EIS clarify whether "no fish" means that the reaches were sampled and no fish were found (and if so, when and how frequently these reaches were sampled), or that reaches were not sampled. Alternatively, the Corps should explain why its existing categories are sufficient in light of the significance and complexity of the discharge activities associated with this project.

Life History Strategies: The DEIS does not disclose potential impacts to life history strategies. Some fish species (e.g., rainbow trout, least cisco, Dolly Varden char, three-spine stickleback, lamprey) exhibit both resident and anadromous forms, each with diverse habitat needs for successful completion of life cycles. Resident and anadromous forms of lamprey were documented in the NFK, SFK, and UTC during the 2007 Baseline studies.[37] The presence of lamprey has also been documented in these headwater streams.[38] Anadromous Dolly Varden have also been documented in Bristol Bay watersheds.[39] We recommend that the EIS analyze life history strategies of the fish species documented to occur in the project impact area, consider potential impacts of the project to these life history strategies, and explain whether anadromous populations of these fish are also present within the Nushagak and Kvichak River watersheds. Alternatively, the Corps should explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not analyze potential impacts to diverse fish spawning strategies (e.g., nest builders versus broadcast spawners; spring versus fall spawners). For example, salmonids and lamprey species build redds in the channel substrate. Least cisco are broadcast spawners with eggs that disperse in the water column. Coho salmon are fall/winter spawners, while rainbow trout are spring spawners. Adaptive spawning strategies may not be resilient to the physical and chemical alterations resulting from the project. We recommend that the EIS analyze impacts of the project to the diversity of spawning strategies known to be used by fish species documented in the project area and resulting changes to the overall ecology of fish populations and assemblages or explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Bivalves: The DEIS does not discuss the presence or absence of freshwater mussels in the Bristol Bay region, nor does it analyze project impacts to bivalves. The Pebble Project Draft Environmental Baseline Studies, 2006 Study Plan, Figure 11.5-1, presents a map of the 2005-2006 project freshwater mussel sampling locations for Lake Iliamna. We recommend that the EIS characterize the pre-existing bivalve populations and analyze potential impacts to bivalves from the project or explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Sampling Design: The DEIS does not describe site selection and sampling design for fish habitat, distribution, or relative abundance studies. The DEIS does not explain methodologies used for the

[37] Northern Dynasty Minerals 2007.
[38] Woody and O'Neal 2010.
[39] Lisac and Nelle 2000, Reynolds 2000, Taylor et al. 2008.

selection of habitat transects (i.e., random, systematic) or if there was statistical reasoning behind the study transect selection. In addition, levels of uncertainty and error are not consistently reported for data used in the analysis. Fish counts reported in PLP's Environmental Baseline Document[40] do not always include estimates of observer efficiency, sampling efficiency, or other factors that affect the proportion of fish present observed. Thus, counts may often underestimate true abundance. The DEIS also includes limited or no information regarding when samples were collected, how many were collected, how often they were collected, and overall sample size on which estimates were based. This information should be included within the DEIS to support its statements. We recommend that the EIS provide information on site selection and study sampling designs and associated levels of uncertainty and error, as well the above-mentioned sample reporting information, for all data included in the DEIS, because this information is necessary to understand and support the presented analysis. Alternatively, the Corps should explain why its existing presentation of sampling design information is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Impacts of Streamflow Alterations: The project proposes to directly alter the natural flow regimes of streams that support resident and anadromous fish. A stream's flow regime—its daily, seasonal, annual, and flood fluctuations—is key to stream structure and function; thus, assessing impacts based only on mean monthly streamflows at large spatial scales does not adequately capture impacts. Numerous case studies in the literature indicate that altering a stream's hydrograph can cause measurable changes in ecosystem structure.[41] Streamflow changes are characterized in the DEIS using changes to monthly and annual mean flows. Fish habitat is created and maintained through daily and seasonal variations (e.g., minimums and maximums) of the natural hydrograph and therefore the time scale used in the DEIS does not capture flow impacts on fish. Reporting mean monthly values alone does not represent the range of flows that occurs each month or during extreme precipitation or drying events. We recommend that the EIS model flow alterations associated with the project on a more conservative basis, such as a daily or diurnal basis, to fully predict potential impacts on fish. We recommend that the EIS also characterize flow alterations such that pre-existing, mine operation, and post-closure hydrographs can be compared in terms of changes in the frequency or magnitude of daily peak and minimum flows. To support this analysis, the EIS could include a table that identifies: stream, reach, length (miles), percent and absolute (cfs) streamflow alteration (in terms of monthly mean, minimum, and maximum flows), and fish species and life stages known to be present. We recommend that the EIS include one or more maps of streams in the mine area that illustrate the specific percent streamflow changes expected along those streams (e.g., see Figure 7-14 in EPA 2014). Alternatively, the Corps should explain why its existing analysis of flow alterations is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not explain how flow alterations may alter ice formation in the Nushagak and Kvichak River watersheds. The DEIS does not include information on locations, thickness, or movement of ice; timing of break up and ice-out; under-ice temperatures; or under-ice spawning and overwintering habitat. We recommend that the EIS evaluate the project's potential impacts on the ice-related factors discussed above or explain why its existing consideration of ice-related factors is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS asserts that increasing flow will only result in positive benefits by increasing habitat. However, increasing flow can have negative effects as well (e.g., via temperature changes, redd

[40] PLP 2011.
[41] Richter et al. 2012.

scouring, and changes in channel stability and form), and it is well established that for many species and life stages, increasing flow does not create more habitat. In addition, the timing, frequency, and duration of increased flows should be considered. We recommend that the EIS further evaluate the extent to which increasing flow will result in potential positive benefits for the species and life stages impacted, as well as the potential negative impacts that could result from flow increases, in terms of the magnitude, timing, frequency, and duration of these changes. Alternatively, the Corps should explain why its existing analysis of the impacts of flow increases is sufficient in light of the significance and complexity of the discharge activities associated with this project.

According to Draft EFH Assessment, the net changes to habitat are expected to be negative across species in an average year and even greater in a dry year. The Draft EFH Assessment (Table 5-3) includes a nine percent decrease of spawning habitat for all four salmon species (Chinook, sockeye, coho, chum) in a dry year. We recommend that the EIS revise or provide supporting information for assertions in the DEIS that the Pebble Project will increase habitat, to accurately reflect analyses showing net habitat decreases. Alternatively, the Corps should explain why its existing analysis is sufficient and accurate in light of the significance and complexity of the discharge activities associated with this project.

In considering mine site impacts on fish resources, the DEIS states that the EIS analysis area (the NFK, SFK, and UTC watersheds, plus a 1,000 ft buffer around the mine site) includes "all aquatic habitats potentially impacted by changes in streamflow from the diversion, capture, and release of water associated with the project that result in a modeled reduction of streamflow greater than 2 percent" (pg. 4.24.-1). We recommend that the EIS provide rationale for why this two percent threshold was selected, the spatial or temporal scale at which this two percent value was calculated, how these delineations were supported by modeled streamflow changes, or whether this area also encompassed streamflow increases greater than two percent, and why it is considered a scientifically defensible threshold for considering impacts to fish resources.

The DEIS states that approximately 2.3 miles of the Tributary 1.190 mainstem and sub-tributary stream channels will remain free-flowing between the TSF and the water seepage pond, and that this could be resident species habitat (Section 4.24.2.1 Habitat Loss – North Fork Koktuli). We recommend that the EIS explain how this stream segment will remain free-flowing if it is blocked on both ends by mine structures, the upstream end of which is designed as a flow-through system such that water in this segment would be, in part, mining process water from the TSF.

The DEIS estimates the potential extent of downstream flow-related impacts of the project. The estimate, however, is unsupported. The DEIS states that "[o]nce the mainstem of the Koktuli is reached, flow changes would not be detectable" (pg. 4.24-13). The EPA's review finds that the DEIS does not contain any support for this conclusion, and that the DEIS does not define 'detectable.' We recommend that the information be added to support this statement regarding downstream flow-related impacts and revise or clarify as necessary.

According to the DEIS surface water modeling chapter (Appendix K.17 and RFI 104), the margins of error for flow model results are high; for example, the maximum difference between actual and modeled flows is approximately 20 percent. We recommend that the EIS, both graphically and tabularly, display flow changes (increases and decreases) for all project phases to show the extent (i.e., 3, 5, and 10 percent) and degree of downstream flow. We also recommend that the EIS show how changes in effluent discharges may result in fish habitat changes, taking into account the 20 percent margins of error in the flow model. Alternatively, the Corps should explain why its existing analysis of flow alteration is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Water Quality Impacts on Fish

Water Chemistry: The DEIS lacks analyses of the potential for fish toxicity from the introduction, relocation, or increase in contaminants in the aquatic environment. Anadromous and resident species are genetically adapted to a relatively narrow and unique range of habitat and water quality parameters within their natal streams.[42] We recommend that the EIS analyze: 1) potential impacts of increased metal loading to fish; and 2) how increases in loading, especially of copper and selenium, would affect fish downstream of the discharge points. We recommend that the level of chemical alteration and potential consequences to fish and fish habitat be evaluated. Alternatively, the Corps should explain why its existing analysis of metal loading and impacts on fish is sufficient in light of the significance and complexity of the discharge activities associated with this project. Additional technical recommendations include:

1. The Pebble Project proposes to treat all discharges to meet water quality standards. The Corps should analyze the potential for discharges to match the existing water quality of the receiving waters. Discharges that meet standards may still impact fish and fish habitat. For example, small changes, such as increases in dissolved copper concentrations, can be lethal or sublethal.[43] In order to improve thia analysis, the Corps should predict changes to concentrations in streams due to project impacts (such as treated water discharges, fugitive dust, and uncaptured groundwater) and evaluate the impacts that these changes could have on fish and fish habitat.
2. DEIS Section 3.24.1, Fish Tissue Trace Element Analysis, does not provide summary baseline or existing concentrations of elements (i.e., zinc, copper, arsenic, mercury, methylmercury). The Pebble Project Draft Environmental Baseline Studies 2006 Study Plan (Figure 11.1-1) includes a map of fish tissue sample site locations and the Draft 2007 Environmental Baseline Studies include a table of fish tissue sample locations (Table 11.1-2). We recommend that the EIS include this information to support analysis of potential impacts to fish from elevated elements.
3. Neither the DEIS nor the Draft EFH Assessment include analyses and discussion of potential toxicity impacts to fish. We recommend that the EIS analyze the potential for the following toxicity impacts:
    - Impairment to olfaction and homing capabilities in salmonids;
    - Attraction to very high lethal levels of water contamination;
    - Interference with respiratory function;
    - Reduction in immune efficiency;
    - Disruption to osmoregulation capabilities;
    - Impacts to the sensitivity of the lateral line canals;
    - Impairment of brain function; and

[42] Woody 2018; Lytle et al. 2004.
[43] Eisler 2000, Baldwin et al. 2003, Sandahl et al. 2006, Hecht et al. 2007, Sandahl et al. 2007, Tierney et al. 2010.

- Changes in enzyme activity, blood chemistry, and metabolism.

Water Temperature: The DEIS and the Draft EFH Assessment do not analyze how disruption in groundwater pathways, surface water flow, and aquifers will alter water temperatures and thermal patterns within the NFK, SFK, and UTC watersheds. Fish are at risk from changes in the heterogeneity of thermal patterns, which drive their metabolic energetics. Fish populations rely on groundwater-surface water connectivity, which has a strong influence on stream thermal regimes throughout the Nushagak and Kvichak River watersheds and provides a moderating influence against both summer and winter temperature extremes (Woody 2011). We recommend that the EIS characterize existing baseline heterogeneity of the water temperature regime and what this heterogeneity means for fish and fish habitat, including analyses of the regulating effects of groundwater/surface water connectivity. We recommend that the EIS analyze how flow alterations will affect pre-existing daily thermal regimes, as well as consequences for fish. A color-coded thermal map of the existing water temperature regimes versus those under the project operations would be helpful to show changes that could occur with project implementation. Alternatively, the Corps should explain why its existing analysis of temperature changes and impacts to fish is sufficient, in light of the significance and complexity of the discharge activities associated with this project. Additional technical recommendations regarding water temperature include:

1. The Draft EFH Assessment Table 5-4 presents a range of average stream water temperatures pre-mine and after release of treated surplus water during winter and summer. We recommend that this analysis be revised to include temperature variability (i.e., changes in daily minimum and maximum temperatures). Broadly characterized winter and summer average temperature ranges are not relevant to disclosing changes in thermal patterns to which NFK, SFK and UTC resident and anadromous fish are locally adapted. We also recommend that the EIS analyze potential short-term effects of water temperature increases during dry years.
2. We recommend that the EIS analyze impacts of temperature alteration to critical life history stages of fish species, particularly in terms of changes in incubation conditions and accumulated thermal units necessary to complete egg development. Egg development is a sensitive life stage and water temperature differences of one degree Celsius can impact growth and development.[44]
3. The DEIS assumes that the impacts of the proposed project to average stream water temperatures during the winter will be negligible or beneficial with no supporting evidence. We recommend that the EIS include analysis to support or revise these conclusions.[45]
4. The Draft EFH Assessment asserts that ice and beaver effects on stream morphology would likely minimize potential effects of flow alteration on channel morphology (5.1.1.3 Water Flow, pg. 70). We recommend that the EIS include additional information to support this conclusion.
5. We recommend that Section 3.24.5 of the DEIS be revised to consider how future changes in the regional climate may affect fish populations. We recommend that the EIS analyze long-term management under expected future climate scenarios, particularly in terms of water treatment and management and salmon populations. As discussed earlier, a key feature of salmon populations in the Bristol Bay watershed is their genetic diversity (i.e., the portfolio effect), which serves as an overall buffer for the entire population. Different sub-populations may be more productive in different years, which affords the entire population stability under variable

[44] Brannon 1987, Beacham and Murray 1990, Hendry et al. 1998, Quinn 2005, Healey 2011, and Martins et al. 2012.
[45] For example, Sparks 2018.

> conditions year-to-year. If this variability increases over time due to changes in temperature and precipitation patterns, this portfolio effect becomes increasingly important in providing the genetic diversity to potentially allow for adaptation; thus, impacting or destroying genetically diverse sub-populations may have a larger effect on the overall population than expected under future climatic conditions.

Nutrient Inputs: The discussion of stream productivity (Section 4.24.2.4) includes unsupported conclusions regarding the importance of marine-derived nutrients, stating "[a]s shown in the baseline data above, marine-derived nutrients do not appear to influence the nutrient availability in the Koktuli or uppermost reaches of the Upper Talarik watersheds in the project area" (pg. 4.24-17). It is not clear what baseline data are referred to in this statement. Further, baseline water quality data are not relevant to supporting such conclusions, as it is likely that marine-derived nutrients in these relatively low-nutrient systems would get taken up quickly by biota rather than remain in the water column. Consideration of whether biotic production differs between anadromous and non-anadromous streams would be of more value in determining the influence of marine-derived nutrients. To evaluate the contribution of marine-derived nutrients to stream productivity, we recommend that the EIS evaluate changes to marine-derived nutrient inputs from the pre-existing condition and the consequences of these changes for stream productivity at multiple trophic levels or explain why its existing analysis of stream productivity is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

The DEIS includes almost no analyses of direct losses of autochthonous and allochthonous inputs from upstream reaches lost and/or disconnected from wetland and other riparian habitats, as well as the incremental reductions in those inputs in downstream segments throughout the stream reaches. We recommend that the EIS analyze these losses of autochthonous and allochthonous inputs and their effects on system-wide primary, secondary, and tertiary production that support fish populations or explain why the existing analysis of these inputs is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

The DEIS similarly includes almost no analyses to address invertebrate transport and production. Invertebrates are a significant source of food for fish. Macroinvertebrate and periphyton data are very spatially and temporally limited in the mine site area, limiting the utility of generalizations about stream productivity. No data on macroinvertebrate exports from headwater streams are presented in the DEIS, despite numerous studies showing these exports can be important in Alaska streams.[46] We understand that a macroinvertebrate technical working group was convened, and limited data on macroinvertebrates were collected in the mine site area and along the northern transportation corridor as part of the environmental baseline for the project; however, the DEIS does not include this information. We recommend that the EIS analyze invertebrate transport and production, using available site-specific data and where necessary supplementing these data with additional sampling and information. Alternatively, we recommend that the Corps explain why its existing analysis of invertebrate exports is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

[46] For example, Wipfli and Gregovich 2002, Wipfli et al. 2007.

Modeling of Impacts to Aquatic Resources: The DEIS identifies significant uncertainty in the groundwater model, which affects the water balance and streamflow alteration predictions[47] (see Groundwater and Surface Water Hydrology comments above). No accuracy or sensitivity analysis was performed on the water quality modeling and predictions (see Water Quality section, above), or the physical habitat simulation modeling (see comments below). The DEIS does not include information about how the uncertainties in modeled predictions (e.g., predictions in flow alterations and sources of water and contaminant contributions) affect predicted impacts to fish and fish habitat. We recommend that the EIS discuss the validity and accuracy of model outputs when assessing project impacts to fish and fish habitat.

The Draft EFH Assessment discloses that a hybrid simulation analysis model (HABSYN) was used to synthesize habitat-flow relationships. According to the document, HABSYN is meant to account for predicted stream flow reductions and treated surplus water discharges from the mine water treatment plants, and its predictions are based on physical habitat simulation system (PHABSIM) modeling at measured transects. PHABSIM forces/assumes a fish-habitat relationship based on water depth and velocity (discharge) alone. We also note that PHABSIM and its subcomponents (habitat suitability curves and wetted usable area) were identified by the Pebble Project Instream Flow Technical Working Group as being problematic and inappropriate for assessing fish habitat in the project area.[48] The DEIS and supporting documents have not established that there is a relationship between discharge and fish habitat selection, which is of particular import given that the impacted sub-watersheds of the proposed Pebble Project mine site are groundwater-driven systems. We recommend that the EIS fully explain the uncertainties and limitations of the PHABSIM and HABSYN models and describe how the limitations affect the analysis of fish and fish habitat impacts. Additional technical recommendations related to habitat modeling include:

1. PHABSIM and associated preliminary watershed model results presented in the Draft EFH Assessment (Table 5-3) indicate habitat losses in the NFK and SFK Rivers for some species and habitats (e.g., coho and Chinook salmon spawning). The DEIS asserts that there are habitat gains downstream (due to increase discharges), but these are modeled increases in discharge, and no analysis is provided to indicate that there will be resulting habitat increases. Table 5-3 also reports net gains in sockeye salmon. However, PHABSIM likely is not appropriate for capturing habitat for species that key into habitat factors, such as areas of groundwater upwelling (e.g., spawning sockeye), that are unrelated to water depth and discharges. We recommend additional analyses be conducted to support the results reported in EFH Assessment Table 5-3.
2. The Draft EFH Assessment discloses that wetted usable area will be used to identify available habitat; however, the information presented in Table 4.24-2 and Table 4.24-3 appears to be based on the assumption that increases in water depth and/or velocity equate to additional spawning and/or rearing habitat (see discussion above regarding limitations of PHABSIM modeling). While the tables may lead to the conclusion that there will be an increase in habitat due to discharges, discharges also may result in negative impacts (e.g., redd scouring). We recommend

[47] Monthly average discharges were chosen as inputs in the streamflow model, which do not represent the range of flows that occurs each month or extreme precipitation events, both of which affect stream ecology. Calibration of the stream flow model indicated that cumulative flows were overpredicted during the first two years of the calibration period and underpredicted during the remaining three years. In some cases, measured and calculated flows differed by more than 20 percent. The model may also not be able to predict the lowest flows (RFI 104).
[48] ISF TWG meeting minutes 2010.

that the Corps evaluate potential impacts of water discharges on all relevant habitat factors, rather than focusing only on increases in water depth and/or velocity.

3. Baseline documents indicate and the Draft EFH Assessment discloses that habitat suitability curves were developed from PHABSIM modeling efforts, but the DEIS does not discuss habitat suitability curves or the appropriateness of their use. We recommend that the EIS include additional data and analyses to demonstrate the validity of this approach.

The DEIS does not include analysis of how the predictive models work together to analyze and quantify the cumulative impacts of potential changes in streamflow or water quality, and the subsequent consequences for fish and fish habitat (e.g., how flow modeling integrates with downstream water temperature modeling to demonstrate lateral and longitudinal changes in the heterogeneity and complexity of side-channel spawning habitat or beaver pond rearing habitat, or how impacts from surface and groundwater flow alterations and corresponding changes in downstream water quality affect distribution and production of benthic macroinvertebrates). We recommend that the EIS analyze and discuss model integration to explain how individual predictive models are combined to assess and quantify project impacts and to identify what consequential outputs mean for fish and fish habitat. Alternatively, the Corps should explain why its existing analysis is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

COMMERCIAL AND RECREATIONAL FISHERIES

The DEIS does not fully describe the value of the Bristol Bay fisheries, which includes the largest sockeye salmon fishery in the world, or the Pebble Project's and project alternatives potential impacts to these fisheries. As a result, many of the conclusions in the DEIS regarding the value of the fisheries lack context to support stated conclusions. Analysis of impacts to commercial fishing "relies on Section 4.24, Fish Values, which estimates that Alternative 1 would not have measurable effects on the number of adult salmon returning to the Kvichak and Nushagak river systems as a result of project operations, due to the limited lineal footage of upper Koktuli River fish habitat affected by placement" (pg. 4.6-5). The DEIS states that the magnitude, extent, duration, and likelihood of project effects of Alternatives 2 and 3 on commercial fishing would be expected to be the same as Alternative 1, with the exception of increased fishing pressure on freshwater waterbodies under Alternative 3 due to the presence of a continuous road providing access to these waterbodies along the north side of Lake Iliamna. As described in our following comments, we recommend that the EIS fully analyze identified issues and utilize the available scientific literature to support conclusions regarding the value of these fisheries.

The analysis of impacts to commercial and recreational fisheries examines expenditures and number of trips for recreational fisheries as well as revenues for commercial fisheries, which are common features of a typical economic impact analysis. However, the EIS does not appear to acknowledge the existence of additional sources of value that should be considered in the analysis. For example, the assessment places a value of zero on passive use, existence, and bequest values associated with these fisheries. Further, when there are potential conflicts the assessment generally assumes that fishermen (commercial and recreational) will alter their behavior, with little analysis of the real costs of that avoidance behavior. We recommend that the EIS identify and consider additional economic values and acknowledge that those values are likely to be positive. We further recommend that the assessment include welfare theoretic values of willingness-to-pay or consumer surplus for a day of recreational fishing in addition to the cost or expenditure data presented in the assessment.

1. In the description of the Cook Inlet gillnet fishery, the DEIS includes the following evaluation: "… the potential for conflict is low because of the depth of the pipeline on the sea floor, and the specifications of drift gillnet gear" (pg. 3.6-19). No evaluation of potential conflict is made for any of the groundfish species or for shellfish and other species. Regarding Cook Inlet groundfish, the DEIS states (pg. 3.6-22) that harvesters have greater flexibility to avoid fixed assets such as pipelines and undersea cables due to the size of the federal management areas. We recommend that the EIS clarify whether this is an estimate or an evaluation of how these fishermen may change their behavior as a result of the proposed pipeline. We recommend that the EIS include analysis of potential pipeline conflicts for all commercial fisheries in Cook Inlet.

2. We recommend that a change in recreational fishing effort as a function of perceived loss of quality in the fishery be considered as one of the potential impacts of the proposed mine and its construction. Examples exist of a recent discussion of these types of losses after the Gulf of Mexico oil spill (English et al. 2019; Glasgow et al. 2019).

3. The DEIS does not fully analyze impacts to recreational fishing on the Kenai Peninsula. While acknowledging that a new compressor station as well as the eastern terminus of the proposed natural gas pipeline are proposed to be constructed in this area, the document states that: "The facility would not be expected to affect angling in the area; thus, Area P (Kenai Peninsula) is not discussed in further detail in this section" (pg. 3.6-27, footnote to Figure 3.6-15). Given that the project will result in on-the-ground impacts associated with construction and operation of this infrastructure, we recommend that the EIS include additional analysis to support the conclusion that the expected effect to recreational angling in Area P is zero.

4. Regarding effects on salmon populations, the DEIS states "In terms of the magnitude of impacts, construction and operation of the project would not be expected to have measurable effects on the number of adult salmon returning to the area. In terms of the extent of impacts, commercial harvesters may have to change fishing patterns based on the proximity of fishing to port operations, or could experience losses if port operations affected salmon returns" (pg. 4.6-6). We recommend that the EIS define the distinction between "magnitude" and "extent" of impacts in this context and resolve apparent conflicts between the two statements above in terms of acknowledging potential impacts to salmon returns and populations.

5. The DEIS states that there would be "no measurable impacts on sport fish" (pg. 4.9-9). However, potential impacts are described elsewhere in Section 4.6. For example, the DEIS acknowledges the potential for there to be economic impacts borne by recreational fishermen and affiliated guides and lodges, stating that "Affected operators could substitute fishing on different streams, albeit at potentially higher costs to themselves and their consumers" (pg. 4.6-8) and states that "the pipeline itself could disturb traditional halibut concentrations…" (pg. 4.6-9). We recommend the impacts on sport fish be quantified in the EIS, and that statements regarding measurable impacts be revised as appropriate.

6. The DEIS states that "The extent of construction and operations of the projects would be to affect the quality of the fishing experience in the immediate vicinity of the project where project facilities are visible…" (pg. 4.6-9). Fishing in an area with an undisturbed watershed is likely a different perceived experience that fishing in an area with an active mine and its infrastructure, regardless of whether or not those facilities are directly visible. We recommend that the EIS

include analysis to support the assumption that impacts on the fishing experience would occur only where project-related changes are visible.

7. The DEIS states that "…revenues would shift between municipalities and companies but not necessarily change in total…" (pg. 4.6-9). We recommend that the EIS clarify what "not necessarily" means in this context, and that the EIS explain which municipalities are likely to be affected even if overall visitation to the region doesn't change.

Subsistence: Currently the assessment of Bristol Bay fish resources does not include subsistence values. The subsistence fishery is addressed in a separate chapter, which quantifies harvest levels of subsistence fish resources but does not quantify the economic value of the subsistence fisheries. Because the DEIS currently considers the commercial and recreational fisheries independently of subsistence values, the DEIS presents an incomplete picture of the value of Bristol Bay fishery resources. We recommend that the subsistence fishery information be combined with the commercial and recreational aspects to provide a comprehensive assessment of the Bristol Bay fishery resource values.

Weathervane Scallops, Roe Herring, and Salmon: The DEIS discloses that the harvest and long-term productivity of the Kamishak Bay weathervane scallop fishery could be affected by the route of the proposed natural gas pipeline (pg. 4-6.2 and pg. 4.6-6), and that the construction and presence of the pipeline may delay or negate future openings of the fishery due to sea bed floor disturbance. The DEIS does not, however, appear to fully analyze the extent, magnitude, or duration of impacts. We recommend that the EIS include an assessment of the weathervane scallop fishery, including the two weathervane scallop beds that are in the path of the pipeline, and the impacts of the pipeline on this fishery.

The DEIS states that in terms of the magnitude of impacts, construction and operation of the Amakdedori port would not be expected to have measurable effects on the number of adult salmonids returning to the Chenik sub-district of Kamishak Bay fishing district (pg. 4.6-6). This is also the same area as the historic Pacific herring sac roe fishery. The DEIS includes no impact assessment of either of these fisheries. The DEIS discloses that the Pacific herring fishery in Kamishak Bay could experience direct or cumulative effects, but no analyses are presented. We recommend the EIS include analyses of these fisheries and the extent, duration, and magnitude of environmental consequences to these fisheries from project impacts and alternatives.

Value of the Fisheries: The DEIS lacks many specifics of the value of the Bristol Bay, Nushagak and Kvichak watershed fisheries. We recommend that the EIS utilize information from the current ADFG Annual Management Report[49] as one of the single best sources of summary information for the Bristol Bay fisheries, including the reporting of last year's record setting Sockeye Salmon returns from the Nushagak District. The DEIS further indicates that Bristol Bay salmon fisheries "suffer" from a lack of value, recognition, and branding. This likely underestimates the known and well-documented value of the Bristol Bay salmon fisheries. Bristol Bay Sockeye Salmon are branded and advertised on the global market.[50,51] We recommend that the EIS either include the best science and information available to support its conclusion or revise the conclusion accordingly. Additional specific comments are below:

[49] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-11.pdf
[50] https://bristolbaysockeye.org/
[51] https://www.bbrsda.com/history

1. The DEIS indicates that the Nushagak River does not particularly stand out for the average size of its sockeye salmon run, (pg. 3.6-4) but does not include that the Nushagak River provides an annual average return of 2.3 million sockeye salmon. Further, the 2018 Nushagak District sockeye salmon harvest of 24.1 million fish was the largest single Bristol Bay district harvest on record.[52] We recommend that the EIS text be revised accordingly.

2. We recommend that the EIS also include that the 2018 Bristol Bay preliminary ex-vessel value of $281 million of all salmon species ranks first in the history of the fishery and was 242 percent above the 20-year average of $116 million. It was 39 percent higher than the $202 million ex-vessel value of the 1990 harvest, which ranks second. The 43.5 million harvest of all species was the second largest in the history of the fishery, after the 45.4 million fish harvest in 1995. The sockeye salmon harvest of 41.3 million ranks second after the 44.2 million fish harvest, also in 1995.[53]

3. We recommend that the EIS include an assessment of the differing run timing of salmon species returning to each district. Differences in run timing are an important aspect of the Bristol Bay salmon portfolio, ecologically and economically. For example, during 2018 the Naknek-Kvichak, Egegik, and Ugashik districts (east side) observed the latest run timing on record, and, because of the disparity in run timing between the Nushagak and the east side districts, the processing sector was able to keep pace with the run. This suggests that, in addition to the variability in abundance of returns, variability in timing of the returns is key to sustaining the economic stability of the processing sector. We recommend that this chapter include consideration of the salmon portfolio effect that accounts for the resiliency of Bristol Bay salmon fisheries in the region.[54]

4. The Nushagak–Mulchatna rivers drainage produces the largest runs of Coho Salmon in Bristol Bay. Within the drainage, there are 4 areas of concentrated recreational effort: the lower 15 miles of the Nushagak River near the village of Portage Creek; the middle section of the Nushagak River in the vicinity of the village of Ekwok; the section of the Mulchatna River between the Stuyahok and Koktuli rivers; and, the upper Nushagak River from the outlet of Nuyakuk River upstream to the outlet of the King Salmon River. Of the areas mentioned above, the lower portion of the Nushagak River and the fishery in the immediate vicinity of the Nuyakuk River outlet have long been the most significant.[55] We recommend the EIS include this information relevant to the value of the fisheries that will be impacted by the project.

5. We recommend that the EIS include all sport fisheries in the project area, including the Sockeye Salmon and Chinook Salmon recreational fisheries or the Rainbow Trout special management areas with in the Nushagak and Kvichak watersheds, including the upper Nushagak, Kvichak River and upper Talarik Creek. Additional information on sport fisheries in the project area can be found on the ADFG website.[56] We recommend this important fishery information be included and impacts analyzed in the EIS.

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[52] http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/989536277.pdf
[53] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-11.pdf
[54] https://www.adfg.alaska.gov/index.cfm?adfg=fishingSportFishingInforuntiming.main&chart=runbbk
[55] https://www.arlis.org/docs/vol1/K/934855450.pdf
[56] https://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2018-2019/bb/FMR18-27.pdf

6. We recommend that the EIS include information on the aesthetic value of the Bristol Bay salmon fisheries or the Upper and Lower Cook Inlet fisheries.

7. Table 3.6-2 Bristol Bay Economic Contribution, 2010 (pg. 3.6-5) cites a 2013 report by Knapp, Guiettabi and Goldsmith. There is a more recent (2018) report on the benefits and economics of Bristol Bay salmon available,[57] and we recommend that this more recent information be factored into the analysis.

Fisheries Management Regime: The DEIS does not fully characterize the historical and ongoing research and management efforts that are in place to help ensure the sustainability of the Bristol Bay, Nushagak, and Kvichak watershed salmon fisheries. We recommend the EIS include discussion of Bristol Bay and Cook Inlet species management plans and the management regime of the ADFG in the EIS. This is important information to include given the financial investment made annually by the State of Alaska to sustain Bristol Bay fisheries through management efforts. We recommend that the EIS include the ADFG management plans currently in place to help ensure the sustainability of the fisheries, including the *Nushagak-Mulchatna King Salmon Management Plan,[58]* The Bristol Bay Five Year Strategic Plan: 2018-2023,[59] the *Nushagak River Coho Salmon Management Plan,[60]* and the sockeye salmon management plan. All include actions and restrictions that should be taken if the in-river runs fall short of management goals. We recommend that the EIS include a comprehensive analysis of the current Bristol Bay fisheries management regime and the potential for regime shifts as a consequence of project impacts to commercial and recreational fisheries.

Additional information that we recommend incorporating into the EIS analysis, including examples of the resources committed to Bristol Bay salmon fisheries due to their well-recognized value and importance to the local, national and international markets, includes:

1. The Bristol Bay genetic baseline that ADFG has built and tested over the past 17 years, found on page 3 of the 2017 Bristol Bay Area Annual Management Report.[61]
2. The Bristol Bay Research Institute sited at Port Moller.
3. The Bristol Bay Regional Seafood Association 2018-2023 Strategic Plan.[62]
4. The work and research of University of Washington's Alaska Salmon Program provides a wealth of information on regional fish populations with many relevant peer-reviewed journal articles that could be referenced to characterize the fish ecology of the region.[63]

Visualization Tools: We offer the following recommendations regarding figures provided for Section 3.6, in order to improve the understanding of Commercial and Recreational Fisheries in the project area:

1. We recommend that maps of commercial and recreational fisheries (e.g., Figure 3.6-10 Upper Cook Inlet Drift Net Management Areas, Figure 3.6-11 Cook Inlet Management Area Groundfish Areas and District Boundaries, and Figure 3.6-13, Cook Inlet Management Area and Shellfish Districts) be overlaid with project components, such as the proposed pipeline. Visualization would assist decisionmakers and the public in understanding the proximity of project components to fisheries.

[57] http://www.pebblescience.org/pdfs/EconomicBenefitsofBristolBaySalmon-July-2018.pdf
[58] 5 AAC 06.361
[59] https://www.bbrsda.com/strategic-plan/
[60] 5 AAC 06.368
[61] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-11.pdf
[62] https://www.bbrsda.com/strategic-plan/
[63] https://sites.uw.edu/aksalmon/

2. We recommend including the percentage of active permits to permits owned above each bar in Figure 3.6-6 Distribution of Quartiles in the Drift Net Fishery by Area of Residence, to aid understanding of how Figure 3.6-6 relates to Table 3.6-4.

3. Table 3.6-9 & Table 3.6-10 present average angling days and statewide harvest survey information for waterbodies in the project area. We recommend including a map showing the location of these waterbodies/rivers relative to the proposed mine site and proposed infrastructure.

GEOHAZARDS

Key issues associated with geohazards pertain to recommendations that the EIS include additional detail regarding embankment designs and seismic stability to support the DEIS conclusions related to the safety and stability of tailings storage facility and water management pond embankments. Accidents or failures associated with the embankments could have significant adverse impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support. Our recommendations regarding these key issues are discussed below. Additional comments to improve the geohazards analysis are provided in the following our key comments.

Embankment Designs and Seismic Stability

Conceptual Level of Design to Evaluate Impacts: The DEIS (section 4.15 and Appendix K4.15) describes the tailings and water management dam designs as conceptual and therefore dam design features and the stability analysis are based on many assumptions. Given that stability of tailings was one of the significant issues arising from scoping, we recommend that that design of the tailings and water management dams be advanced beyond the conceptual design stage to at least a preliminary design level so that the EIS analysis is based on information more reflective of what would be constructed, with fewer assumptions and uncertainties. Other recent mining EISs developed by the Corps have included more than conceptual design information (e.g., Donlin and Haile) and we recommend that additional information also be analyzed and included for the Pebble Project. Alternately, we recommend that the EIS further explain why the approach using conceptual level designs is sufficient and how that approach impacts the accuracy of the impact conclusions.

Water and Seepage Management Associated with Embankments: The DEIS states that control of water is an important consideration in achieving a stable tailings deposit and embankment. However, the DEIS does not provide details on: 1) the specific freeboard allowance (feet) for the pyritic and bulk TSF embankments and IDF (see also our comments on surface water hydrology); 2) whether liners “and/or” core/filter/transition zones would be used for the non-flow through TSF embankments (see Table K4.15-1); 3) grout curtain depth and extent in comparison to location-specific bedrock characteristics to demonstrate that it would contain seepage flows; and 4) the design and spacing of basin and embankment underdrains to maintain a reduced phreatic surface. Since water control is important, we recommend that these details be provided in the EIS along with a preliminary design of tailings dams and seepage management systems to support EIS assumptions related to the effectiveness of water control for both seepage collection and stability.

Core Zone Material Types and Quantities: Appendix K4.15 indicates that sufficient quantities of low permeability materials for the bulk TSF main embankment filter and transition zones may not be available on site, so alternatives could be used. We recommend that material quantities be determined, as was done for other mine site components, so that the need for additional quarries (which would impact the fill used and/or project footprint) is determined and explained in the EIS analysis. If alternatives are used that involve off-site materials this could impact the amount of transportation to the site during construction. We recommend that the EIS evaluate and explain how much material is needed, where it would come from, and the environmental impacts associated with obtaining and transporting it to the mine site.

Static Stability Analysis: Static stability was modeled and predicted for several of the TSF embankments, the WMPs, and the Bulk TSF SCP. Although not described as such in the main text of the DEIS (Section 4.15.2.1), the reference documents supporting the stability analysis state that it was a "preliminary static stability analysis" based on a "simplified concept" and that geotechnical and hydrogeologic data collection is ongoing to confirm assumptions in the preliminary stability analysis. Reference documents also state that embankment designs and stability analysis will be updated accordingly to reflect actual foundation conditions (RFI-008). We recommend completion of the geotechnical and hydrogeologic programs and revision of the stability analysis in the EIS to reflect further developed or actual foundation conditions. We understand that this would be required for ADSP permitting, but we believe that using actual conditions is consistent with ensuring a fair evaluation of potential impacts and risks. This is an important issue since a specific weak foundation condition was a contributing cause of the Mt. Polley TSF breach (Morgenstern et al. 2015).

In addition, as with any model, we recommend that sensitivity and uncertainty be discussed in the EIS so that the accuracy of the static stability model predictions can be assessed. This is particularly important given the conceptual nature of the dam designs and preliminary nature of the stability analysis.

Seismic Hazard Analysis: The DEIS provides a probabilistic and deterministic seismic hazard analysis, however aspects of the analysis in the DEIS are not based on current best practices and data. The DEIS and RFI 008c indicates that the seismic analyses will later be updated to incorporate: 1) current best practices, since the seismic analysis is based on a 2013 Knight Piésold report; 2) New Generation Attenuation (NGA) equations, since the DEIS seismic hazard analysis is based on 2008 NGA equations and revised equations were published in 2014; and, 3) updated United States Geological Survey (USGS) ground motion data. We recommend that the seismic hazard analysis in the EIS be updated to reflect best practices and current information. Alternatively, we recommend that the EIS explain why the approach (which is not based on best practices) is sufficient and explain the level of uncertainty associated with the seismic hazard analysis.

Pseudo-Static Deformation Analyses and Seismic Safety: The DEIS does not fully characterize the stability and performance of the TSF and main WMP embankments in response to a seismic event (earthquake). Pseudo-static deformation analyses are important to determine the embankment safety factors under seismic loading and to evaluate the stability and performance of an embankment during a seismic event. There was no deformation analysis conducted for the pyritic TSF embankment and the Main Water Management Pond embankment. In regard to the bulk TSF embankment, the DEIS relies on pseudo-static deformation analysis from an earlier design of the TSF main embankment (Appendix K4.15) to assess bulk TSF embankment seismic stability and deformation during earthquake loading conditions and does not fully describe whether the deformation analysis on the earlier design is representative of earthquake-induced stability changes and dam deformation that could occur based on the current dam design.

The TSF and Main WMP embankments are significant structures that range in height up to 545 feet and with combined lengths of 7.2 miles (for the TSF dams) and 3.6 miles (for the WMP dams). We recommend that pseudo-static deformation analysis be developed for the current bulk TSF embankments based on the current project plan and for the pyritic TSF and WMP embankments and that safety factors under seismic conditions and the impacts to these embankments in the event of a range of earthquake scenarios be included. If this analysis is not conducted, then we recommend that lack of a representative pseudo-static deformation analysis for the bulk TSF and lack of any pseudo-static deformation analysis for the pyritic TSF and Main WMP embankments be identified in the EIS as a data gap that affects analysis of how these dams would be impacted by an earthquake.

Additional Geohazards Analysis Comments and Recommendations

Following are additional comments and recommendations related to the geohazards analysis.

Foundation Conditions Under the WMPs: The DEIS (Appendix K4.15) mentions weak foundation conditions under the open pit WMP and main WMP and assumes that any potential foundation conditions (glacial clay layers) would be mitigated during design and construction after the collection of additional geotechnical information. We recommend that further detail, including mapping, be provided in the EIS that identifies the areas of weak foundation conditions and that PLPs construction and design documents be updated to identify these conditions and describe how these conditions will be managed. This level of information is important to assess the effectiveness of foundation condition mitigation.

State of Alaska Dam Safety Guidance: The DEIS refers to the Alaska Dam Safety Program (ADSP) guidance (ADNR 2017a) and relies on this guidance to conclude that the dams associated with the TSFs and WMPs will be stable and safe. The ADSP guidance is stamped "draft revision" and the guidance itself contains recommendations (as opposed to requirements) and notes that that dam safety statutes at AS 46.17 and 11 AAC 93 are the legal governance for the ADSP. The ADSP guidance also notes that compliance wth the ADSP "is intended to establish a minimum standard of care; however, additional effort by the dam owner may be required to fully understand and manage the associated risks and liabilities of owning a dam." We recommend that the evaluation of geohazards and dam stability in this section consider the legal requirements as well as the draft guidance. Since the ADSP guidance states that it is the minimum standard of care, we recommend that this section of the DEIS further describe how the specific embankment criteria selected (OBE, MDE, Safety Factors, slopes) are appropriate and conservative for the specific embankments and specific conditions at the site.

AIR QUALITY

The proposed project includes many potential sources of mine pollutant emissions, including from the operation of heavy machinery and equipment, other mobile sources (e.g., vehicles, ships, aircraft), stationary sources (e.g., power plant), and fugitive dust. Key issues include particulate matter impacts from the mine site, which are likely underpredicted in the EIS based on the modeling parameters used, as well as deficiencies in the air quality modeling assessment for the port facilities which, if corrected, may result in potential exceedances of the NAAQS for 1-hour or annual NO_2. Our recommendations regarding these key issues are discussed below. Additional comments and recommendations for improvement to the air quality analysis are provided following the key comments.

Air Quality Modeling

Mine Site Ambient Air Boundary: Air impacts based on dispersion modeling of the mine site are reported only at receptors outside of the ambient air boundary, as those are areas to which the public would have access. The ambient air boundary appears to extend far from the mine operations area, especially on the southeast side where most of the maximum air impacts occur. It is therefore critical to ensure that the correct ambient air boundary has been modeled, so that potential air quality impacts may be reported accurately. According to Appendix K4.20, the ambient air boundary used in the modeling is based on a safety zone that "would be established to ensure that the public would not be exposed to work site safety risks." We were unable to locate additional information regarding the establishment of this safety zone, including the rationale for determining its extent or the means through which it will be enforced. We recommend that this information be added to the EIS as part of the description of the proposed action. Specifically, additional information should be attached or referenced that provides the details regarding the safety zone and what steps (fencing, posting, patrols, etc.) PLP will take to preclude public access to these areas and confirmation that the land within the boundary is under the full control of PLP. While the State of Alaska will determine whether the ambient air boundary is properly established during the air permitting of the project, the Corps should consider including this information in the EIS, in order to accurately and adequately assess impacts.

Modeling of Mine Site Fugitive Dust Impacts: The modeling parameters used to simulate emissions from the mine pit appear to have resulted in an underprediction of particulate matter emissions from the pit. Modeling for the DEIS has been conducted using AERMOD's OPENPIT algorithm to simulate emissions from the mine pit. Based on the parameters provided in Table 4 of Appendix A, the effective depth of the pit calculated by AERMOD is 580 meters. Given a final central pit depth of 700 meters, the average effective depth of 580 meters represents conditions near the end of the life of the mine. In addition, the release height of the emissions is only 5.0 meters, which effectively results in the release of pollutants at a height 575 meters below the lid of the parameterized pit. These parameters likely result in an underprediction of particulate matter emission from the pit, especially during the early years of the project where the average pit depth is much less than the effective 580 meters depth simulated. We recommend using a more conservative estimate based on pit dimensions nearer to the beginning or middle of the life of the mine, where pit depth is less. Also, given that the pit shape is spherical instead of a box (as assumed in the OPENPIT algorithm), we recommend using an average release height that is more representative of the average height of emissions across a spherical pit, rather than the current assigned 5-meter release height that effectively results in emissions released at the bottom of the center of the pit.

Air Impacts at Amakdedori Port: The modeling analysis of potential air quality impacts of operations at the Amakdedori port was conducted using screening meteorology and a conservative conversion factor to estimate annual emissions. The screening meteorology approach likely results in a significant overprediction of results when emissions are properly simulated. In addition, the modeling assumed 8,760 hours per year use of the emergency engines which is highly conservative. On the other hand, only stationary unit emissions were modeled, despite the fact that the mobile emissions associated with the facility are much greater. Further, emissions from the hoteling ships don't appear to have been included in the analysis. As a result, it is possible that air quality impacts would be substantially higher than what was modeled. We recommend that the modeling analysis be revised provide an accurate estimate of air impacts at the site and support conclusions made in the EIS.

The air quality modeling for Amakdedori port also only addresses the annual NO_2 standard, based on a determination that this is the only modeling that would be required to obtain a minor source permit to construct and operate a stationary source at the port. However, the EIS should evaluate the potential for the proposed project to cause or contribute to a violation of any of the national ambient air quality standards (NAAQS). We recommend that the revised air quality modeling also include analysis of impacts to all NAAQS, including the 1-hour NO_2 standard. Such analysis is particularly important given that the annual NO_2 impacts are shown to be high at the fence line of the port, 90 percent of the NAAQS, indicating a potential for exceedances of the 1-hour standard. Although analysis of 1-hour NO_2 may be exempt from the modeling analysis of a minor-source permit application under state law at 18 AAC 50.540(l), the 1-hour NO_2 impacts are evaluated internally by ADEC. Regardless, the requirements of the State of Alaska's minor-source permit application process are not relevant in the context of NEPA review of ambient air quality impacts. If any exceedances of the 1-hour NO_2 AAAQS are predicted, we recommend that mitigation be evaluated in the EIS.

Air Quality Impacts of Alternatives and Variants

An air quality modeling assessment was performed only for Alternative 1. The DEIS assumes that Alternatives 2 and 3, as well as variants to all alternatives, are similar to Alternative 1 in terms of the air quality impacts. While this assumption may be accurate for the mine site, there are many differences in the proposed transportation corridor, port site, and natural gas pipeline, in terms of both emission rates and locations, which are not considered in the modeling assessment performed. We recommend that the EIS include additional assessment of the potential air quality impacts of Alternatives 2 and 3, and of the variants.

No air quality analysis was conducted for the Diamond Port facility as part of Alternative 2, and the DEIS assumes that the Alternative 1 Amakdedori Port air quality analysis is sufficient to quantify impacts from any of the port alternatives. However, given differences in land-use and terrain between the two sites, we anticipate that there are differences in meteorological conditions that could have a large influence on the maximum air quality impacts. The Diamond Port is also adjacent to much higher and more complex terrain, where plumes could more easily impact the surface. This is significant since the Alternative 1 Amakdedori Port modeling showed NO_2 impacts approaching the annual NAAQS, in addition to the model deficiencies described in the above comment. These issues, if corrected, may result in potential exceedances of the National Ambient Air Quality Standards for 1-hour or annual NO_2. We recommend modeling the Diamond Port facility using the most representative of the Pebble meteorological datasets, as there are three Prevention of Significant Degradation (PSD) quality datasets collected for this project within five miles of the site. We further recommend that this modeling account for related project emissions and include analysis of relevant NAAQS and averaging times. Alternatives 2 and 3 include dredging and recommend that emissions from dredging operations be included in the air quality model. Given the lack of representative meteorological data for the Amakdedori Port area and the more complex terrain at the Diamond Port site, we recommend that the Corps consider whether the Diamond Port modeling results could be used as a more representative and conservative estimate of port impacts for all Alternatives.

Other differences between Alternatives 2 and 3, and the information in Alternative 1 that was used in the air quality analysis, do not appear to be considered in the analysis. For example, Table 2-2 lists the differences in road length between Alternatives 1, 2, and 3. Similarly, there are differences in the length of ferry trips. We recommend that the air quality analysis for Alternatives 2 and 3 address how the change in road miles traveled for concentrate trucks and other vehicles, as well as the differences in ferry miles traveled, would affect air pollutant emissions and impacts to air quality. In addition, while differences in mileage are discussed, there is no discussion about changes in elevation that different routes might require. An alternate truck route with larger elevation changes could result in greater emissions of criteria pollutants due to the engines working harder. We recommend that these air quality considerations be further analyzed in the EIS.

The DEIS air quality analysis also does not address the potential changes to air quality impacts from the "Summer-Only Ferry Operations" variant. This variant would group all the mobile source emissions caused by transferring concentrate from the mine site to the port into a six-month timeframe. Additionally, since no concentrate vehicles would travel from the site to the port during winter months and fugitive dust emissions from roads would be greater during summer months, the volume of fugitive dust generated by a summer-only variant would be greatly increased over the modeled year-round scenario. This would lead to higher atmospheric concentrations of the various combustion and fugitive emissions. We recommend that these impacts be evaluated in the EIS. Emissions would be concentrated during the growing season, and therefore would be likely to result in increased impacts to vegetation, which we recommend should also be evaluated in the EIS.

The DEIS describes maximum project air quality impacts in terms of a fraction of the standards but does not indicate what air pollutants resulted in the highest impacts nor the location of these impacts. We recommend that the EIS include a table listing the maximum design concentrations compared to the air quality standards, as well as discuss what pollutants resulted in the maximum impact and where these impacts were located. In addition, the text of the DEIS repeatedly refers to the "average" NAAQS value. However, it is not the average value that is of importance, it is the Design Value (DV), which is compared to the NAAQS. Please refer to the EPA's website[64] for information on appropriate NAAQS levels, averaging times, and form of the standard.

Additional Air Quality Analysis Recommendations

<u>Emissions Inventories</u>: Our review found potential errors in the emissions inventory report based on the use of incorrect emission factors. This includes use of outdated emission factors, use of stationary source emission factors to calculate emissions from mobile sources, use of an engine standard level rather than an emission factor, and failure to use the EPA's latest emissions model, MOtor Vehicle Emission Simulator (MOVES). MOVES is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics.[65] Because the EPA guidance was not followed in generating the emissions inventory, we do not recommend using this emission inventory in air quality modeling or to otherwise support conclusions regarding the potential air quality impacts of the Pebble Project. We recommend revising the inventory in accordance with published emissions guidance and using the updated emissions in the EIS and offer the following technical comments to assist in this effort. Alternatively, we recommend that the Corps explain the decisions made in selecting emission factors, and provide information to support the accuracy and reliability of the air quality modeling analysis based on the current emissions inventory.

We recommend addressing the following potential errors in the DEIS source document "RFI 007 Emissions Inventory Report" or providing a more-detailed explanation for their retention:

[64] https://www.epa.gov/criteria-air-pollutants/naaqs-table
[65] https://www.epa.gov/moves

1. RFI 007 Appendix A-2:
    a. We recommend that Table 3 (PDF pg. 56 of 509) use an emission factor for the mobile sources on this table, rather than the actual standard level listed in the regulations;
    b. We recommend that emission factors for vehicles be developed using the MOVES model rather than using AP-42 Volume II table. The AP-42 web page indicates that Volume II, regarding all mobile sources, is no longer maintained, as non-outdated EFs can be developed using the MOVES model;
    c. We recommend ensuring that emission factors from stationary sources are not used to calculate emissions from mobile sources. This recommendation also applies to Tables 3 through 7 (regarding criteria pollutants).
2. RFI 007 Appendix A-3: We recommend including additional documentation for calculations and confirming that break and tire wear have been included in the emissions calculations.
3. RFI 007 Appendix B: We recommend the same corrections in Appendix B as described above for Appendix A-2 regarding criteria pollutants from mobile sources and for Appendix A-3 regarding fugitive sources.
4. RFI 007 Appendix C-1. We recommend verifying that appropriate sources were used for emission factors.
5. RFI 007 Appendix C-2. We recommend the same corrections in Appendix C-2 as described above for Appendix A-2 regarding criteria pollutants from mobile sources and for Appendix A-3 regarding fugitive sources.

The emissions inventory tables in the DEIS include a column quantifying “Total HAPs.” This is not a useful metric, as HAPs differ by toxicity, reactivity, etc., and we recommend that HAP emissions be broken out by type.

Background Concentrations: Background concentrations are an important element of an accurate analysis of impacts to ambient air quality, however, Appendix K4.20 does not include information on the background concentration analysis. We recommend that the EIS include the source of the background concentration values used in the air quality analysis. Background annual NO_2 is assumed to be 0 micrograms/cubic meter ($\mu g/m^3$) in the air quality modeling analysis conducted for Amakdedori Port. We recommend that the EIS provide supporting information that explains such a low background concentration, including addressing whether there are local representative measurements.

PSD Increment Impacts: While we support the inclusion of an impact comparison to PSD increments in the DEIS, there are several potential inaccuracies with the way PSD increments were calculated and disclosed. The DEIS states that a PSD increment consumption analysis is not required for temporary projects (less than 24 months), and therefore, the DEIS does not include a comparison to the particulate matter (PM) increment. However, we note that comparison of impacts to the PSD increments is done in NEPA analyses to gauge the significance of the impacts, recognizing the increment as a measure of significant deterioration, rather than to conduct a regulatory PSD increment analysis. We recommend that all modeled values be compared to the PSD increments, as a comparison measure of temporary degradation. In addition, the RFI 007 Emission Inventory finds that the mine site power generation facility will likely require a PSD permit for both PM10 and PM2.5, and therefore, a PSD increment consumption analysis may be required as part of the state permitting process. We therefore recommend the EIS identify the nearest Class I area and the distance of the Class I area from the project, as well as any minor source baseline dates that may have been established at this Class I area. If the baseline date has been set, we recommend the Corps consider analyzing the likelihood of significant Class I increment consumption from project operation emissions. If this is determined to be significant, 40 CFR Part 51,

Appendix W contains screening procedures to determine if a cumulative Class I increment consumption analysis is warranted.

We recommend that the DEIS text clarify that PSD regulations are not specific to major stationary sources, as is currently stated. Rather, the PSD increment is the allowed maximum increase in air pollutant concentration allowed in an airshed after a baseline date, and analysis of PSD increment consumption is required under New Source Review air permitting of major stationary sources in areas where the baseline dates have been set. Further, in reporting the results on the PSD increment comparison, the document states "Compliance with modeled … PSD Class II increments is demonstrated" (pg. 4.20-6). We recommend instead stating that the modeling demonstrates that the level of air quality deterioration is lower than the PSD increment, which can be used as a measure of significant deterioration for any given project.

Air Quality Related Values Impacts to Sensitive Areas: The DEIS discusses the potential for impacts to Air Quality Related Values (AQRVs) in Class I areas and concludes that, because the nearest Class I areas are “more than 62 miles from the source,” negligible impacts are anticipated. The analysis described in Section K4.20 includes a visibility impacts screening method as well as a comparison to deposition critical loads for Denali National Park. We recommend that the EIS include additional analysis and disclosure of potential visibility and deposition impacts to Tuxedni Wilderness Area, which is the nearest Class I area and is “approximately 50 miles east-northeast of the mine site” according to the DEIS (pg. 3.20-6).

There are numerous other federally or state-managed areas within the potential impact area of the Pebble Project, as described in Section 3.5 of the DEIS. The nearest of these include: Katmai National Park and Preserve, Lake Clark National Park and Preserve, Alaska Maritime National Wildlife Refuge, McNeil River State Game Sanctuary, and the McNeil River State Game Refuge. We recommend that the AQRV analysis address the potential for any adverse impacts, including visibility or deposition impacts, to these protected areas. As an initial step in this analysis, we recommend that it would be appropriate to consult with the relevant land management agencies regarding whether the environment of the federal or state-managed area is considered to be sensitive as related to any AQRVs.

Hazardous Air Pollutants: In discussion of HAPS selected for the analysis, that ethylbenzene and xylene have been omitted from the list of HAPs. Because trucks and nonroad equipment use diesel fuel, we recommend considering all BTEX constituents in the analysis.

ENVIRONMENTAL JUSTICE

Environmental Justice is not among the primary issues summarized in the EPA’s cover letter. However, based on our review, we are providing the following recommendations to improve identification and protection of vulnerable populations.

Identification of Vulnerable Populations

The DEIS cites the 1997 CEQ Environmental Justice Guidance under the National Environmental Policy Act (CEQ 1997b) to state that a minority community is “defined as a community with a majority (i.e., 50 percent or greater) minority population” (pg. 3.4-1). The DEIS does not currently acknowledge that the CEQ guidance also indicates that a minority population should be identified where “the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis." The CEQ guidance provides ample flexibility to methodologically respond to local conditions and population patterns. Furthermore, the EPA Environmental Justice guidance (EPA 1998) states that "[a] factor that should be considered in assessing the presence of a minority community is that a minority group comprising a relatively small percentage of the total population surrounding the project may experience a disproportionately high and adverse effect. This can result due to the group's use of, or dependence on, potentially affected natural resources, or due to the group's daily or cumulative exposure to environmental pollutants as a result of their close proximity to the source." Additionally, the Federal Interagency Working Group on Environmental Justice[66] has stated that, "[to] sufficiently identify small concentrations (i.e., pockets) of minority populations, agencies may wish to supplement Census data with local demographic data. Local demographic data and information (including data provided by the community and Tribes) can improve an agency's decision-making process. Anecdotal data should be validated for accuracy whenever possible. Agencies should disclose, as appropriate, when anecdotal data has not been validated." (Federal Interagency Working Group on Environmental Justice 2016).

The EPA maintains that the exclusive use of the 50 percent threshold in the CEQ 1997b guidance could result in missing smaller communities, segments, or pockets of low income, minority, or vulnerable populations within larger community settings who might be impacted. For example, in Table 3.4-2, communities within the Kenai Peninsula Borough and Bristol Bay Borough are not identified as EJ communities. Therefore, there may be pockets of minority or low-income populations, or entire communities, that might disproportionately experience cumulative impacts, but these are not acknowledged in the DEIS. We recommend that the EIS provide the rationale for selecting the 50 percent threshold definition of minority community, and not another available methodology. In addition, we recommend that the environmental impact analysis in the EIS also include demographic and locational information on any minority and low-income populations living in communities not identified as EJ areas, due to not meeting the 50 percent threshold, and analyze disproportionate and cumulative impacts to those populations.

Analysis of Potential Environmental Justice Impacts

Potential Impacts to Children: Table 3.3-1 presents the Population Characteristics of Affected Communities. Notable in some of the affected communities are the high percentages of children, a vulnerable population in Environmental Justice terms. Research in recent years has revealed and highlighted the unique vulnerabilities and susceptibilities of children to environmental harms (Barros et al. 2018). Native Alaskan children sometimes experience environmental impacts disproportionately (Sarche and Spicer 2008). We recommend that the DEIS specifically address the short and long-term health and safety of children in the analyses of disproportionate impacts, cumulative effects, and socio-economics, especially in terms of nutritional dislocations and potential exposures environmental contaminants.

Socio-Economic Impacts of Mine Closure: Mine closure will result in loss of jobs and declining economic activity, which, based on the discussion in the DEIS, could potentially be followed by a decline in community infrastructure, with subsequent impacts on the health and welfare of community residents. The DEIS notes the boom and bust cycle that characterizes the Alaskan economy. Community development, sustainability, and revitalization are recognized as essential components of Environmental

[66] https://www.epa.gov/environmentaljustice/federal-interagency-working-group-environmental-justice-ej-iwg

Justice.[67] However, sustainable economic development can be seen as a model for mitigating the impacts of the bust of mine closure. While extractive industries can disrupt the resources and cultural patterns of economic activity, the lengthy time frame of mine operation and inflows of capital could provide the space for community-based planning efforts to build sustainable economies in the region (EPA 2013). We recommend that economic disruptions in these communities be undertaken delicately with the full participation and informed consent of the people most directly impacted. The Corps may choose to review any locally developed Economic Development Assessments/Plans specific to the communities of the Region. These plans would be an integral component to sustainable, community driven, economic development in the region. Finally, a Community Benefits Agreement or other formal instrument (such as a Memorandum of Understanding or Memorandum of Agreement) could be developed to ensure minimum levels of employment, improvements and enhancements to health facilities, joint planning and consultative opportunities and other elements related to the long-term, sustainable development of impacted communities. This could be in addition to, or an aspect of, the ANCSA village corporation agreements described in Table 5-2.

SUBSISTENCE

Subsistence is not among the primary issues summarized in the EPA's cover letter. However, given the importance of subsistence resources in the project area, we are providing the following recommendations to strengthen the analysis in the EIS.

Age of Subsistence Studies Cited in the EIS: The subsistence information presented in the DEIS is from studies that are almost all over a decade old, and many are based on data collected by the Alaska Department of Fish and Game (ADF&G) in 2004. These studies may show past harvest levels, but they cannot show potential recent changes in resource use due to shifts in animal populations or from ecosystem impacts of exploration activities. Without more recent studies, current consumption levels are uncertain, and it is therefore difficult to tell what the impacts of the mine on subsistence harvest levels will be. We recommend that the EIS incorporate any more recent data available and acknowledge the challenges that the older data present in assessing impacts of the Pebble Project on present harvest levels.

Impacts to Subsistence Practices and Patterns: The DEIS makes many statements that presume adaptation to changes in historical and current subsistence practices and patterns. For example, the DEIS states: "Adaptive strategies for the harvest of resources ***would likely maintain harvest levels for affected communities***, but potentially at the cost of additional time and money" (pg. 4.4-5, emphasis added); and "Subsistence users ***would likely adjust*** the seasonal round, resource use areas, and species composition of harvest resources to target resources that would be less affected by project activities" (pg. 4.4-7, emphasis added). We recommend that the EIS provide additional support for these and other similar statements regarding how likely the adaptation/adjustment is to occur or how effective it would be in maintaining subsistence harvest levels, including addressing the ability, capacity, or cultural willingness to access alternate areas and make dietary substitutions across all sectors of the population (e.g., different dietary needs of children and elderly). Underlying many of these assertions are what appear to be unsubstantiated behavioral assumptions about the value calculations and the resulting actions of individuals with regard to income from outside employment. By presuming adaptation, the EIS may be underestimating the potential impacts of the proposed Pebble Project. We recommend that the document

[67] https://www.epa.gov/environmentaljustice/resources-creating-healthy-sustainable-and-equitable-communities

state the underlying assumptions upon which the analysis, where present, is based, including citing evidence of such adjustments by individuals and communities in similar circumstances.

<u>Replacements Costs</u>: We recommend that the EIS include the total amount of traditional foods used by tribal communities, including the replacement costs for those foods. For example, mining activities may cause caribou to be less accessible if the caribou herd does not return to their traditional range. We recommend considering what it costs a family to replace that protein by shopping at a store. As acknowledged in the DEIS, grocery costs are very high in the region, and replacement of traditional foods could result in a tangible economic impact for communities that still rely on the traditional economy of hunting, trapping, and harvesting. We recommend that replacement costs from reduced subsistence harvest be analyzed in the EIS and included as a potential impact of the proposed Pebble Project.

<u>Harvest Levels if the Mine is Permitted</u>: We recommend that the EIS include a detailed plan for how subsistence harvest levels will be documented during Pebble Project construction and operations, so that potential impacts to subsistence can be monitored and adaptive management strategies can be implemented as needed to support sustainable levels of subsistence harvest.

<u>Impacts of Increased Traveling Distance for Subsistence Harvesters</u>: We recommend that the EIS analyze the potential impacts to harvesters' travel times and distances. With increased distance comes increased cost and risk. If mine activities cause harvesters to travel farther to hunt, this increases the resource commitment to engage in the traditional way of life, including increased fuel costs, increased wear and tear on vehicles, greater risks of accident and injury, and more challenging transportation logistics. In addition, we recommend that the EIS analyze whether the greater distances traveled for hunting may further limit the number of active harvesters, and thus reduce the amount of traditional foods available to the entire community and result in high replacement costs.

<u>Access</u>: The DEIS indicates that subsistence access could be increased by use of the roads and pipeline rights of way (ROW). For example, the DEIS states that "[t]he addition of a pipeline ROW would potentially create an overland route that could be used by Nondalton residents to access additional subsistence resources." In contrast to this statement, the project description describes the road as being "private." In order to support the conclusions in the document, we recommend that the EIS discuss the development of a detailed agreement between PLP and the affected communities to provide access to the transportation infrastructure. The EIS would be strengthened by providing the agreement itself. In the alternative, any language referencing increased subsistence access due to the ROW should be removed throughout the EIS. In addition, we recommend that the EIS confirm whether the complete boundary of the mine site safety zone has been considered when determining which areas would be restricted from subsistence access, rather than using the footprint of mine facilities.

<u>Mapping</u>: The DEIS shows the subsistence use areas by community, but to understand potential changes to the region, it would be helpful to have a map that shows overlapping subsistence harvest areas, so that areas of higher value because of their use by multiple communities could be more easily evaluated. We recommend including a map in the EIS that indicates: 1) Areas where all communities harvest; 2) Areas where some communities harvest; 3) Areas where few communities harvest; 4) Areas where one community harvests; and 5) Areas where no community harvests.

<u>Seals</u>: The DEIS does not fully describe the impact of ferry use on seal hunting. Seal is high in omega-3 essential fatty acids, which contribute to human health in a number of ways. These nutrients are difficult

to replace in the western diet, so disruption of seal habitat and reduced opportunities to harvest may have health implications. We recommend that additional information be included in the EIS to clarify the characteristics of the seal population in the lake and their habitat uses, so that the potential impacts of ferry use can be analyzed. We also recommend that the EIS quantify the potential impact of the Pebble Project on seal harvests.

Traveler Safety on Lake Iliamna: Changes to ice integrity from winter ferries and the impacts of these changes on traveler safety do not appear to be fully analyzed and considered in the DEIS. The DEIS mentioned that markings would be put out to alert travelers to the ferry lane, but does not state whether these markers will be effective for winter travel in dark or white out conditions. We recommend that the EIS further consider traveler safety during winter travel on Lake Iliamna.

SPILL RISK

Key issues associated with the spill risk analysis includes recommendations for improvement of the analysis of the environmental fate and behavior of spilled concentrate and tailings including consideration of the role of oxygen in aquatic environments, timing for release of mineral components, and reactivity in porewater. In addition, we recommend that a Bulk TSF failure scenario be developed and potential impacts be evaluated. Our recommendations regarding these key issues are discussed below. Additional detailed recommendations for improvement to the spill risk analysis are provided following the key issues.

Bulk Tailings Release Scenario

The release of tailings from the bulk TSF due to an embankment breach or failure was not evaluated in the EIS based on the conclusions of the EIS-phase Failure Mode Effects Analysis (FMEA) (Section 4.27.6.9). The FMEA indicated that it was based on an early stage conceptual level of embankment designs and did not assess the confidence level of the failure modes and effects as is typically done (AECOM 2018i and Robertson 2003). FMEA can be a valuable tool in identifying potential failure modes, effects, and mitigation. However, it is unclear how the FMEA was used to determine the TSF release scenarios as the FMEA contained limited rationale for how the likelihood of failure risks were determined and did not describe the confidence or uncertainty associated with the release scenarios. Given the conceptual stage of and many assumptions associated with the embankment design and the limited seismic analysis that was not conducted on the current bulk TSF dam design (see our Geohazards comments), we recommend that alternate scenarios, including a breach scenario, be considered. In addition, the FMEA is based on limited information since: 1) it utilizes conceptual embankment designs (as opposed to more advanced designs); 2) there is a lack of a seismic analysis; 3) specific design information on the seepage management systems, underdrain system, and the core and filter/transition zones is not provided; 4) the material sources are not identified; and, 5) it is assumed in the DEIS that embankment raises would be done proactively, however the Project Description and DEIS do not provide a schedule for these embankment raises in comparison to freeboard and tailings placement rates. In addition, due to underestimated open pit groundwater inflows there is significant uncertainty associated with the water balance and one of the adaptive management strategies discussed in the DEIS to maintain the water balance is to transport water to the bulk TSF (pg. 4.16-8). Implementing this strategy would result in mine operations that are different than the conceptual design.

The FMEA risk register identified a number of adverse factors that could occur during engineering, construction, and operations, and the DEIS assumes that they would all be overcome. Yet, a recent study on tailings dam failures notes that the dominant cause of failures arises from deficiencies in engineering practice associated with the spectrum of activities embraced by design, construction, quality control, and quality assurance (Morgenstern 2018). Therefore, there is credible information highlighting that, even assuming that the tailings dam is adequately designed, dam failure could still happen due to weak engineering associated with construction and operations. We recommend that this possibility be taken into consideration in the FMEA and the EIS by analyzing a breach scenario.

The DEIS states: "In accordance with National Environmental Policy Act (NEPA) guidelines, failure scenarios selected for analysis in the DEIS were of relatively low probability and a comparatively high level of consequence." Further, the DEIS describes that a catastrophic failure, such as a total embankment breach, was ruled out as an extremely unlikely, "worst-case," scenario. However, given the occurrence of multiple large-scale tailings dam releases in recent years at modern operating mining facilities, the possibility of a dam breach may not be too remote and speculative. For example, breach and inundation analysis are regularly required for environmental assessments for mining projects in Canada since the Mt. Polley dam failure. We therefore also recommend that the EIS include additional information describing how the agency determined which release scenarios to model.

We recommend that the Corps develop a breach scenario and consider using the following recent approaches for estimating tailings release volumes based on evaluations of tailings facility failures. "Tailings Dam Failures: Updated Statistical Model for Discharge Volume and Runout (Larrauri, P.C. and Lall, U. 2018) and "Floods from Tailings Dam Failures" (Rico, M. , Benitio, G., and A. Diez-Herrero 2008.

Consideration of Water Treatment Plant Residuals

The DEIS does not appear to consider the impacts of WTP residuals in the fate and impacts of the pyritic TSF spill scenario. The Pebble Project proposes that both liquid and solid treatment residuals (precipitates) will be disposed into the pyritic TSF. In water treatment, one of the chemicals noted as being used is sodium hydrosulfide (NaHS), which will dissolve into HS^- and Na^+ ions and the HS^- will sequester metals to form metal sulfide precipitates in the water treatment process where it is used. If there is any residual dissolved HS^- in the water disposed of in the pyritic TSF, and it is released in a spill to surface or groundwater having a pH less than 7 (the pKa), the equilibrium reaction [H_2S (aq) = HS^- + H^+] will begin to shift to the left and form dissolved hydrogen sulfide, which is highly toxic to fish at very low concentrations (0.002 parts per million maximum acceptable for aquatic life under the EPA's National Recommended Water Quality Criteria[68]). Depending on pressure and temperature, some H_2S (aq) may be converted to H_2S gas. Additionally, oxidized and reduced precipitates and membrane reject from water treatment are going to be placed into the pyritic TSF. Some of these are at high concentrations (see Table 4.18-13). When oxidized precipitates are exposed to anoxic conditions, they undergo reductive-dissolution; when reduced precipitates are exposed to oxic conditions, they undergo oxidative-dissolution. Reactivity of the precipitates will depend on the exact conditions in the TSF at points in time and over time. Therefore, the supernatant and leachate associated with the pyritic TSF may have different water chemistry over time that isn't reflected in the modeling referenced in the DEIS or the pre-mining leaching tests. Additionally, when introduced to the environment, changes in pH and ionic strength could mobilize any metals/metalloids that are sorbed to the iron precipitates or oxidize elemental selenium to mobile selenite or selenate, for example. We recommend that the discussion of

[68] https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

fate and behavior of released tailings from the pyritic TSF be revised to include analysis and disclosure of the impacts of a spill including both the liquid and solid treatment residuals.

Impacts of Spilled Concentrate and Tailings

We recommend that the EIS analysis of metal leaching and acid production associated with spilled concentrate and tailings be revised to more accurately reflect the anticipated fate and behavior of the concentrate and tailings particles in the environment. The EIS would be strengthened by additional consideration of the role of oxygen in aquatic environments, timing for release of mineral components, and reactivity in porewater, in order to support conclusions regarding the potential environmental impacts of spills of these materials. Based on these revisions, we recommend that discussions of impacts to resources be updated in the EIS. Our specific technical comments regarding the discussions of environmental fate and behavior of spilled concentrate and tailings (Sections 4.27.4.3 and 4.27.6.3), and recommendations to address issues identified, are described below.

Oxygen in Aquatic Environments: Throughout the spill risk chapter, there are many instances where it's stated that solids released from spills (concentrate and tailings) would not generate acid in aquatic environments because the water would "prevent oxidation of the sulfides," that "almost no oxygen gas would be present in still water," and similar statements. However, the DO content of any water body depends on multiple factors, including the depth of the overlying water and the microorganisms present to use up any existing DO. Diffusion of oxygen through a deeper water layer and through tailings porewater limits oxidation of sulfides in a TSF using subaqueous disposal; however, it will not completely stop oxidation unless the water has essentially zero DO and is a reducing environment. Additionally, if ferric iron is present (such as near the reacting surface) from oxidation of chalcopyrite or pyrite, it will catalyze the oxidation of the sulfides.

In a potential spill scenario, concentrate, tailings, or PAG waste rock will have the potential to oxidize unless the particles settle into, and remain in, an anoxic and reducing environment. The DEIS characterizes the baseline surface water resources generally being "well-oxygenated, low in alkalinity…" (pg. 3.18-7). The DEIS states that mean DO concentrations across the analysis area are 10.2 to 10.5 mg/l for streams and 2.6 to 9.1 mg/l for groundwater wells, and the saturation concentration for the altitude of the site and at 4 °C is given as 12.3 mg/l. Based on this information, we recommend that the discussions throughout the spill risk analysis be revised to accurately reflect potential for, and consequences from, oxidation of minerals from concentrate and tailings particles resulting from spills in the aqueous environments.

Time Required for Particles to React: The DEIS includes many statements asserting that timing for acid generation "requires years to decades." Whether this assertion is true with respect to metal leaching and acidity depends on the site-specific water quality parameters (pH, redox, temperature, microbial community, other ions or particulates in the water, etc.), particle size, and specific mineral composition. The DEIS does not provide data to support conclusions related to reaction time and appears to misrepresent information found in the reference materials. For example, the DEIS states that "Geochemical studies on rocks from the proposed mine site indicate that PAG material present in the tailings may require up to 40 years under local conditions to generate acid (SRK 2018a)" (pg. 4.27-68). However, the reference (SRK 2018a) states: "Some PAG components will become acidic as soon as exposed to oxygen but the median on-set period is 10 years (under site conditions). All PAG rock is expected to be acidic after 20 years of exposure unless managed to limit oxygen availability." The Summary Section of the Supplement to the EBD (PLP 2018a) states: "Kinetic testing of the rocks showed that acidic leachate was produced from rocks with low levels of neutralization potential. Under field conditions, onset of acid generation is expected to be delayed by at least two decades, based on observations from weathering of core on site, laboratory and field based kinetic testing, and information derived from stored bag tests." The references SRK 2018a and PLP 2018a present different conclusions, both of which differ from what is presented in the EIS. We recommend that the EIS accurately discuss the reference information. We recommend verifying which reference accurately reflects the anticipated onset of acidic conditions in the waste and tailings storage areas that are representative of the current proposed project, and then updating the reference(s) and EIS discussions, including the analysis of fate and behavior of spilled tailings, to reflect that data.

The DEIS also states: "No measurable metals would be leached from deposited tailings solids because the process of ML would require decades (Section 3.18, Water and Sediment Quality)" (pg. 4.27-81 for bulk TSF; pg. 4.27-99 for pyritic TSF). The referred section of the DEIS states: "Paste pH results for aged rock cores stored at the site suggest that acidification may be delayed up to 40 years for 95 percent of the pre-Tertiary mineralized rock (SRK 2011a). Given differences in the test conditions, laboratory and field tests suggest that oxidized pre-Tertiary mineralized rock may take up to several decades for acidification to occur" (pg. 3.18-4). Because paste pH is not a kinetic test, we recommend that the EIS provide additional information to support this conclusion. In addition, rock cores are not the same as tailings that have undergone processing, which will affect reactivity. PAG tailings will weather even more quickly than the larger PAG waste rock materials (the same holds for bulk tailings vs. waste rock), if not kept from oxygen in the air or water when released into the environment, due to having a higher specific surface area for reactivity. A spill of the pyritic TSF could include both pyritic tailings and PAG waste rock, since they will be stored in the same facility. We recommend that the analyses of the fate and behavior of spilled waste materials be revised to reflect these considerations.

The concentrations of ions and acidity released into pore water and surface water, which will depend on the amount of particles not recovered, and the extent of their dilution are what will dictate if there are any short or long-term, local or broad-ranged adverse impacts. While it is true that acid generation and metal leaching from the concentrate and tailings particles will not cause immediate acute impacts, there will be potential for post spill impacts (potentially acute as well as chronic toxicity, given the very low concentration of copper [and other ions, such as mercury, arsenic, and silver] causing toxicity to aquatic and benthic organisms) from leaching of particles not recovered. This is because smaller particles have a larger specific surface area for reactivity to oxidation (in air or water with dissolved oxygen). In areas where flowing water is rapid, if there is only a small mass of particles, acid generation might be diluted quickly and might not be an immediate issue to aquatic organisms; however, in areas of slower flowing water, the acid-forming (and propagating) reactions could be prevalent in shallow pooled water or in pore-water and influence benthic organisms, as well as developing concentrations of metals high enough to influence overlying water and hence fish. We recommend revising all discussions of leaching and acid production in the EIS to more accurately reflect the anticipated behavior of the concentrate and tailings particles in the environment. Based on these revisions, we recommend that discussions of impacts to resources also be updated accordingly.

Three references that might be useful for the topic with respect to post tailings spills are Byrne et al. 2018 (stream quality post Mt. Polley spill), Kossoff et al, 2012, and Kossoff et al. 2014.

Additional Technical Comments on Spill Risk

1. Analysis Area for Tailings and Contact Water Releases: We recommend that the Section 4.27.1.2 discussion of the affected environment for tailings and untreated contact water releases refer to the chapter figures that depict the analysis area discussed.

2. Water Use in Analysis Area: The DEIS states (pg. 4.27-3) that downstream communities use groundwater as a drinking water source. We recommend that the EIS discuss whether there is there any connection between groundwater and surface water over the affected environment for bulk and pyritic tailings and untreated contact water releases.

3. Diesel Spill Scenarios: There is significant discussion in the DEIS and reference documents that there are more frequent spills of smaller volumes of diesel than larger volumes. The scenario analyzed in the DEIS uses a spill volume of 3,000 gallons and the conclusion is that there would be an average of 1 spill of this size every 90 years. The reference (AECOM 2019a) presents an additional way to evaluate the potential for spills, but this is not included in the EIS. AECOM 2019a used the total number of smaller volume spills over 6 years from the Dalton Highway (22 spills averaging 400 gallon/spill) to indicate that there could be 5 expected spills over 20 years and 18 over 78 years – an average of 1 spill of about this volume every 4.1 years, which equals a potential cumulative spill volume of 2,000 gallons over the project life. Because small spills are more likely to occur, we recommend that this information be provided in the EIS discussion to provide a broader perspective for potential spill frequency and size.

4. Spills from the Lake Ferry: We recommend that the EIS provide supporting information for the statement that the operation of the ferry would be more secure and regulated than that of marine barges (pg. 4.27-31).

5. Extent of Spilled Tailings and Concentrate Impacts: Many sections discuss transport of tailings (and concentrate) further downstream from flushing but fail to discuss the long-term influence of these particles in the watershed. They will be continually moved around and have potential to be flushed further downstream and influence larger parts of the watershed over longer time due to their continual leaching, and eventually some will be deposited into the lakes at the mouths of the affected streams. We recommend adding discussions considering the longer-term and larger distances that may be influenced by spills of concentrate and tailings.

6. Fate and Behavior of Released Gas: The DEIS states (Section 4.27.3.2) "Natural gas pipeline releases would not be expected to cause contamination of water or soil; therefore, detailed impact assessment of leak scenarios is not included in this section." While it is true that contamination likely would be short-term (depending on the time before a leak was detected and stopped), and a scenario might not be useful, there still could be impacts to aquatic life from leaks in underwater portions of the pipeline. We recommend that the EIS discuss this potential.

7. Concentrate Pipeline Failure Rates: Regarding the potential for failure of the concentrate pipeline, the DEIS states: "Based on a 20-year operational lifetime of this proposed pipeline, external corrosion leading to failure would be very unlikely" (pg. 4.27-39). We recommend that the EIS include additional data to support this statement. Further, this statement leads to the question of how the potential for failure due to external corrosion would change if the operating life of the mine were extended by 78 to 98 years under the Pebble Mine Expanded Development Scenario. The risk of a

concentrate pipeline spill is not addressed in the Cumulative Impacts Section. To enable accurate understanding of the potential impacts associated with a longer mine life, we recommend that a discussion of this risk, including supporting data as appropriate, be added to the document.

8. Concentrate Pipeline Liner: The DEIS states "EPA (2014) points out that the potentially corrosive nature of the concentrate slurry could increase pipeline failure rates above historic failure rates due to internal corrosion. As described below under Mitigation, the concentrate pipeline would have a full internal liner that would protect against both internal and external corrosion" (pg. 4.27-39). We recommend that the EIS include additional context for the referenced information here, including acknowledging that EPA (2014) stated that the pipelines would follow standards of the American Society of Mechanical Engineers, which include protection against internal corrosion. Further, the failure rates for the copper concentrate in EPA (2014) and in this EIS are based on those from oil and gas pipelines because the failure rate of concentrate pipelines isn't known. Potential for corrosion of an internal liner (which would decrease its protection of the internal pipe surface) from the concentrate (i.e., rough material) would be higher relative to the potential for corrosion of an internal liner of an oil and gas pipeline reflected in historic failure rates. We recommend that this discussion be revised to more accurately reflect the potential for internal corrosion of the concentrate pipeline, and to explain how an internal liner would protect against both internal and external corrosion.

9. Response Capability to Respond to a Concentrate Spill: The DEIS states "There are currently no organizations in Alaska that specialize in response to spills of ore concentrates. PLP would have a spill response plan in place that would address spills of ore concentrate and other hazardous materials" (pg. 4.26-39). We recommend that a draft spill response plan be included or referenced in the EIS. Such information is important to evaluate the potential impacts of the project associated with an unanticipated spill event. Given the statement that there are no organizations in Alaska that specialize in response to spills of ore concentrates, it is particularly important to have a spill response plan available for review and comment, to ensure its adequacy with regard to response actions and timeframes.

10. Mitigation for Copper Concentrate Transfer to Marine Vessels: The mitigation discussion for copper concentrate transfer to marine bulk vessels includes lids that "would not be opened until the container is within the hold of the marine bulk carriers" (pg. 4.27-40). This is a mitigation measure against dust generation during movement of the concentrate. Please provide mitigation measures for potential loss from the ship if under adverse conditions or an accident. We recommend considering whether leaving the concentrate within the cargo containers would be a better mitigation measure against potential for loss of concentrate to the marine environment in the event of an accident.

11. Mitigation for Concentrate Pipeline: The DEIS identifies avoidance and mitigation features for the concentrate pipeline including "manual isolation and drain valves would be located at intervals no greater than 20 miles apart" (pg. 4.27-41). We recommend that the DEIS discuss whether the use of automatic valves that can be remotely activated would be a better mitigation measure.

12. Discussion of the Pipeline Rupture: The DEIS states that "[t]he automatic leak detection system would detect the leak, and the surrounding isolation valves would be closed within 5 minutes (PLP 2018-RFI 066)" (pg. 4.27-50). This doesn't seem to be a reasonable scenario, when using manual shutoff valves. Please clarify how a manual isolation valve would be able to be closed within 5

minutes of leak detection if located farther away than 3-4 miles from a responding individual or revise the scenario to be more realistic.

13. Trucking Concentrate Spill Scenario: The DEIS (Section 4.27.4.4) discusses that there were 18 spills along the Red Dog haul road over 23 years (1995-2018) and approximately 30 between 1989 and 2002. This leads the EPA to understand that there were 0.78 spills per year (based on the 23 years) or 2.3 spills per year (based on the 13 years) associated with Red Dog, without reference to how many miles were driven. However, the DEIS states "…the estimated annual spill rate for a trucking-related concentrate spill in the proposed project is 0.78×10^{-6}, which equates to an average of 0.4 trucking-related concentrate spills per year for the 66 miles of Alternative 1 road transport" (pg. 4.27-42). We recommend that the EIS clarify that the 0.78×10^{-6} is per truck mile, as well as include some detail from the reference for how this number was reached. We also recommend verifying the calculations, as the annual tonnage of concentrate for Pebble used in the reference differs from the PLP project description (Appendix N), as well as demonstration how the 0.78×10^{-6} was calculated from the Red Dog data. Additionally, we recommend discussing any limitations associated with these values.

    The diesel spill scenario utilized the maximum spill volume on the Dalton Highway. However, the concentrate spill scenario (Section 4.27.4.7) assumed a spill of 80,000 pounds rather than the maximum reported spill of 145,000 pounds. We recommend that the 145,000-pound spill scenario be evaluated in the EIS.

14. Potential Impacts of a Concentrate Spill to Wetlands: The DEIS states "Although the concentrate is not expected to affect wetlands through acid generation or ML…" We recommend that the EIS clarify that this is in the short-term, as over time these particles will react unless they are buried in anoxic and reducing environments (which is more likely in a wetland than in an open river/stream).

15. Potential Impacts of Concentrate Spill to Lake Iliamna: Regarding potential impacts of the concentrate pipeline rupture, the DEIS states "Depending on the volume and location of the spill, some of the concentrate could be transported downstream into Iliamna Lake or Iliamna Bay, where it would settle out as deltaic deposits" (pg. 4.27-53). We recommend that the EIS include additional details to support the analysis of potential downstream impacts of a concentrate pipeline spill. For example, we recommend analyzing the distance concentrate would travel under various spill scenarios, whether concentrate would be transported into Lake Iliamna or Iliamna Bay, and the potential environmental impacts of concentrate deposition in those waterbodies.

16. Impacts of Concentrate Pipeline Spill vs. Concentrate Truck Spill: The DEIS asserts that impacts of a concentrate spill from a pipeline would be similar to that from a truck spill (pg 4.27-55). This statement is not supported by information provided in the DEIS. We recommend that the analysis be revised to acknowledge that the truck and pipeline spills will differ in that the trucked concentrate will be filtered and relatively dry and the pipeline concentrate will be a slurry and contain process water and chemicals. The concentrate transported via pipeline has an aqueous phase that not only will contain residues of chemical reagents, but will also contain dissolved copper, which is highly toxic to aquatic life. One of the potential chemical residues is hydrogen sulfide from any residual sodium hydrogen sulfide, dissolved H_2S is highly toxic to fish at very low concentrations. We recommend that the EIS include analysis of the potential short and long-term impacts from dissolved copper in the concentrate aqueous phase on all the resources discussed. We also recommend considering the potential effects if dissolved hydrogen sulfide is present in the mixed water source if

pH is less than 7 (background pH ranges indicate that some areas have acidic pH, so would react with the NaHS).

17. Discussion of Chemical Reagents: The DEIS includes the following statements regarding xanthate: 1) "The EPA reports that the presence of xanthate would render the tailings slurries toxic; but that if released in a spill, degradation and dilution would render the downstream waters non-toxic (EPA 2014)." (pg. 4.27-60); 2) "The EPA reports that this type of tailings slurry would be toxic due to the presence of xanthate (a reagent), but that if released in a spill, degradation and dilution would render the downstream waters non-toxic (EPA 2014)." (pg. 4.27-67, discussion of tailings spill); and, 3) "The EPA reports that the tailings slurries would be toxic due to the presence of xanthate (a reagent), but that if released in a spill, degradation and dilution would render the downstream waters non-toxic." (pg. 4.27-85, residual toxins from tailings spill).

    These are not accurate statements, and it appears these statements originate from taking the following statement from the BBWA out of context: "The concentration of sodium ethyl xanthate was not estimated in the receiving streams. Although the aqueous phase of the tailings slurry would be toxic due to xanthate, we expect that xanthate would occur at non-toxic levels in ambient waters below TSFs due to degradation and dilution (Xu et al. 1988)." This statement was made in Chapter 8 of the BBWA (Water Collection, Treatment, and Discharge) and regarded TSF leachate entering ambient water, as is clear from the "in ambient waters below the TSFs." Additionally, it was qualified (Chapter 8, Uncertainties) by the statement: "If xanthate does not degrade rapidly in the tailings, the estimate that it would not leach into streams at toxic concentrations could be incorrect." Specific to spills of chemicals, EPA 2014 stated: "Given the liquid form and toxicity of sodium ethyl xanthate (Section 8.2.2.5), it is expected that a spill of this compound into a stream along the transportation corridor would cause a fish kill. Runoff or groundwater transport from a more distant spill would cause effects that would depend on the amount of dilution or degradation occurring before the spilled material entered a stream." The EPA 2014 reference did not include discussion of sodium ethyl xanthate at all in the TSF failure scenario. Reference to it in Chapter 9 is: "However, those results do not include process chemicals (e.g., xanthates and cyanide) that may be associated with the supernatant but that are not quantified in this assessment."

    We recommend either deleting these statements or revising them to accurately reflect what the EPA reported in the BBWA regarding sodium ethyl xanthate.

18. Discussion of NaHS: The DEIS states "Sodium Hydrogen Sulfide (NaHS) is very soluble, and if spilled into water it would dissolve, and give off nitrogen oxides and sulfur oxides (PLP 2018-RFI 052)" (pg. 4.27-60). The reference document referred to states "The decomposition products include nitrogen oxides and sulfur oxides (Cayman Chemical Company, 2013)." The Cayman reference is a Safety Data Sheet,[69] which states the decomposition products are sodium oxides and sulfur oxides. Additionally, these are decomposition products, not dissolution products. NaHS will dissolve in water to release HS^- and Na^+ ions. We recommend revising the EIS discussion for clarity.

19. Spill Rates: The EIS notes that the ADEC spill database has no records specific to spills of reagents from trucking, marine, or ferry transport (pg. 4.27-61). With respect to truck transport, we recommend using the spill rate in EPA 2014 (1.9×10^{-7}).

[69] https://www.caymanchem.com/msdss/10012555m.pdf

20. Fate and Behavior of Released Tailings: We recommend that the EIS clarify in Section 4.27.6.3 that it is the low percentage of metal sulfides in the bulk tailings that would cause a lower risk of acid generation, relative to the pyritic tailings. Also, please explain why acid or metals generated would be "produced on such a slow timescale" (pg. 4.27-65) or revise as indicated in other EPA comments on leaching and acid generation.

21. Impact of Stream pH on Tailings: In Chapter 3.18, there is discussion that pH ranged from 3.31 to 9.33 in the stream samples, with the NFK having the lowest pH and UTC having the highest. The bulk tailings pipeline scenario discusses a spill into the NFK. We recommend including discussion of behavior of tailings particles if spilled in (and unrecovered from) reaches having acidic pH, since some areas are naturally acidic.

22. Discussion of Dam Failure Rates: When making the statement that "regarding dam failure rates and height of dams, higher dams have historically *not* failed more than lower dams…" (pg. 4.27-70), we recommend providing a reference to the height being compared, and point out the fact that, historically, the numbers of higher height dams (e.g., > 300 ft) in existence was fewer.

    The DEIS also states "A review of ICOLD data reveals a clear trend in the higher probability of dam failure during active dam operations. Ninety percent of tailings dam failures have occurred in active dams during operations, as opposed to dams in closure (ICOLD 2018). Data also show that failures of tailings embankments under dry storage conditions (with no ponded water above tailings) after mine closure is small compared to dams in active operations with ponded water (Donlin Gold EIS 2018). Therefore, the probability of a failure of the bulk TSF in closure would be expected to be even lower than the estimates above (EPA 2014)." (pg. 4.27-71). We recommend that the EIS explain how the EPA 2014 assessment relates to the rest of the paragraph discussing data reviewed from a 2018 reference, or how it could relate to estimates in previous paragraphs for this document.

23. Emergency Action Plan: There are several places in the DEIS where an emergency action plan is mentioned (e.g., pg. 4.27-72). We recommend that a draft emergency action plan be included or referenced in the EIS, to support conclusions regarding what actions would be taken and residual impacts that could remain.

24. Centerline vs. Downstream Dam Construction: The DEIS states that centerline construction was selected for the bulk TSF to "limit the footprint and volume of materials required for construction." It also states that "Data on dam failures around the world demonstrate that dams designed with downstream construction methods are less likely to fail than dams using centerline construction methods, especially under seismic shaking (ICOLD 2018)." (pg. 4.27-73). Because stability against failure is important, we recommend that the Corps consider this in identifying the LEDPA, since a limited footprint and lower volume of construction materials may not outweigh the inherent increased resilience of a downstream dam in considering potential for failure as compared to centerline construction.

25. Modeling Release Scenarios: The tailings release scenarios were modeled to determine the inundation (Section 4.27.6.9). As with any model, we recommend that the EIS include discussion of uncertainties associated with the modeling and how the uncertainties could impact model results. In addition, we recommend that the further information be supplied to describe how the volume of pyritic tailings released was selected since the volume appears to be less than what would be

expected based on recent studies of tailings failures (see references under Bulk Tailings Release Scenario).

26. Blasting Residuals: The DEIS asserts that bulk tailings and pyritic tailings would not contain residue from blasting agents, and states "This rock would be monitored until explosive residues have been leached (PLP 2018-RFI 021c)" (pg. 4.27-85 and 4.27-104). Such monitoring would be unusual, and the statement does not appear to be accurate as the discussion in the cited reference refers specifically to runoff from embankments. The October PLP project plan also discusses this in context to the rock for embankments. Additionally, nitrate and ammonia are noted in K4.18 as being components in water from both TSFs. We recommend that the EIS discuss the potential for blasting residues to be in the tailings' supernatant water, and analyze the potential impacts in the spill scenarios.

27. Discussion of Sediments: The DEIS includes contradictory statements with respect to the potential for entrained tailings in existing sediments to release ions (pg. 4.27-85 and 86). We recommend that the EIS clarify why they would behave differently in the situations, or that the discussion be revised.

28. Pyritic TSF Spill Scenario: In order to better understand the extent and magnitude impacts of this scenario, we recommend that the inundation maps included in the reference (Knight Piésold 2018p) be added to the EIS in this section or in an appendix.

29. Water Management Pond Release Probabilities: The probability of release from the WMP isn't presented because it is stated that "there are no known precedents for such a large lined WMP; therefore, there are no reliable statistics on their failure rates." (pg. 4.27-115). We recommend that the EIS provide information on known failure rates for ponds that approach the same size (or the largest that is common), either with or without a liner, to support the DEIS analysis.

30. Wetlands Impacts Due to Spill Scenarios: In discussing release from the WMP, wetland vegetation is stated as being impacted through uptake of contaminants because of the scenario being set in early spring. We recommend also discussing this potential with respect to metals in supernatant from the concentrate and tailings spills.

31. Fish Impacts Due to Spill Scenarios: The DEIS states that "the low-level use of the habitat to be impacted (based on the distribution and densities of juvenile and adult salmon observed in the area) indicates that drainage-wide or generational impacts to populations of salmon from direct habitat losses associated with the scenario would not be expected" (pg. 4.27-88). We recommend that the EIS define what losses are expected, and explain, for example, the significance of the loss of a year-class of salmon from the NFK within the context of population diversity.

INDIRECT AND CUMULATIVE IMPACTS

The cumulative nature of project impacts to streams, wetlands, lakes, and ponds and the fishery areas they support in multiple watersheds is an important consideration for both the EIS and the 404(b)(1) Guidelines review. The Guidelines require the prediction of cumulative effects to the extent reasonable and practicable.[70] Our key issue is a recommendation for further analysis to support the Corps'

[70] 40 C.F.R § 230.11(g)(2).

conclusions regarding potential cumulative impacts of the Pebble Mine Expanded Development Scenario as explained in greater detail below.

Pebble Expanded Development Scenario

General Recommendations: The evaluation of cumulative impacts in the DEIS presents impacts in general terms, with little or no quantitative evaluation of additional impacts resulting from this scenario. For example, page 4.18-36 states, "The potential for cumulative impacts on surface groundwater, and sediment would increase substantially," but the DEIS does not attempt to estimate the magnitude, duration, or extent of these impacts. In addition, the DEIS does not recommend mitigation measures to reduce impacts. In our scoping comments, we recommended that the EIS evaluate the expansion and continued operation of the currently proposed project as a reasonably foreseeable indirect effect of the proposed action. We recommend that the EIS include a more robust evaluation of the indirect and cumulative effects of reasonably foreseeable future activities, particularly in terms of the Pebble Mine Expanded Development Scenario.

Description of Expanded Development Scenario: The DEIS provides a summary of the Pebble Project Expansion in Table 4.1-2. While this summary is helpful, more information is recommended to support the subsequent impact assessment. We recommend that the table be expanded to provide the estimated amounts of ore and waste rock that would be mined and the amount of tailings produced. We also recommend that the table include a footnote that summarizes the uncertainty associated with the assumptions in the table (e.g., the first few sentences of the RFI-062 response). In addition, we recommend that the figure in RFI-062 be included in the EIS so that the layout and size of the mine site components can be visualized.

Future impacts of the Pebble Project Expansion will vary depending on which alternative is selected in the Record of Decision for the current proposed action. Assumptions for the Pebble Project Expansion presented in Table 4.1-2 include construction of a concentrate pipeline and diesel pipeline from the mine site to a deepwater loading facility in Iniskin Bay. Under Alternative 1, this would include construction of a second road for pipeline servicing, whereas the project access road could be used for servicing pipelines in Alternative 2 and 3. In addition, assumptions in Table 4.1-2 for the Pebble Project Expansion under Alternative 1 include continued use of the ferry to transport supplies and molybdenum concentrate to Amakdedori Port. However, under Alternative 2, it is assumed that the ferry would be discontinued after 20 years and that a road would be constructed to connect the two ferry terminals to transport supplies and molybdenum concentrate to Diamond Point port. Neither the DEIS nor RFI-062 explain why continued use of the ferry is anticipated under Alternative 1 but not Alternative 2. We recommend that this be clarified in the EIS. In addition, we recommend that the Corps consider the cumulative impacts of future expansion when considering which alternative is currently environmentally preferable.

Pebble East: The project applicant has proposed mining the deeper Pebble East portion of the deposit,[71] potentially during a future phase using surface or underground mining techniques. We recommend that mining this this portion of the deposit (Location Alternative 006) be included as part of the expanded mine scenario or that the EIS explain why evaluating the impacts of mining the deeper Pebble East portion is not reasonable or practical.

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[71] Northern Dynasty Minerals, The Pebble Project: The Future of U.S. Mining and Metals, January 2017.

Resource-specific comments: Our comments regarding the analysis of impacts of the Pebble Mine Expanded Development Scenario in specific resource sections are as follows:

1. Surface Water Hydrology: We recommend that the analysis of the cumulative effects of the Pebble Mine Expanded Development Scenario on surface water hydrology (Section 4.16.7.2) include a figure or table that shows the extent of changes to surface water hydrology for the expanded development scenario so that the magnitude and extent of impacts is included. In addition, we recommend that the EIS describe the range of variability associated with the estimates of the changes so that it is clear whether these predictions are average, reasonable worst case, etc.

2. Groundwater Hydrology: We recommend that the analysis of cumulative effects of the Pebble Mine Expanded Development Scenario on groundwater hydrology (Section 4.17.7.2) include a figure that shows the extent of the groundwater zones of influence for the major mine components (TSFs, water management ponds, open pit) so that the magnitude and extent of impacts to groundwater quality and quantity is understood. In addition, we recommend that the EIS describe the range of variability associated with the estimated mine expansion described in this section (Section 4.17.7.2) so that it is clear whether the additional predictions are representative of the expanded development scenario.

3. Water Quality: The potential cumulative effects of the Pebble Mine Expanded Development Scenario on water and sediment quality (Section 4.18) are discussed in terms of the increased footprint and in terms of sedimentation and fill placement. We recommend that the impacts analysis also address the potential impacts associated with increased storage time of waste rock and tailings. Page 4.18-36 of the DEIS states, "[t]he potential for cumulative impacts on surface groundwater, and sediment would increase substantially," but the DEIS does not fully estimate the extent of these impacts.

4. Wetlands: Section 4-22 of the DEIS does not indicate how many stream miles would be lost due to the expanded mine scenario. While this section does note that an "additional 12,445 acres" of aquatic resources would be "potentially affected" at the mine site, the DEIS does not identify whether this estimate includes both direct losses and functional degradation from secondary/indirect effects, what type of aquatic resources and functions would be lost or degraded, or the severity or significance of these impacts. We recommend the EIS characterize the geographic extent of cumulative direct and secondary/indirect effects (e.g., acreage of wetlands and other aquatic resources impacted, miles of stream impacted – by impact types), the expected change in functions provided by the affected aquatic resources, and the severity or significance of these changes. Given the extensive available information about the expanded mine development scenario it appears reasonable for the Corps to include and evaluate this information. Alternatively, the Corps should explain why its current approach is sufficient in light of the significance and complexity of the discharge activities associated with this project.

5. Spill Risk: In discussion of the potential spill risk impacts associated with the Pebble Expanded Development Scenario, the DEIS states, "In summary, the cumulative effects of unintentional releases associated with Pebble mine expansion would be similar to those discussed previously in this section, but potentially involve larger volumes over a slightly larger geographic area" (4.27-128). We recommend that the analysis of impacts of this scenario be revised to include additional potential impacts not acknowledged in this statement. For example, the pyritic waste

rock (and tailings) will not be able to be placed into the pit after 20 years, will therefore not be submerged, and will be weathering over time. Therefore, a potential future spill from the TSF under the Expanded Development Scenario would be expected to have acidic and metal laden water released. We recommend that the EIS discuss potential cumulative effects from increased time of storage on water quality in the TSFs and potential for increased risk of failure of the WMP and TSFs with increased time of operation.

Potential Future Use of Cyanide: A summary of differences between the proposed project and the reasonably foreseeable expansion of the project notes that the expansion would need additional tailings storage, additional water storage, new waste rock storage facilities, additional processing facilities, a concentrate pipeline, and a deep-water loading facility. This inventory is based on RFI-062, dated August 2018. However, based on recent public statements made by Northern Dynasty Minerals (Doug Allen, Vice President of corporate communications; Vancouver Resource Investment Conference, January 2019), it may also be expected that a cyanide circuit would be proposed in the future. We recommend that the Corps verify with PLP if a future expansion of operations after the currently proposed 20-year project would include a cyanide gold-recovery circuit. If it is to be part of the reasonably foreseeable future action, then we recommend that it be added to the "Description" column of Tables 4.1-1 and 4.1-2 and impacts from that component of the project should be evaluated in the subsequent resource-specific sections.

Additional Comment on Indirect and Cumulative Impacts

Clarification of RFFAs: The DEIS states under the "Timeframe" section of the "Reasonably Foreseeable Future Actions in the EIS Analysis Area" (Section 4.1.1.3) discussion that there would be consideration of other (in addition to PLP's potential expansion) reasonably foreseeable future activities that may occur "during construction and operation of the proposed project." Table 4.1-1 presents numerous potential activities and whether they would be "reasonably foreseeable." For most activities where the table states "No – for development," meaning that the action was determined not to be reasonably foreseeable for development, there is also a statement reflecting that there is no indication that development would occur "within the operations timeframe of the proposed Pebble Project." However, for two activities having "Yes – for development" (Donlin and Drift River), there are statements that the projects are considered "reasonably foreseeable in the 78-year timeframe." It is likely that several of the projects in the table currently noted as "no" for development may actually be "yes" if looked at over a 78-year timeframe. We recommend that the criteria used to support which activities are reasonably foreseeable future actions be clarified in the EIS.

MITIGATION

The conceptual level of key project plans and design features, and some plans that are not developed at all, makes mitigation effectiveness evaluations challenging for these features and, in some cases, unsupported. Further, the draft Compensatory Mitigation Plan contains only a conceptual discussion of compensatory mitigation, does not fully address indirect impacts to waters of the U.S. that may occur, and does not identify any specific mitigation projects; therefore, the availability and effectiveness of compensatory mitigation to offset unavoidable impacts is not disclosed. These key issues are discussed below followed by additional comments and recommendations regarding the Applicant's Proposed Mitigation, best management practices, and additional mitigation being considered by the Corps.

Applicant's Proposed Mitigation

Conceptual Level of Key Project Plans and Components: Regarding PLP's proposed mitigation and procedures, the DEIS states (Section 5.2.2) "Where there is insufficient detail to determine effectiveness, the measure could not be incorporated into the impact analysis, but serves to inform the public of PLP's commitments…Engineering design and construction, operations, or closure-phase procedures are often preliminary at the time that an EIS is prepared; typically, final engineering designs and construction and operations plans are finalized during the successive state permitting phase." (pg. 5-5). We agree that designs and plans may be preliminary during EIS analysis. However, several key designs and plans proposed by PLP are either not available (Reclamation and Closure Plan, Monitoring Plan, Adaptive Management Plan, Fugitive Dust Control Plan) or at a conceptual or early stage which is less than a preliminary design stage (open pit dewatering system, TSF and WMP embankments, waste rock characterization and management plan, seepage collection/pumpback system, closure water treatment process). We recommend that these components and plans be developed with a reasonable level of detail and discussed in the EIS to support the Corps' review of their effectiveness and potential impacts in a meaningful evaluation. Our specific recommendations related to these project components and plans have been provided in our comments above (see "Conceptual level of design and development of key project features and plans").

Effectiveness and Jurisdiction of Applicant's Proposed Mitigation: The DEIS conducts an assessment of the effectiveness and jurisdiction/enforcement of each of the mitigation measures proposed by the Corps during the EIS process (Table M-1). The DEIS does not appear to include a similar assessment of PLP's proposed mitigation (Table 5-2). We recommend that the EIS conduct this same assessment for PLP-proposed mitigation identified in Chapter 5 and that columns describing effectiveness and jurisdiction/enforcement be added to Table 5-2.

List of Applicant's Proposed Mitigation: Numerous mitigation measures described in the EIS are not fully included in Table 5-2 (Applicants Proposed Mitigation Incorporated into the Project). We recommend that Table 5-2 be revised for completeness, so that a complete listing of all mitigation measures considered is available. Additional detailed comments on Table 5-2 are as follows:

1. Reclamation and Closure Plan: Our comments related to the RCP (pg. 5-6/7) include:
    - The DEIS states, "Where feasible, mine facilities would be reclaimed in such a manner as to create new wetland areas and ponds." In order to analyze impacts to wetlands at reclamation and closure, we recommend a draft RCP be developed that describes what is meant by "where feasible" and that specifically describes reclamation that would occur to create new wetland areas.
    - The DEIS states "The RCP would document the plan for long-term closure of the site in a stable condition…and would serve as the basis for the development of the closure cost estimate and associated bonding." We recommend developing a draft RCP that defines what is meant by a stable condition and documents specific plans for long term closure, or that the EIS provide some other reasonable basis for assessing the impacts at closure.
    - See also our comments regarding the RCP under "Conceptual Project Features and Plans…"

2. Bonding and Financial Assurance: Table 5-2 discusses bonding in the context of the RCP. Financial assurance would also be required by the State of Alaska for the Integrated Waste Management Permit and dam safety certification. We recommend that this be clarified. In addition, we

recommend that a draft financial assurance cost estimate be provided to enable evaluation of the adequacy of financial assurance given the need for long-term water treatment. Please see our comments on "Conceptual Project Features and Plans…" for more information.

3. Fugitive Dust Control Plan: According to the DEIS, a fugitive dust control plan would be developed and "methods would be established to control dust from vehicle travel on unpaved roads, material handling, and wind erosion from disturbed areas. Control measures *could* include speed limits, use of approved chemical dust suppressants, and application of water" (pg. 5-8, emphasis added). We recommend that a draft fugitive dust control plan be included in the EIS that specifies the control measures that would be used. This would ensure disclosure of the extent to which fugitive dust releases would be mitigated and any potentially significant remaining environmental and human health impacts. We recommend that the draft fugitive dust control plan consider inclusion of the following:
    - Site:
        - Dust control fence/barrier/plantings at perimeter of operations;
        - Establish inspection schedule to verify plan is working;
        - Establish a standard for identifying a dust event (e.g., percent opacity);
    - Processing facility:
        - Minimize ore drop distance as practicable;
        - Inspect equipment and enclosures regularly for physical integrity. Address identified issues as soon as practicable;
    - Storage piles:
        - Minimize drop height as practicable;
        - Define when water/chemicals are needed;
    - Roads:
        - Define when water/chemicals will be used;
        - Identify measures to load and transport material in trucks to minimize dust (drop height into bed, level of fill in the bed, etc.);
        - Establish a level for triggering dust control measures;
    - Drilling:
        - Address whether a wet method will be used for drilling;
        - Set limit on percent opacity;
    - Inspections:
        - Establish a regular schedule for inspection;
        - Establish a routine maintenance schedule;
        - List the schedules for watering, treating and periodic cleaning of roads, trafficable areas and storage piles;
    - Staff
        - List of staff responsible for implementation of plan;
        - All employees report high dust; and,
    - Equipment:
        - List equipment to be used (spray trucks, chemical application systems, etc.).

    In addition, we recommend that the EIS include discussion regarding the toxicity of dust suppressants (see, e.g., McTigue et al. 2016), and that this factor be addressed in the draft plan.

4. Aquatic Resources Monitoring Plan: The DEIS suggests that an ARMP would be developed at a later time in consultation with ADFG and ADNR. We recommend that a draft ARMP be included in the EIS to provide support for the conclusion in column 2 of Table 5-2 that it would monitor change to aquatic communities and allow for adaptive management to address any project-related impacts.

5. Spill Response: Table 5-2 states that the project would contract with a Spill Response Organization. As discussed in our comments on Spill Risk (Section 4.27), we recommend that a draft spill response plan be included in the EIS. We recommend that this plan identify organizations contracted to deal with all anticipated types of spills (oil, concentrate, tailings, natural gas, chemicals), as well as discuss spill response actions including actions that would be taken to notify potentially affected communities and plans for spill remediation.

6. Pit Lake: Table 5-2 of the DEIS provides a general discussion of the pit lake being maintained "at a level that promotes hydraulic containment…protecting site groundwater." And "…providing for additional storage capacity…" (pg. 5-13). It will also be very important that water level be maintained in the pit enough to keep the PAG materials in an anoxic zone (where there is no infiltration of oxygenated water). We recommend that the EIS address how these needs will be balanced, the depth required to satisfy these needs, and plans for monitoring the water level. Additionally, while final storage of the PAG materials in the pit will mitigate the need for treatment in perpetuity of seepage from the pyritic TSF or from a PAG waste rock pile (if one were proposed), the pit will require treatment and release of water, likely in perpetuity, to sustain those conditions. We recommend that this measure acknowledge the likelihood that water treatment for the pit would continue in perpetuity.

7. Waste Rock Management Plan: Table 5-2 of the DEIS identifies PLP's "primary approach" confirming use of NAG and non-metal leaching materials in construction and that it would "confirm sulfur and element characteristics" (pg. 5-13). As discussed in our comments on Conceptual project Plans and Features and Water Quality, we recommend providing more detail regarding the specific criteria and procedures that would be used to separate PAG/metal-leaching waste from NAG/non-metal leaching wastes in order to evaluate the extent to which these procedures would be effective at reducing the risk of impacts to water and wetlands from ARD and leached metals.

8. Storage of PAG Materials: Two entries in Table 5-2 describe measures that would be taken for storage of PAG Materials during operations and at closure and discuss the impacts that would be mitigated by these measures (pg. 5-15, first and second rows). We recommend revising the text to reflect that the impacts being mitigated include negating the need for perpetual treatment of runoff and seepage and potential failure of the pyritic TSF, but that the measure will result in required monitoring and treatment of the pit in perpetuity. Also, we recommend that the EIS state more accurately that the subaqueous storage will "limit" or "minimize" oxidation and subsequent acid generation, depending on the depth of the water cover and provision of anoxic and reducing conditions, but would not necessarily "eliminate oxidation and acid generation."

9. Treated Water Discharge: Table 5-2 references the use of "strategic timing" for water release at three separate discharge points, but details on the timing are not provided in the DEIS (Chapter 2 or Appendix N). We recommend that the EIS provide a reasonable description of the plans for treated water discharge, including what is meant by "strategic timing," how the goal of "minimize, or avoid, impacts to fish habitat" would be achieved, and where treated water would be stored prior to its release if there is need to release smaller amounts than what is being treated at any time. Also related

to this topic is text in 4.24 stating that "treated water would be discharged through buried infiltration chambers designed to provide energy dissipation, erosion control, and freeze protection." Presumably these are mitigation measures against damage to the streams (erosion, resuspension of settled solids, etc.) by velocity of discharge, as well as to protect aquatic life from the force of the water. We recommend that this measure be added to Table 5-2.

10. <u>Redundancy in BMPs</u>: The Water Quality Section includes a statement regarding potential for overwhelming BMPs "resulting in an influx of fine sediment and increased turbidity into gravel-dominated streambeds" (pg. 4.18-19). We recommend redundancy in BMPs in areas near these streams and that settling basins/ponds/ditches on the mine site be sized to consider extreme events to mitigate against release off-site.

11. <u>Road Access</u>: Table 5-2 states "The project would provide for controlled use of the road corridor and ferry for local residents, improving the supply of goods and reducing the cost of importing goods." However, Chapter 2 describes the road as a "private road." We recommend that the EIS define what is meant by "controlled use" to confirm general statements made here and elsewhere (e.g., Section 4.9 Subsistence) about positive benefits to community. We also recommend that the allowable use of the road be clarified in the project description.

12. <u>Independent Review of the TSF and WMP dams</u>: We recommend that the mitigation table include an independent review of the TSF and WMP dams proposed for the project. These are significant structures that retain tailings and contaminated water. We recommend that the Corps require independent review of these structures[72].

Best Management Practices

The DEIS defines Best Management Practices and Industry Standards as "predictable actions necessary to comply with regulations and standard permit requirements that are designed to reduce impacts to the environment. These are typically reflected in the applicant's design and are analyzed as part of the proposed project." Where such actions are presumed in the analysis of the proposed project, it is important that the DEIS include the actions that will be taken and how they will be enforced. We recommend the BMPs and other standard actions assumed for the project be compiled in a new table, or that these measures be added to Table 5-2. Consistent with our recommendation for Table 5-2, we recommend that this table include the effectiveness and jurisdiction/enforcement of the measure. Many of the items listed in Section 5.2.1.2 are examples of where BMPs would be required by regulation or are likely to be used, rather than being a description of the action itself, and we recommend providing details on the anticipated measures.

As part of the description of BMPs, the DEIS discusses the Alaska Large Mine Permitting Team (LMPT) process (Section 5.2.1.1). The DEIS states "The goal of the LMPT process is to coordinate the sequencing and intergovernmental review of the numerous permits required of a large, complex, hardrock mine." However, the DEIS mentions only three of the state permits/approvals: the Plan of Operations approval, Reclamation and Closure Plan approval, and Integrated Waste Management Permit as being part of an application package and subject to public comment. We note that the state also issues air quality permits, Alaska Pollutant Discharge Elimination System permits, dam safety certifications, water rights, and fish habitat permits for mining projects and these permits/approvals are not discussed.

[72] 33 CFR 325.1(d)(6)

We recommend that this section be revised to clarify whether these other major state permits/approvals are part of the LMPT process or if they are processed separately.

The DEIS provides numerous steps that are conducted for the State LMPT process, but does not explain where the Corps' 404 permitting and the NEPA process factor in to the state's process. Under the section for the Applicant's Proposed Mitigation Incorporated into the Project, there is a statement that designs are often preliminary in the EIS and are "finalized during the successive state permitting phase", which implies that the 404 permitting phase occurs first. We recommend that the EIS clarify the timing of the Corps' 404 permit application and NEPA process in relationship to the state and local processes when discussing the state and local processes.

Compensatory Mitigation

Appendix M contains the applicant's draft conceptual Compensatory Mitigation Plan (CMP). Our primary comments on the CMP is lack of proposed mitigation projects, lack of inclusion of temporary and secondary impacts, and functional assessment is not considered. These issues are discussed below. Our letter on the CWA 404 Public Notice (see Section I.X. of the letter) also reflects these issues and discusses the CWA 404(b)(1) Guidelines.

The CMP provides summary information regarding the compensatory mitigation regulations, the potential impacts, and potentially affected watersheds. It states that PLP proposes to compensate for 3,524 acres of direct permanent losses of waters of the United States. It also states that "PLPs compensatory mitigation approach will focus on opportunities that benefit water quality and fish and their habitat. While the intent is to seek such opportunities within the watershed, if opportunities are not available PLP will reach for similar opportunities outside the watershed." The CMP does not include any proposed compensatory mitigation projects or information regarding type and location of compensatory mitigation under consideration. It states that "[t]his CMP will be amended in the future to include proposed mitigation plans." The DEIS states (pg 5-23) that "[s]pecific mitigation conditions would be determined following completion of the environmental review and would be included in the ROD for any permit that may be issued."

The Corps should provide an opportunity for meaningful public comment on a CMP that includes a level of detail "commensurate with the scope and scale of the impacts" as well as the "amount, type, and location" of compensation they could potentially provide. Alternatively, the Corps should further explain why, considering the scope and scale of the impacts associated with the proposed project, the CMP contains the level of detail and information required by the public notice regulations at 40 C.F.R. § 230.94(b)(1). In addition, the Corps should explain why the information included in the public notice provided the public or other federal agencies with an opportunity to provide meaningful comment or recommendations on the proposed mitigation as contemplated by the regulations. The Corps should further explain why the CMP complies with the requirements under Section 404 discussed above or the NEPA requirements that mitigation measures be discussed in the EIS sections on alternatives and environmental consequences.[73] This is particularly important in light of the significance and complexity of the discharge activities associated with this project.

[73] 40 C.F.R. § 1502.14(f) and § 1502.16(h).

The Guidelines identify that "[c]ompensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular DA permit."[74] They also specify that "the amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions."[75]

The CMP indicates that PLP proposes to compensate for 3,524 acres of direct permanent losses of waters of the United States. As discussed in our DEIS comments, the DEIS may not have accounted for and characterized all of the potential direct and secondary/indirect impacts of the discharges of dredged or fill material. In addition, the CMP does not address potential compensatory mitigation for the other impacts acknowledged in the DEIS: the direct impacts to over 80 linear miles of streams, the temporary impacts to 510 acres of wetlands and other waters, and the more than 2,800 acres of secondary/indirect impacts to wetlands, streams and other aquatic resources. We recommend that PLP's revised CMP explain how the amount of compensation reflects the amount necessary to meet applicable requirements for the full scope of direct and secondary/indirect impacts of the discharge of dredge and fill material. This information is particularly important in light of the significance and complexity of the discharge activities associated with this project.

The factual determinations underlying the Corps' Guidelines conclusions involve a determination of "the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms."[76] "Compensatory mitigation requirements must be commensurate with the amount and type of impact"[77] identified and "sufficient to replace lost aquatic resource functions."[78] The Guidelines state that where functional assessments are available (as they are here), they should be used to determine the amount of compensation that would be sufficient to offset the authorized impacts.[79] Functional assessments provide a mechanism to quantify the extent of functional loss (debits) and functional gain (credits). Debits represent the loss of function at the impact site, while credits represent the accrual or attainment of aquatic functions at a compensatory mitigation site.

The Corps Alaska District has a Credit Debit Methodology that uses function or condition data to quantify the functional losses or gains between the current and proposed future condition. These functional deltas are used to calculate debits and credits, as recommended by the regulations.

Data was collected that could support development of a functional assessment to identify the amount of functional losses resulting from impacts to wetlands and other aquatic resourced and inform compensatory mitigation decisions. However, this data was not used in the DEIS. As discussed in our DEIS comments on wetland and fish, additional information and analysis is recommended to identify the amount of losses specifically associated with fish-related functions. This information and analysis are important to informing decisions regarding the appropriate type and amount of compensation necessary to offset impacts to fish and fish habitat. We recommend that the Corps should use available data that was collected to support aquatic resource functional assessments and supplement that data where necessary, particularly to identify the amount of losses associated with fish-related functions and use this information to inform decisions regarding the appropriate type and amount of compensatory

[74] 40 C.F.R. § 230.93(a)(1).
[75] 40 C.F.R. § 230.93(f)(1).
[76] 40 C.F.R Section 230.11(e).
[77] 40 C.F.R. § 230.93(a)(1).
[78] 40 C.F.R. § 230.93(f)(1).
[79] 40 C.F.R. § 230.93(f)(1) and 73 FR 19633 (2008).

mitigation necessary to offset the expected functional losses from the proposed Pebble Project. These analytical steps are particularly important in light of the significance and complexity of the discharge activities associated with this project.

Monitoring and Adaptive Management

The DEIS states that PLP proposes to use monitoring measures through construction, operations, and closure of the proposed project to assess predicted impacts and effectiveness of mitigation. The monitoring would have an adaptive management component to identify, assess, and implement changes to the required mitigation measures. The DEIS does not include or reference any specific monitoring or adaptive management plans. The DEIS states that the monitoring plan would be developed during state permitting. As discussed in our comments under Conceptual-level of Design and Development of Key Project Features and Plans, a reasonably detailed monitoring plan and adaptive management plan(s) is important for the EIS analysis. Otherwise, there is no basis for assuming that the monitoring plan (at unspecified locations, frequencies, parameters, etc.) would be effective at detecting changes and no basis for assuming that unspecified adaptive management would be successful at correcting mitigation measures. We recommend that reasonably detailed draft monitoring and adaptive management plans be included in the EIS.

Additional Comments on Mitigation

Appendix M – Additional Mitigation: We appreciate that the Corps has identified additional mitigation measures (Table M-1) beyond those proposed by PLP. Our specific comments on Table M-1 are as follows.

1. Table M-1 identifies numerous proposed mitigation measures that could "indirectly" be enforced by the Corps. We recommend that the EIS define what is meant by the term "indirectly."

2. Table M-1 presents some proposed measures having "jurisdiction/enforcement" noted as "not likely to be enforceable due to remoteness of the project area." Although the project area is remote, and perhaps enforcing compliance couldn't be done daily, projects such as this may still be monitored and/or audited. We recommend that the EIS clarify why a requirement, if made, would be unenforceable solely because of it being a remote project.

3. Automatic isolation valves for concentrate pipeline variant are listed as a "possible" measure in Table M-1 (pg. M-5). The DEIS evaluates a tailings release scenario from the bulk TSF due to a pipeline rupture (Section 4.27.6.9), and states that it would take six hours to detect the leak and shut off the pumps. We recommend that automatic isolation valves, as well as use of a leak detection system, be further assessed as a mitigation measure since it would enable a quicker response to pipeline incidents and minimize the impacts of a pipeline accident or malfunction.

4. Table M-1 lists a double liner system under the pyritic TSF and main WMP as "possible" (pg M-6), but concludes that a double-liner is not reasonable since these facilities already include a liner and a seepage collection system. Minimal information regarding the design of the seepage collection system is provided in the EIS and therefore, it cannot be assumed that it would be effective in preventing groundwater contamination. We recommend that either a double-liner be considered, or additional information be provided regarding the seepage collection system.

5. We recommend revising the Table M-1 to correctly identify that the discharge of bilge water is not under the jurisdiction of the State of Alaska (pg. M-4) and acknowledge that the EPA Vessel General Permit is currently the mechanism by which treated bilge water discharges are regulated. We also note that in the next few years, this authority will transfer to the US Coast Guard (under the Vessel Incidental Discharge Act of 2018).

6. We recommend that additional air quality mitigation measures be added to Table M-1.
    - Regarding use of dust palliatives to reduce fugitive dust, we recommend including a commitment to implement non-toxic palliatives/dust BMPs;
    - As noted in our comments on air quality, the proposed port facility has very high NOx emissions. We therefore recommend considering using access to natural gas to generate shore power to provide to the vessels while they are in port, rather than having the vessels idle, which would significantly reduce NOx at that location; and,
    - We recommend use of the highest Tiered vehicles available for all mobile sources, to reduce engine emissions.

7. Additional mitigation is suggested in several areas of the DEIS that is not identified in Table M-1. We recommend that this additional mitigation be included in Table M-1, including the following:

    - Appendix K4.15 (Geohazards) identifies concerns related to the possibility of uneven deposition of tailings around the perimeter of the bulk TSF that could lead to smaller tailings beaches and added seepage pressure on the embankments. Deposition of tailings on ice in the winter is mentioned as a possible method to mitigate this effect (Pg. K4.15-9). We recommend that this mitigation be added to Table M-1.

    - An additional concern identified in Appendix K4.15 was the possibility that weak foundation conditions (such as a buried glacial clay layer) could be undetected by geotechnical investigations which could result in a very low to low probability of global instability. The DEIS notes that as a result PLP proposed a design change to remove overburden to competent bedrock (pg. K4.15-20). However, that design change is not included in the Project Description. Therefore, we recommend that this be included in Table M-1.

    - Chapter 4.18 (water quality) and AECOM 2018i noted concern that salt and selenium could build up over time that could lead to increased TDS and selenium concentrations that could not successfully be treated. It was concluded that further investigation and mitigation measures or improved management processes are recommended to ensure that WTP performance will meet treatment goals. We recommend that additional mitigation or treatment system adjustments be identified in Table M-1 with enough detail and added analysis to demonstrate that it would improve WTP performance to meet water treatment goals.

<u>Additional Mitigation</u>: Our DEIS comments have noted significant deficiencies with the level of detail associated with key aspects of the project and the environmental analysis that effects the ability to assess the level of environmental impacts. After these deficiencies are corrected and the impact assessment revised, we may recommend additional mitigation measures be included.

<u>AVAILABILITY AND USE OF DATA</u>

As discussed above, data gaps related to important but conceptually developed project components are a key issue for the EIS. Our recommendations regarding data gaps as well as additional recommendations regarding data use and information disclosure are provided below.

Data Gap Analysis

Our comments regarding the specific data gaps identified in Section 3.1 are as follows:

<u>Reclamation and Closure Plan</u>: The DEIS identifies lack of a detailed reclamation plan as a data gap since "a detailed reclamation plan is potentially essential to a reasoned choice among the alternatives." We agree and, based on our comments above (see "Description of the Proposed Project"), a reasonably detailed reclamation and closure plan is important in order to determine reasonably foreseeable significant adverse impacts during the reclamation and closure phase of the project.

<u>Subsistence</u>: The DEIS identified lack of current (post-2008) subsistence data as potentially essential to making a reasoned choice among the alternatives. The DEIS states that it is common that current site-specific information on subsistence use are not available during NEPA compliance, although no references are cited for this statement. There are examples where current traditional knowledge and/or subsistence data was gathered for mining EISs where subsistence was determined to be a significant issue (e.g., Red Dog Aqqaluk SEIS, Donlin Gold EIS). We recommend that the Corps consider acquiring more recent data given the importance of the subsistence resources or further explain why the current analysis is sufficient.

<u>Other Data Gaps</u>: The DEIS states there are only 4 data gaps based on data gap analysis; however, as discussed in our comments on other sections of the DEIS, other data and information gaps exist and the extent of data gaps is underestimated. Some of the other data gaps are mentioned throughout the DEIS. We recommend a more complete accounting of relevant data gaps in the DEIS and a discussion regarding how the gaps impact the accuracy of the EIS conclusions (e.g., especially along the transportation corridor and the ferry and port sites). Examples of where other data gaps are mentioned in the DEIS or are otherwise apparent include (see our comments on Chapter 2 and Chapter 4 sections for details) – note these are just examples as more data gaps are apparent:

- Lack of a detailed waste management plan that would include criteria and specific details regarding how metal-leaching vs. non-metal leaching wastes will be separated;
- Lack of a seepage collection and monitoring/pumpback well system design for the TSFs and water management ponds;
- Lack of compensatory mitigation projects;
- No monitoring or adaptive management plans, beyond general statements and several examples that monitoring and adaptive management would occur;
- Embankment designs lack detail to support seismic stability analysis and seismic stabilty analysis was not conducted was not conducted on some of the embankments;
- "[N]o existing estimate of recreational use at the mine site…" (pg. 3.5-14). This is also true at the port site and along the transportation corridor;
- No stream gages along mine access road or spur road (Fig 3.16-4);

- “Streamflow information for the other streams crossed by the road is not available at the time of this writing… Drainages in the analysis area south of Iliamna Lake have not been the focus of any known hydrologic studies to date.” (pg. 3.16-26);
- “To date, limited geochemical testing has been performed on the representative concentrate because possible designs for metallurgical processes are still at an investigative stage.” (pg. 3.18-3);
- Surface water quality along port access road;
- Groundwater quality along northern access road (1 sample collected in Pedro Bay); and,
- “No substrate data is available for streams along the southern portion of the mine access road.” (pg. 3.18-21).
- There is incomplete discussion of the importance of headwater streams and wetlands, despite the fact that these are the habitats that will be affected by the mine site. There is an extensive body of evidence supporting the idea that headwaters are critical aquatic habitats (e.g., Schlosser 1995; Wipfli 2007).

Additional Comments on Data Quality and Use

Data quality is generally discussed in the DEIS, which would be strengthened by explaining whether all the data were used, whether any were determined to be anomalous and excluded, or how decisions were made for what data were used. For example, in some cases, one-half of the detection limit was used for data that were below the detection limit, but the DEIS does not acknowledge that the number of samples having measurements below detection will influence the meaning of the mean and may indicate an analyte is present at a value above detection when most of the time it is not. We recommend that the EIS provide discussion of data quality assurance for all types of data (e.g., background surface water quality, sediment quality, and geochemical testing data) including:

1) Present all limitations on each type of data;
2) Provide the frequency of detection in the tables to assess whether the analyte is commonly present or commonly absent;
3) When presenting sample means, provide a measure of dispersion around the mean (i.e., range, standard error, standard devisions, etc.) as well as the sample size associated with generating the mean. This is important for understanding the variability and robustness of the dataset; and,
4) Include in discussions of the data how data limitations influence uses of the means determined.

In addition, we recommend that the EIS clearly indicate whether results being discussed in various sections are based on total or filtered (dissolved) samples. Finally, when using qualifiers (e.g., “Relatively high”, “significantly higher”, “high”, “higher”, “slightly higher”, “slightly lower”, “small”), we recommend that the EIS provide the values being compared to justify the statements.

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