4.20 AIR QUALITY

This section addresses air quality impacts during the project. Direct and indirect air quality impacts from all phases of the project were evaluated using project emissions, and air modeling results where applicable. Project emissions consist of criteria pollutants, hazardous air pollutants (HAPs), and greenhouse gases (GHGs). The HAP species associated with the project with the most emissions are acetaldehyde, benzene, formaldehyde, hydrochloric acid (HCl), toluene, xylenes, and methanol.

The Environmental Impact Statement (EIS) analysis area includes the area surrounding and in the vicinity of each project component. Emissions and impacts caused by a project component in its respective defined area of analysis are described as direct impacts. Direct impacts are caused by the project component's activity, occurring at the same time and location.

Scoping comments were received regarding impacts to air quality from construction, fugitive dust emissions, vehicle equipment emissions, and mining activities. Concerns were raised regarding fugitive dust pollution from the mine and roads. Scoping comments also included requests for assessment of impacts from transporting ore and materials, loading and shipping ore concentrate, and impacts to related values (e.g., visibility). Additional comments regarding GHG included requests to assess the contribution from the power plant to GHG and to provide an emissions inventory of criteria pollutants, GHG emissions, and significant HAP emissions for all project components and phases. It is important to note that all project components would be in isolated areas of Alaska, which are characterized as attainment/unclassifiable areas for air quality. Section 4.11, Aesthetics, discusses the potential effects of localized changes to smells that could result from project-related actions that alter the existing natural smells.

4.20.1 Summary of Key Issues

Table 4.20-1: Summary of Key Issues for Air Quality Resources

Impact-Causing Project Component and Phase	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Mine Site				
Construction	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once construction is complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.
Operations	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once mine operations cease, all emissions and impacts associated with operations would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.

Table 4.20-1: Summary of Key Issues for Air Quality Resources

Impact-Causing Project Component and Phase	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Closure	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Impacts would return to baseline conditions once the closure is complete.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.
Transportation Corridor				
Construction	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once transportation corridor construction is complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected along the transportation corridor. Potential impacts associated with dust would vary with road length.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected along the transportation corridor. Because Alternative 3 includes a longer road, potential impacts associated with dust would occur over a larger geographic area than Alternative 1a, Alternative 1, and Alternative 2.
Operations	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once transportation corridor operations are complete, all emissions and impacts associated with operations would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to the Alternative 1a.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected along the transportation corridor. Potential impacts associated with dust and vehicle emissions would vary with road length.	Impacts would be similar to or less than Alternative 1a. Because Alternative 3 entails a longer road and eliminates ferry traffic transportation across Iliamna Lake, potential impacts associated with dust and vehicle emissions would occur over a larger geographic area than Alternative 1a, Alternative 1, and Alternative 2.
Closure	Depending on agreements associated with the continued use of transportation corridors by the public, portions of the transportation corridor and associated impact may remain. For the portions of the	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a. Depending on agreements associated with public use of transportation	Impacts would be similar to or less than Alternative 1a. Depending on agreements associated with public use of

Table 4.20-1: Summary of Key Issues for Air Quality Resources

Impact-Causing Project Component and Phase	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	transportation corridor (e.g., Iliamna Lake ferry terminals, portions of the access road) that would be reclaimed, direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources impacts, and would return to baseline conditions once the closure is complete.		corridors, different geographic areas would be affected by road dust.	transportation corridors, different geographic areas would be affected by road dust.
Port Site				
Construction	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once the port construction is complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected.
Operations	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once port operations are complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected.
Closure	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Impacts would return to baseline conditions once the closure was complete.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected.
Natural Gas Pipeline Corridor				
Construction	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Once pipeline construction is complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected along the pipeline corridor.	Impacts would be similar to Alternative 1a. However, different geographic areas would be affected along the pipeline corridor.

Table 4.20-1: Summary of Key Issues for Air Quality Resources

Impact-Causing Project Component and Phase	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Operations	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources, and would be limited to the compressor station. Once operations activities are complete, all emissions and impacts associated with operations would cease, and would no longer contribute to cumulative impacts.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.
Closure	Direct, indirect, minimal, and localized impacts to air quality may occur as a result of stationary, fugitive, and mobile sources. Impacts would return to baseline conditions after closure.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.
Variants				
	No variants were analyzed under this alternative.	***Summer Only Ferry Operations, Kokhanok East Ferry Terminal, and Pile-Supported Dock Variants***: The impacts of any of these variants are anticipated to be similar to Alternative 1 impacts without the variants, except that there would be no emissions from truck traffic and ferry operations during the winter season, and truck traffic would double during the summer period along with associated long- and short-term emissions.	***Summer-Only Ferry Operations, Pile-Supported Dock, and Newhalen River North Crossing Variants***: The impacts of any of these variants are anticipated to be similar to Alternative 2 impacts without the variants, with the exception of the Summer-Only Ferry Operations Variant. During that variant, there would be no emissions from truck traffic and ferry operations during the winter season, and that truck traffic would double during the summer period along with associated short-term emissions.	***Concentrate Pipeline Variant***: The impacts of this variant are anticipated to be similar to Alternative 3 impacts without the variant, except that construction emissions associated with the pipeline would be higher, and truck traffic and associated emissions would decrease along the transportation corridor with concentrate shipped through the pipeline. There could be added emissions at the port site, depending on treatment options for water derived from dewatering the concentrate.

4.20.2 Methodology for the Analysis of Air Quality Impacts

The assessment of the project's potential air quality impacts was completed via a characterization of existing air quality in the project region (see Section 3.20, Air Quality); an evaluation of air quality regulatory requirements for the project; and a demonstration that all project components would comply with applicable Clean Air Act (CAA) requirements. This section expands on and uses emissions inventory calculations, regulatory evaluations, and modeling demonstrations provided in Appendix K3.20, PLP 2018-RFI 007, PLP 2018-RFI 007b, PLP 2018-RFI 009, PLP 2018-RFI 009b, and PLP 2018-RFI 012 to assess air quality impacts for the project alternatives and variants. Components and phases selected for emission calculation and modeling were those anticipated to produce impacts with the highest magnitude, largest geographic extent, and longest duration. Impacts from other components and phases are smaller than those modeled and are assessed by proxy.

The approach taken does not explicitly predict impacts for all aspects of the project; however, this approach uses codified screening levels to determine whether impacts can be considered minimal or substantial, considering current regulations and standards. This approach is similar to the way the Alaska Department of Environmental Conservation (ADEC) implements CAA to provide reasonable assurance that sources would not cause or contribute to the exceedance of health- and welfare-based thresholds.

Ultimately, anticipated air quality impacts are evaluated based on the emission and estimates, dispersion modeling, screening criteria, and current regional air quality status.

Emission sources are categorized three ways: fugitive, mobile, and stationary point sources.

- **Fugitive emission sources** are those that could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening (40 Code of Federal Regulations [CFR] Part 52.21[b][20]). Some examples of fugitive sources are fugitive dust from vehicles on unpaved roads, fugitive leaks from piping and connectors, blasting, rock crushing operations not connected to baghouses[1], and uncovered conveyors and drop points.
- **Mobile sources** include on-road and off-road vehicles, non-road engines, or portable sources such as light plants, portable generators, construction equipment, vessels, and aircraft.
- **Stationary point sources** are those that pass through a stack, chimney, vent, or other functionally equivalent opening (40 CFR Part 52.21[b][20]). Examples of stationary sources associated with the project are enclosed material processing and handling activities (for which emissions pass through a stack or vent, such as mine mill activities connected to a baghouse), power plant generators, and incinerators.

Impacts are assessed based on the following factors:

- **Magnitude**—Impact magnitude is based on (either directly or by proxy) comparing modeled project impacts to Alaska Ambient Air Quality Standards (AAAQS) and Prevention of Significant Deterioration (PSD) increments (Appendix K4.20, Table K4.20-10). For this analysis, magnitude is quantified as follows:
  - Minimal impact for:
    - Near-field impact below the AAAQS and/or PSD increment
    - Far-field impact below the AAAQS, PSD increment, and/or air quality-related value (AQRV) screening thresholds

[1]A **baghouse** is a fabric filter that removes particulates out of the air.

    - Substantial impact for:
        - Near-field impact above the applicable AAAQS and/or PSD increment
        - Far-field impact above the applicable AAAQS and/or AQRV screening thresholds
- **Duration**—Impact duration is assessed by the length of time project activity would impact the air quality conditions relative to an individual project's activity duration. For this analysis, duration is quantified as follows:
    - If an activity's air quality impacts would only remain while project activities occur, the activity would be considered short-term. Once activity is complete, it would no longer contribute to cumulative impacts, and air quality would return to the baseline conditions. Note that an individual project activity could be considered short-term, even if another activity would be expected to follow (e.g., operations activity following short-term construction activity). In contrast, if a single activity is expected to last through multiple other activities (e.g., construction activity lasting through operations and closure activities), the activity would be considered long-term.
    - If an activity's air quality impact would remain after closure; the activity would be considered permanent. In contrast, a non-permanent activity is an activity where impacts would only exist while the activity is occurring; on completion, the activity would no longer contribute to cumulative impacts.
- **Geographic Extent**—Geographic extent is assessed based on the spatial range where the project activity would impact the air quality conditions. For this analysis, geographic extent is quantified as follows:
    - Localized impact—modeled concentrations return to background levels within 1,640 feet of the boundary, which preludes public access
    - Regional impact—modeled concentrations return to background levels beyond 1,640 feet of the boundary, which preludes public access
- **Potential**—Impact potential is assessed based on the likelihood that the project activity would impact the air quality conditions. For this analysis, potential is quantified as follows:
    - Air quality impacts that may occur have a greater than 50 percent chance of occurring
    - Air quality impacts that are unlikely to occur have a less than 50 percent chance of occurring

Project direct and indirect GHG emissions and impacts from project emissions present a special case when assessing impacts under the framework previously described. Because GHG emissions are long-term in the atmosphere, project GHG emissions would be integrated with the atmosphere and transported globally without directly causing short-term and local impacts. The combination of project emissions with all other global emissions past and present has the potential to translate to impacts in the analysis area. Due to these complexities, no standard methodology currently exists to assess how a proposed project's GHG emissions would translate into physical effects in the analysis area. Therefore, although the project's direct GHG emissions are presented in Appendix K4.20, the magnitude of the impacts from those emissions is not addressed. However, given that GHG emissions remain in the atmosphere for extended time periods and are globally transported, the impact duration would always be permanent, and the geographic extent global. Under all alternatives, the project would contribute to global GHG emissions during all phases of construction, operations, and closure.

The PSD increments and AAAQS criteria used to evaluate the impact to air quality based on the magnitude of the dispersion model–predicted pollutant concentrations are provided in Appendix K4.20. The comparison of impacts to PSD increments has been provided for informational purposes only and does not represent a regulatory PSD increment analysis, which would require a detailed assessment of increment consumption and expansion possibility of regional sources. PSD increment consumption would need to be assessed as part of a formal increment consumption analysis during the permitting process.

Project direct impacts are compared to applicable thresholds using near-field dispersion models for Class II areas, and far-field modeling assessment tools for federal Class I areas. The federal Class I area status is assigned to federally protected wilderness areas and allows the lowest amount of permissible deterioration. All other areas are Class II, allowing for a moderate amount of air quality deterioration. The near-field dispersion model is used to assess the impact near the project area, extending out to roughly 30 miles. The far-field modeling assessment tools are used to project impacts beyond the near-field.

4.20.3 No Action Alternative

Under the No Action Alternative, federal agencies with decision-making authorities on the project would not issue permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the Applicant's Preferred Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, Pebble Limited Partnership (PLP) would retain the ability to apply for continued mineral exploration activities under the State's authorization process (ADNR 2018-RFI 073) or for any activity not requiring federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other individuals or companies.

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

Impacts to air quality from exploration would continue at current levels. Although these activities would also cause some changes to air quality, air quality would return to baseline conditions after reclamation.

4.20.4 Alternative 1a

The results of the assessment of emissions and impacts from Alternative 1a are addressed for each project component by project phase (construction, operations, and closure) in the following sections. When discussing analyzing emissions and impacts of one project component on another, the direct impact from one of the other project components is considered an indirect impact on the project component being assessed, and vice-versa.

Alternative 1a could cause air quality impacts during construction and operations of the mine site, transportation corridor, Amakdedori port, and the natural gas pipeline corridor. The magnitude, duration, extent, and potential of impacts from each these components are described in the sections below. Based on those assessments, minimal and localized impacts (as defined under "Methodology for the Analysis of Air Quality Impacts" above) would occur while the components are being constructed and/or operated.

4.20.4.1 Mine Site

The analysis area for the direct impacts and emissions for the mine site encompasses the area where the mine site activities would occur. The direct emissions from the construction, operations, and closure phases are presented. The extent of potential mine site direct impacts is presented for mine construction activities and mine operations activities by completing a near-field and far-field impact assessment that primarily relies on the results of dispersion modeling. For indirect impacts, the analysis area includes the Amakdedori port site and transportation corridor, because these areas would be indirectly affected by the mine site.

Relevant and primary indirect air quality impacts associated with the construction, operations, and closure phases of the mine site would result from emissions associated with transporting workers, supplies, construction equipment, and materials to and from the mine site through the Amakdedori port and transportation corridor. The impacts from transporting supplies through the transportation corridor along the access roads and ferry routes are discussed under “Transportation Corridor.” The impacts from transportation to and from the port are discussed as direct impacts under “Amakdedori Port.” As stated in the respective sections, if indirect impacts from the mine site occur, the magnitude and extent would be minimal and localized; impacts would only occur for the duration of construction, operations, and closure.

Construction

Direct emissions during construction would be related to quarry crushing operations, concrete batch plant operation, incineration, and power generation. Total emissions were calculated based on the worst-case mine site construction year. The construction mine site emissions for Alternative 1a are similar to those presented in Appendix K4.20, PLP 2018-RFI 007, and PLP 2019-RFI 007b.

Near-field air quality impacts from mine site construction have been demonstrated to comply with applicable AAAQS through modeling (see Appendix K4.20 for modeling information). In addition, modeling has demonstrated that the level of project-related air quality deterioration is lower than the applicable PSD increments. Maximum impacts are less than 45 percent of the AAAQS, and less than 2 percent of the PSD Class II increments. The extent of maximum impacts reaches to the mine site safety boundary closest to the modeled sources. Minimal and localized impacts may occur during construction of the mine site. The duration of the impacts would be short-term and non-permanent. Once complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts. Details of the near-field impact assessment are presented in Appendix K4.20.

The far-field impacts would be comparable to those described as occurring during the operations phase of the mine site. However, because construction activities are temporary and occur over a shorter time period relative to the operations phase, far-field impacts are unlikely to occur (i.e., less than 50 percent probability). If impacts do occur, the magnitude and duration would be minimal and non-permanent.

Operations

Direct emissions during mine site operations would be related to mining activities, ore-processing activities, incineration, and power generation. The mine site stationary emission unit inventory would include a combined-cycle combustion turbine 270-megawatt power plant, fire water pump natural gas engines, back-up diesel generator, boilers, fuel storage tanks, and a small waste incinerator. The mobile equipment inventory used for various mining activities would include haul trucks, bulldozers, graders, shovels, light-duty vehicles, and loaders that would be used in the mining activities. Fugitive emissions would result from blasting and drilling in the pit and quarry,

vehicle traffic on unpaved roads, and material handling. The mine site emissions from operations for Alternative 1a are similar to those presented in Appendix K4.20, PLP 2018-RFI 007, and PLP 2019-RFI 007b.

A near-field modeling assessment was prepared to assess air quality impacts related to operations at the mine site. Compliance with applicable AAAQS has been demonstrated through modeling; modeling has also demonstrated that the level of project-related air quality deterioration is lower than applicable PSD increments. Maximum impacts are less than 55 percent of the AAAQS, and less than 90 percent of the PSD Class II increments. The extent of maximum impacts reaches just beyond 328 feet from the boundary of the mine site closest to the modeled sources.

A far-field impact assessment was prepared to assess representative air quality impacts related to the operation of a mine site and included an analysis of PSD Class I increments and impacts to AQRVs at nearby federal Class I areas, such as Denali National Park and Preserve and Tuxedni Wilderness in Alaska Maritime National Wildlife Refuge. AQRVs are a resource adversely affected by a change in air quality, such as visibility, acidic deposition, and ozone. Based on the combination of inputs, distances modeled, conservative model assumptions, and model-predicted impacts, it has been shown that the PSD Class I increments would not be exceeded; visibility and acidic deposition screening criteria established for federal Class I areas would not be exceeded, eliminating the need for a cumulative impacts analysis to demonstrate that the project would not contribute to regional haze and acidic deposition.

However, because future project assessments may require further analysis of acidic deposition impacts, a sulfur and nitrogen deposition analysis was conducted. Based on the low sulfur dioxide (SO_2) emissions, SO_2 impacts were not modeled for the mine site, and it is unlikely (i.e., less than 50 percent probable) that SO_2 emissions from the mine site operations would be large enough to contribute to sulfur deposition impacts. Although the nitrogen deposition value presented in Appendix K4.20 is a high estimate, the analysis still shows the magnitude of impacts to be equal to the lowest critical-load value for lichens and the bryophytes ecosystem, which is an ecosystem found in nearby federal Class I areas, such as Denali National Park and Preserve and Tuxedni Wilderness in Alaska Maritime National Wildlife Refuge. The extent of impact would be 0.6 mile from the source. Any nearby federal Class I areas are greater than 62 miles away, as Denali National Park and Preserve and Tuxedni Wilderness in Alaska Maritime National Wildlife Refuge are approximately 195 and 95 miles away from the mine site, respectively. Minimal impacts are expected at these distances. This aligns with the Q/D[2] analysis performed for PLP 2018-RFI 012, which also indicates that minimal impacts are likely.

Based on the near- and far-field analyses, air quality impacts that may result from mine operations would be minimal in magnitude and localized in extent. However, the duration of impacts would be short-term and non-permanent. The impacts would be certain to occur if the project were permitted and constructed (see Appendix K4.20 for additional information regarding the near-field and far-field assessments).

Closure

Closure and reclamation activities are described in Chapter 2, Alternatives. Support facilities would include operation of the camp and power generation. The reclamation emissions inventory would include internal combustion engines, a gas turbine, boilers, and an incinerator. Mobile equipment would include haul trucks, shovels, bulldozers, compactors, graders, and service and light-duty vehicles. Fugitive dust emissions would result from stockpiled overburden handling,

[2] **Q/D** is the sum of certain pollutant emissions (tons per year) divided by distance (kilometer) from Class I area.

bulldozing, grading, vehicle traffic on unpaved roads, and wind erosion of road surfaces and active reclamation areas. The duration of the closure phase at the mine site is expected to be approximately 20 years. The maximum closure and construction activities and emissions in a given year would be similar. Assuming that closure impacts would be similar to those from the construction phase, near-field impacts may occur, but far-field impacts are unlikely (i.e., a less than 50 percent probability) to occur because closure activities are temporary, and occur over a shorter period of time relative to the operations phase. If near-field impacts were to occur, they would be minimal in magnitude, localized in extent, and of short-term duration. They would also be non-permanent, only occurring while closure activities are ongoing. Impacts would be limited to the duration of mine site closure, and air quality would return to baseline conditions once closure is complete. Mine site closure emissions for Alternative 1a are similar to those presented in Appendix K4.20, PLP 2018-RFI 007, and PLP 2019-RFI 007b.

4.20.4.2 Transportation Corridor

For the analysis of direct impacts to air quality, the analysis area of the transportation corridor includes gravel access roads, ferry terminals on Iliamna Lake, port, a spur road, and the onshore pipeline segment at the port, because the pipeline and road would be constructed jointly. The transportation corridor would be operational throughout the life of the project. The area of analysis for the indirect impacts includes the area encompasing the Amakedori port site.

This section addresses the direct and indirect emissions from the construction, operations, and closure phases of the transportation corridor facilities. Because the road and onshore pipeline would be constructed in the same right-of-way (ROW) at the same time, the emissions from the construction of both the road and onshore pipeline are calculated together.

Relevant and primary indirect air quality impacts associated with the construction, operations, and closure phases of the transportation corridor would result from emissions associated with transporting labor, supplies, and construction materials to and from the Amakdedori port via marine vessels. The impacts from transporting supplies to and from the port are discussed as direct impacts under the “Amakdedori Port” section; if impacts do occur, their magnitude and duration would be minimal and localized, occurring long-term throughout construction, operations, and closure activities. They would also be non-permanent, and expected to occur if the project were permitted and constructed.

Construction

During construction, direct emission sources would include heavy-duty, non-road, and mobile construction vehicles, as well as fugitive dust generated by vehicles on unpaved roads, and wind erosion. Additional fugitive emissions would result from blasting, drilling, rock crushing, and material handling. Stationary emissions sources would include engines and vapor vented from fuel storage tanks. Emissions from material mining and crushing operations required for fill material are also included in this assessment. The representative emissions were calculated based on the total construction duration of the transportation corridor and estimated equipment operation. The duration of construction for the road corridor and onshore pipeline facilities is expected to be approximately 1 year. Construction emissions for Alternative 1a are similar to those found in Appendix K4.20, PLP 2018-RFI 007, and PLP 2019-RFI 007b for the transportation corridor because the total footprint and road length are similar.

It is anticipated that construction of the transportation corridor would have lower near-field and far-field impacts than those presented for the mine site, because the construction of the transportation corridor would require less activity, and therefore fewer emissions. As discussed in the mine site impact analysis, air quality near-field and far-field impacts would be possible, although the far-field impacts are not likely to occur. If near-field impacts did occur, they would be

minimal in magnitude, localized in extent, and short-term in duration. Impacts would also be non-permanent (occurring only during construction). Once construction is complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.

Operations

Direct emissions during the transportation corridor operations would come from power generators at the ferry terminals, vessels crossing the waterways, vapor vented from fuel storage tanks, and other fuel-burning engines such as ferry engines, light-duty vehicles, truck/trailer vehicles, container-handing forklifts, graders, and aircraft. In addition, fugitive dust emissions would result from vehicle traffic on unpaved roads. The operations emissions for Alternative 1a are similar to those presented in Appendix K4.20 for the transportation corridor because the number of ferry and truck trips are similar.

Because of lower activity level and emissions at the transportation corridor relative to the mine site, it is anticipated that the operations of the transportation corridor would have lower near-field and far-field impacts than those presented for the mine site. As discussed for the mine site impact analysis, air quality near-field and far-field impacts may occur and would be minimal in magnitude, localized in extent, short-term, and non-permanent in duration, only occurring during the activity.

Closure

The transportation system would be retained if required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. As operations end, the Iliamna Lake ferry terminal facilities would be removed except for those required to support shallow draft tug and barge access to the dock, and all supplies would be transported across the lake using a summer barging operation. Depending on agreements associated with the landowner for the continued use of transportation corridors, portions of the transportation corridor and associated impact during operations may remain. The closure/post-closure and construction activities and emissions would be similar to each other in a given year. Assuming impacts would be similar to those from the construction phase, near-field impacts may be possible, but far-field impacts are unlikely (i.e., less than 50 percent probable to occur because closure activities are temporary short-term). If near-field impacts did occur, they would be minimal in magnitude, localized in extent, and short-term and non-permanent in duration, only occurring during closure/post-closure activities. For the portions of the transportation corridor (e.g., Iliamna Lake ferry terminals, portions of the access road) that would be reclaimed, impacts would return to baseline conditions once the closure is complete.

4.20.4.3 Amakdedori Port

This section presents the emissions from the construction, operations, and closure phases of the Amakdedori port. In addition, the underwater pipeline portions in Cook Inlet and Iliamna Lake are included in the analysis of the port construction phase. For the port, the area of analysis for the direct impacts includes the Amakdedori port and marine vessel traffic in Cook Inlet. For the indirect impacts, the area of analysis includes the region beyond the project boundary in Cook Inlet.

The transportation of labor, supplies, and materials in Cook Inlet to Amakdedori port are included in the assessment of the direct impacts. However, relevant and primary indirect air quality impacts associated with the construction, operations, and closure phases of the port would result from emissions associated with transporting supplies and construction materials beyond the project boundary in Cook Inlet. To quantify the possible impacts from marine vessel traffic in Cook Inlet, the assessment completed for the Bureau of Ocean Energy Management (BOEM) Cook Inlet Planning Area Oil and Gas Lease Sale 244 Final EIS (FEIS) (referred to as BOEM Lease Sale

FEIS) (BOEM 2016a) was reviewed. The BOEM Lease Sale FEIS assessed oil and gas lease sales in Cook Inlet and found increased air pollutant concentrations due to emissions from engines and generators on drill rigs, platforms, marine vessel traffic in Cook Inlet, and helicopters. The emissions estimate used for the modeling assessment of the impacts included about 312 support vessel per year during the production and development phase of the BOEM Lease Sale FEIS. This is comparable to the amount of vessel traffic included in the project, which estimates about 330 support vessels per year during the operations phase. Given the BOEM Lease Sale FEIS finding of minimal impacts in Cook Inlet, and that it included other emission sources in addition to marine vessel traffic, which is comparable to the project, it is likely that indirect impacts would also be minimal, short-term, and localized. Indirect impacts are unlikely to lead to additional impacts beyond the existing air quality conditions in Cook Inlet.

Construction

The construction of the port and offshore pipeline uses similar equipment and methods. Therefore, the emissions are calculated together; however, construction would not occur at the same time. Construction of the offshore pipeline would occur after port construction. Construction emissions are calculated based on the estimated construction time, regardless of which activity would occur first.

Port site construction activity would include construction of port facilities to support later phases of construction and mine operations. Emissions from material mining and crushing operations required for fill material are captured in the road construction emissions provided for the transportation corridor. Emissions associated with operation of port facilities, including trucking or offshore pipeline construction, are assumed to be similar to emissions during mine operations, and are represented by the annual transportation emissions estimate for mine operations.

The construction activity associated with the port and offshore pipeline would include engines, an asphalt plant, boilers, fuel storage tanks, and a small incinerator. The mobile equipment inventory would include bulldozers, excavators, loaders, and cranes in the port construction; and tugs, long-reach excavators, and welders in the pipeline construction. Fugitive emissions would result from site grade preparation and mobile equipment traffic. The construction of the port and offshore pipeline is expected to take approximately 1 year. Although the subsea pipeline length is longer than what is used for emissions calculations in Appendix K4.20, resulting in higher emissions, Alternative 1a does not include construction of an earthen-filled access causeway. The causeway emissions would more than offset the added pipeline construction emissions, resulting in lower emissions than described in Appendix K4.20, PLP 2018-RFI 007, and PLP 2019-RFI 007b.

The Applicant has not specified a specific dredge technology to install the buried pipeline crossing in the outer continental shelf (OCS) of Cook Inlet. PLP 2019-RFI BSEE 1 outlines multiple methods that may be used for installing the buried portions of pipeline that include ploughing, clamshell dredge (bucket dredge), conventional excavation (hydraulic backhoe), mechanical trencher (barge-mounted chain cutter or tracked crawlers), and jet trenching (jet sled or jet remotely operated vehicle [ROV]). Each of these five dredge technologies require different equipment, but would not appreciably change the overall emissions.

It is assumed that construction of the Amakdedori port would have lower near-field and far-field impacts than those presented for the mine site during construction, because the emissions are lower for the port relative to the mine site. Based on that similarity, the magnitude, duration, and extent of air quality impacts that may occur would be minimal, localized, short-term, and non-permanent (only occurring during construction activities). Once construction is complete, all emissions and impacts associated with construction would cease, and would no longer contribute to cumulative impacts.

Operations

Direct emissions from operations would consist of marine vessels traveling in Cook Inlet, barge loading and unloading activities, lightering activities, power generation, heating, and incineration.

The Amakdedori port emission unit inventory would include power generator engines, heaters, vapor vented from fuel storage tanks, and a small incinerator. Mobile equipment would include light-duty vehicles, skidsteers, forklifts, and container-handing forklifts. Marine vessels would include barges, tugs, and bulk carriers at the lightering locations. The concentrate containers would be emptied into the bulk carriers at a bulk carrier lightering point (see Section 4.27, Spill Risk, for description of mitigation measures to prevent or reduce fugitive dust from concentrate handling). Operations emissions at the port for Alternative 1a would be the same as those in Appendix K4.20, PLP 2018-RFI 007 and PLP 2019-RFI 007b. In addition, as part of the Applicant's proposed mitigation (Chapter 5, Mitigation, Table 5-2), shore power would be provided for vessels that are docked at Amakdedori port.

Near-field air quality impacts from port operations emissions have been demonstrated through modeling to comply with applicable AAAQS. The magnitude and extent of maximum impacts would be less than 90 percent of the AAAQS, with the maximum impact occurring on the port boundary closest to the modeled sources.

The far-field impact assessment is based on a Q/D analysis of the port emissions that would affect the AQRVs in the federal Class I areas (Tuxedni Wilderness, part of the Alaska Maritime National Wildlife Refuge, and Denali National Park and Preserve, which are 78 miles and 217 miles away from the Amakdedori port, respectively). As a result of this assessment, the AQRVs would not likely be impacted at any of the federal Class I areas. Near- and far-field impacts from the port may occur, but the impacts would be minimal in magnitude, short-term for the duration of port operations, and localized in extent; impacts would be non-permanent (see Appendix K4.20 for details of the near-field and far-field impact assessment).

Closure

There would continue to be emissions and air quality impacts associated with the port until operations end, when physical site closure work would commence. At that time, Amakdedori port facilities would be removed, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. Closure and construction activities and emissions in a given year would be similar. Assuming closure impacts would be similar to those from construction, near-field impacts may be possible, but far-field impacts are unlikely (i.e., less than 50 percent probability) to occur, because closure activities are temporary and short-term. If near-field impacts were to occur, their magnitude would be minimal, short-term in duration, and localized in extent, occurring while closure activities are ongoing; impacts would be non-permanent. Although impacts may occur if the project is permitted, built, and undergoes closure, air quality would return to the baseline conditions once the closure was complete.

4.20.4.4 Natural Gas Pipeline Corridor

The analysis area for the direct impacts from the pipeline corridor consists of the onshore pipeline in the transportation corridor, the pipeline-only segment near Newhalen to the mine access road, the offshore pipeline across Cook Inlet and Iliamna Lake, and the Kenai compressor station. The construction air quality impacts of the onshore portion of the pipeline are addressed above under "Transportation Corridor." Construction air quality impacts of the offshore portion of the pipeline are addressed above under "Amakdedori Port." Therefore, this section only addresses emissions and air quality impacts from the construction of the Kenai compressor station on the eastern landfall of the natural gas pipeline corridor, as well as the air quality impacts from operations and

closure of the entire pipeline corridor. For the indirect impacts, the area of analysis includes the mine site and Amakdedori port.

Relevant and primary indirect air quality impacts associated with the construction, operations, and closure phases of the pipeline corridor would result from emissions associated with transporting workers, supplies, and construction materials through Amakdedori port during the construction, operations, and closure of the pipeline and compressor station. The impacts from transporting supplies through, and to and from, the port are discussed as direct impacts under "Amakdedori Port," above. Additional indirect impacts would be from the combustion of the natural gas at the mine site. Impacts from these emissions are discussed as direct impacts under "Mine Site." As stated in the respective sections, if indirect impacts from construction activities in the pipeline corridor occur, they would be minimal in magnitude, localized in extent, and short-term, only occurring during construction, operations, and closure phases.

Construction

Construction of the compressor station would involve site grading and mobile equipment used for assembly of the compressor station from pre-constructed modules. The compressor station construction emissions inventory would include engines and mobile equipment, as well as bulldozers, loaders, excavators, cranes, and light-duty vehicles. The fuel-burning equipment would be sources of combustion-related air pollutant emissions. Fugitive dust emissions would result from site grade preparation and mobile equipment traffic. Construction emissions for the pipeline corridor under Alternative 1a are similar to those in Appendix K4.20, PLP 2018-RFI 007, and PLP 2019-RFI 007b because the pipeline lengths are similar, with the same compressor station.

It is assumed that construction of the compressor station would have lower near-field and far-field air quality impacts compared to those presented for construction of the mine site, because the construction of the compressor station has fewer emissions than the construction of the mine site, making the mine site a conservative proxy. As a result, the magnitude, duration, and extent of air quality impacts would be minimal, localized, short-term, and non-permanent, only occurring during construction. Impacts would be expected to occur if the project is permitted and constructed. On completion of construction, all associated emissions and impacts would cease, and would no longer contribute to cumulative impacts.

Operations

During operations of the natural gas pipeline corridor, direct emissions and associated impacts from the onshore and offshore pipelines would be minimal, and less than those analyzed for the Kenai compressor station. The Kenai compressor station would be the only compressor station for the natural gas pipeline, and would have emissions and possible air quality impacts. For the operations phase, only the compressor station is assessed.

The Kenai compressor station inventory would include natural-gas-fired simple-cycle combustion turbines. Because the compressor station would be same under Alternative 1a, operations emissions would be the same as those in Appendix K4.20 and PLP 2018-RFI 007.

Near-field air quality impacts from the compressor station have been demonstrated through modeling to comply with applicable AAAQS. The far-field impact assessment is based on analysis of the compressor station emissions that would affect the AQRVs in the nearby federal Class I areas. As a result of this assessment, the AQRVs would not likely be impacted at any nearby federal Class I areas. Based on the modeling screening analyses conducted, both near- and far-field impacts from the compressor station would be minimal in magnitude, short-term in duration, localized in extent, and non-permanent, lasting as long as the natural gas pipeline is in operation.

The impacts would likely occur if the project is permitted and the pipeline and compressor station are constructed (see Appendix K4.20 for details of the near-field and far-field impact assessment).

Closure

The natural gas pipeline would be maintained until it is no longer required to provide gas to the project site. The pipeline would be pigged and cleaned before being abandoned in place, which would result in minimal impacts to air quality and less than those analyzed for the compressor station. The compressor station associated with the pipeline would be removed, and the compressor site reclaimed. Closure and construction activities and emissions in a given year would be similar. Assuming closure impacts would be similar to those from the construction phase, near-field impacts may be possible, but far-field impacts are unlikely to occur because closure activities are temporary and short-term. If near-field impacts did occur, their magnitude, duration, and extent would be minimal, localized, short-term, and non-permanent, only occurring while closure activities are ongoing for compressor station closure. Impacts would likely occur if the project is permitted, the pipeline and compressor station are constructed, and eventually undergo closure. On completion of closure, air quality would return to baseline conditions.

4.20.5 Alternative 1

The mine site under Alternative 1 would be same as under Alternative 1a (see Chapter 2, Alternatives). Under Alternative 1, the locations of the transportation corridor and the natural gas pipeline corridor would be slightly different. However, it is anticipated that emissions and impacts from construction, operations, and closure of the project components from Alternative 1 would be similar to Alternative 1a because the total permanent footprint for each alternative is similar. The total footprint for the Alternative 1 is slightly smaller than Alternative 1a (see Chapter 2, Alternatives, Table 2-2). It is not anticipated that this difference would result in meaningful air quality impact differences. The results of the assessment of emissions and impacts of Alternative 1 are addressed for each component by project phase in the following sections.

4.20.5.1 Mine Site

Direct and indirect emissions from mine construction, operations, and closure would be the same as those under Alternative 1a. Although modeling was not directly assessed for Alternative 1, maximum potential near-field and far-field effects from mine construction, operations, and closure would be the same as the direct and indirect impacts predicted under Alternative 1a.

4.20.5.2 Transportation Corridor

Relative to Alternative 1a, the length of road for Alternative 1 is slightly longer, and the distance of the ferry route for Alternative 1 is shorter (see Chapter 2, Alternatives, Table 2-2). Although the total length of road and distance of the ferry route would be different under Alternative 1 as compared to Alternative 1a, it is not anticipated that the total emissions presented for Alternative 1 would differ meaningfully from Alternative 1a, and the number of ferry and truck trips would be similar. Therefore, the possible project direct and indirect impacts would be similar to those under the Alternative 1a transportation corridor.

4.20.5.3 Amakdedori Port

Direct and indirect emissions from port construction, operations, and closure would be the same as those presented for Alternative 1a. Air quality and fugitive dust impacts would not be different than those under Alternative 1a. Although dock construction would be different under Alternative 1, it is assumed that the construction equipment and duration involved would remain similar to those under Alternative 1a.

4.20.5.4 Natural Gas Pipeline Corridor

For the onshore and offshore pipeline segments, the emissions and impacts from construction of the pipeline would be similar to those presented under Alternative 1a (see Chapter 2, Alternatives, Table 2-2). Differences in emissions based on pipeline construction changes would not be meaningfully different compared to Alternative 1a, which would be expected to have minimal and localized impacts. Therefore, it is not anticipated that the small increase in emissions due to the increased pipeline footprint would result in substantial regional impacts. As a result, the impacts due to pipeline construction under Alternative 1 would be expected to be similar to those presented under Alternative 1a; emissions from operations and closure of the pipeline would be minimal, and less than those analyzed for the compressor station.

Because the compressor station would be the same for Alternative 1 as that for Alternative 1a, emissions from compressor station construction, operations, and closure would be the same; maximum potential near- and far-field effects from the compressor station construction, operations, and closure would also be the same.

4.20.5.5 Alternative 1 Variants

The magnitude, duration, extent, and likelihood of impacts on air quality of the Summer-Only Ferry Operations Variant, the Kokhanok East Ferry Terminal Variant, and the Pile-Supported Dock Variant would be similar to those described for Alternative 1 (during summer) without these variants.

Alternative 1—Summer-Only Ferry Operations Variant

Under the Summer-Only Ferry Operations Variant, concentrate would be stored at or near the mine site for up to 6 months per year. Concentrate would be stored in an enclosed structure for protection from wind and water erosion, eliminating the potential for an increase in fugitive dust (and runoff). The mine site would increase by 40 acres, resulting in a larger footprint. Under the Summer-Only Ferry Operations Variant, truck traffic and ferry traffic would approximately double during the summer, and cease in the winter, as compared to Alternative 1a (see Chapter 2, Alternatives, Table 2-2). During summer, fugitive dust and combustion emissions would increase due to a substantial increase in haul road use compared to Alternative 1 without the variant; however, annual combustion and fugitive dust emissions would be the same as Alternative 1 without the variant because the amount of road use would not change on an annual basis. As discussed in Section 4.14, Soils, and Section 4.18, Water and Sediment Quality, dust control measures would be implemented, and dust suppression water would be used. A conceptual fugitive dust control plan (FDCP) has been developed for the project (PLP 2019-RFI 134), and best management practices (BMPs) would be implemented for fugitive dust management (see Chapter 5, Mitigation).

Although the daily emissions associated with truck and ferry traffic and corresponding daily air quality impact would increase in the summer, the daily impacts would still likely be below applicable air quality thresholds based on the modeling conducted, which uses predicted mine site impacts as a proxy for impacts along the transportation corridor. Therefore, the change in the seasonal traffic pattern would not likely alter expected magnitude of air quality impacts meaningfully; expected air quality impacts would be similar to Alternative 1.

Alternative 1—Kokhanok East Ferry Terminal Variant

The Kokhanok East Ferry Terminal Variant has different access road configurations and road corridors than Alternative 1, which would generate indirect impacts from fugitive dust; the magnitude, duration, and extent of impacts from fugitive dust and other air quality parameters would be similar to or slightly lower than Alternative 1.

Alternative 1—Pile-Supported Dock Variant

Under the Pile-Supported Dock Variant, air quality and fugitive dust impacts would be the same as those described for Alternative 1. Although the dock design would be different under this variant, construction equipment and duration involved would presumably remain similar to Alternative 1.

4.20.6 Alternative 2—North Road and Ferry with Downstream Dams

The mine site under Alternative 2—North Road and Ferry with Downstream Dams would be similar to the mine site under Alternative 1a, with the exception of embankment designs (see Chapter 2, Alternatives). Under Alternative 2, the locations of the transportation corridor, natural gas pipeline corridor, and port would be different. However, it is anticipated that emissions and impacts from the construction, operations, and closure of the project components from Alternative 2 would be similar to Alternative 1a, because the total footprint for each alternative is similar. The total footprint for Alternative 2 is slightly larger than Alternative 1a (see Chapter 2, Alternatives, Table 2-2). It is not anticipated that this difference would result in a meaningful increase in air quality impacts for Alternative 2 compared to Alternative 1a. The results of the assessment of emissions and impacts of Alternative 2 are addressed for each component by project phase in the following sections.

4.20.6.1 Mine Site

Emissions from mine construction, operations, and closure would be similar to those presented for Alternative 1a. Although modeling was not directly assessed for Alternative 2, the magnitude, duration, extent, and likelihood of representative near-field and far-field air quality direct and indirect impacts from mine construction, operations, and closure would be similar to Alternative 1a.

4.20.6.2 Transportation Corridor

Relative to Alternative 1a, the length of road for Alternative 2 is shorter, and the distance of the ferry route for Alternative 2 is longer. Although the total length of road and distance of the ferry route would be different under Alternative 2 versus Alternative 1a, it is not anticipated that the total emissions presented for Alternative 1a would differ meaningfully from Alternative 2, because the number of ferry and truck trips would be similar. Therefore, possible project direct and indirect impacts would be similar to the transportation corridor under Alternative 1a.

4.20.6.3 Diamond Point Port

The Diamond Point port location would require dredging to ensure year-round marine vessel access, and would have a larger footprint, differing from Alternative 1a. Because this activity would not be required under Alternative 1a, construction of the port could result in more emissions and slightly larger near-field impacts. In addition, the area surrounding the Diamond Point port is mountainous, resulting in different topographic conditions, which may be conducive to increased air quality impacts in the vicinity of the port compared to the Amakdedori port location. Potential increases in air quality impacts due to topography would depend on the specific site location and engineering design at the time of permit-related air quality modeling.

Although operational activity and emission levels at the Diamond Point port are expected to be similar to those at Amakdedori port under Alternative 1a, topographical influences may be conducive to increased air quality impacts in the vicinity of the Diamond Point port compared to the Amakdedori port location. Modeling associated with the port showed impacts at 90 percent of the AAAQS; while those impacts are likely overestimated due to conservatism related to the modeled meteorological dataset, a refined engineering design of the port (e.g., revising emissions

sources and building locations and stack heights) may be required to meet ambient air quality standards at the Diamond Point port location. However, it is anticipated that applicable air quality standards would be met. Therefore, the magnitude of impacts due to port operations for Alternative 2 should be similar to those presented under Alternative 1a.

In addition, the Diamond Point port is approximately 50 miles from a federal Class I area (Tuxedni Wilderness in Alaska Maritime National Wildlife Refuge), which is much closer than the mine site. Because of this closer distance, far-field AQRV impacts may be a greater concern. Although they are a concern, AQRV analyses performed at the mine site indicated that the impacts are local to the source location, and result in minimal impacts at the federal Class I areas. Using expected emissions for Amakdedori port and the distance from the port to Tuxedni Wilderness, a Q/D analysis results in a value indicative of minimal impacts. For this reason, far-field AQRV impacts resulting from Diamond Point port emissions would be expected to be higher than those estimated at the Amakdedori port, but not high enough to be a substantial impact.

Because construction, operations, and closure activities at the Diamond Point port would be similar to those estimated at the Amakdedori port, the duration, extent, and likelihood of impacts from emissions during operations would be similar to those for Alternative 1a. Maximum potential near-field effects from the operations at the port would be similar to or slightly higher than the direct and indirect impacts under Alternative 1a.

4.20.6.4 Natural Gas Pipeline Corridor

For the onshore and offshore pipeline segments, the magnitude, duration, extent, and likelihood of emissions and impacts from the construction of the pipeline would be similar to Alternative 1a. Although a portion of the pipeline under Alternative 2 would not follow a road alignment along the northern side of Iliamna Lake, the differences in emissions based on pipeline construction changes would not be meaningfully different compared to Alternative 1a, which would be expected to have minimal and localized impacts. Therefore, it is not anticipated that the increase of emissions due to the increased pipeline footprint in Alternative 2 would result in substantial impacts. As a result, impacts from pipeline construction for Alternative 2 would be similar to those presented under Alternative 1a. For reasons similar to those discussed under Alternative 1a, emissions from operations and closure of the pipeline would be minimal, and less than those analyzed for the compressor station.

Because the compressor station would be the same as under Alternative 1a, emissions from compressor station construction and operations would be the same as under Alternative 1a. Therefore, maximum potential near- and far-field effects from compressor station operations would be the same as the direct and indirect impacts under Alternative 1a.

4.20.6.5 Alternative 2 Variants

The magnitude, duration, extent, and likelihood of impacts on air quality of the Summer-Only Ferry Operations Variant, the Pile-Supported Dock Variant, and the Newhalen River North Crossing Variant would be similar to Alternative 2 without either of these variants.

Alternative 2—Summer-Only Ferry Operations Variant

Under the Summer-Only Ferry Operations Variant, the expected air quality impacts would be similar those described for the Alternative 1 Summer-Only Ferry Operations Variant because variant activities are the same as for Alternative 1.

Alternative 2—Pile-Supported Dock Variant

Under the Pile-Supported Dock Variant, air quality and fugitive dust impacts would not change from those described for Alternative 2. Although the dock design would change with this variant,

it is assumed that construction equipment and duration involved would remain similar to Alternative 2.

Alternative 2—Newhalen River North Crossing Variant

The Newhalen River North Crossing Variant has somewhat different access road configuration and road corridors, which would generate impacts from fugitive dust; however, the magnitude, duration, and extent of impacts from fugitive dust and other air quality parameters would be similar to Alternative 2 without the variant.

4.20.7 Alternative 3—North Road Only

Alternative 3—North Road Only requires trucking of concentrate on a road to a port location north of at Diamond Point and does not include ferry operations across Iliamna Lake; this alternative includes the north access road as compared to Alternative 1a. It is anticipated that emissions and impacts from construction, operations, and closure of the project components from Alternative 3 would be similar to those for Alternative 1a, for reasons similar to those discussed under Alternative 2. The total footprint for Alternative 3 is larger than Alternative 1a due to the increase of access road length in the transportation corridor. However, it is not anticipated that this difference would result in any meaningful air quality impact differences. The assessment of emissions and impacts of Alternative 3 are addressed for each component by project phase in the following sections.

4.20.7.1 Mine Site

Direct and indirect emissions from mine construction, operations, and closure would be the same as Alternative 1a. Although modeling was not directly assessed for Alternative 3, the maximum potential near-field and far-field effects from mine construction, operations, and closure would be the same as the direct and indirect impacts predicted under Alternative 1a.

4.20.7.2 Transportation Corridor

Relative to emissions calculated for Alternative 1a transportation corridor construction, the increase in road length under Alternative 3 would increase construction emissions, while the removal of ferry traffic and terminal construction would decrease emissions. Overall, the changes in the construction, operations, and closure emissions inventory are not anticipated to be meaningfully different from Alternative 1a because the increase of the emissions due to longer road length would be balanced by the decrease in emissions from the ferry terminals and associated traffic, which would not be constructed. Therefore, the direct and indirect air quality impacts are not anticipated to be different than Alternative 1a.

4.20.7.3 Diamond Point Port

Because the Diamond Point port under Alternative 3 has the same design and operations as under Alternative 2, the direct and indirect air quality impacts would not be different. Construction, operations, and closure activities at Diamond Point port would be similar to those estimated at Amakdedori port; therefore, the duration, extent, and likelihood of impacts from emissions during operations would be similar to Alternative 1a. Maximum potential near-field effects from operations at the port would be similar to or slightly higher than the direct and indirect impacts presented under Alternative 1a.

4.20.7.4 Natural Gas Pipeline Corridor

For the onshore and offshore pipeline segments, emissions and impacts from the construction of the pipeline would be similar to Alternative 1a because Alternative 3 has a shorter pipeline length

than Alternative 1a, but would require more material sites for construction. The differences in emissions, attributable to pipeline construction, between Alternative 3 and Alternative 1a would not be meaningfully different, and would be expected to have minimal and localized impacts. Therefore, it is not anticipated that the change in emissions due to the pipeline corridor differences would result in substantial and regional impacts. As a result, the impacts from pipeline construction for Alternative 3 would be similar to those presented under Alternative 1a. For reasons similar to those discussed for Alternative 1a, emissions from operations and closure of the pipeline would be minimal and less than those analyzed for the compressor station.

The compressor station would be the same as under Alternative 1a; therefore, emissions from compressor station construction and operations would be the same. Maximum potential near- and far-field effects from the compressor station operations would be also the same as under Alternative 1a.

4.20.7.5 Alternative 3 Variant

The magnitude, duration, extent, and likelihood of impacts on air quality from the Concentrate Pipeline Variant would be similar to those described for Alternative 3 without this variant.

Alternative 3—Concentrate Pipeline Variant

Under the Concentrate Pipeline Variant, the mine site footprint would be increased by approximately 1 acre. This variant would also slightly increase the north access road corridor width to incorporate the concentrate pipeline and optional return water pipeline, which would be co-located in a single trench. Truck traffic and associated emissions would decrease along the transportation corridor with copper-gold concentrate shipped through the pipeline. There could be added emissions at the port site depending on concentrate water treatment options.

4.20.8 Climate Change

As outlined in Section 3.20, Air Quality, it is projected that the project area would see an overall increase in temperatures, with an increase in precipitation (liquid equivalent) during the winter months, and a slight decrease of precipitation during the summer months. The near-field and far-field modeling impacts discussed previously would not be sensitive to small projected changes in temperature and precipitation. However, a decrease in precipitation, especially in the summer months, could result in drier exposed areas associated with the project, which could lead to more fugitive dust if left unmitigated (see Chapter 5, Mitigation). Additionally, an increase of temperature and changes in precipitation could lead to an increase of wildfire frequency and duration, as well as an increase in sparsely vegetated areas, which would increase background particulate matter concentrations. All projected impacts of climate change on the project area, including temperature, precipitation, and wildfire, are anticipated under all alternatives (including the No Action Alternative).

4.20.9 Cumulative Effects

Impacts to air quality would be those related to emissions of criteria pollutants, HAPs, and GHG.

The geographic area considered in the cumulative effects analysis for air quality would extend through a wide-reaching analysis area, including alternatives and variants, the expanded mine footprint (including road, pipeline, and port facilities), and any other reasonably foreseeable future actions (RFFAs) in the vicinity of the project that would result in potential synergistic and interactive effects. The analysis area is not near a federal Class I area, or in or near a non-attainment, maintenance, or area with local regulations.

As listed in Section 4.1, Introduction to Environmental Consequences, all RFFAs that are anticipated to occur in the development and operations period of the project have been considered in the cumulative effects analysis.

Total GHGs are expected to increase due to the RFFAs; however, the scales of these emission releases are around 1 to 2 million tons. Note that global fossil fuel related to carbon dioxide (CO_2) emissions were projected to be 32 gigatons (Gt) (IEA 2019). From a global perspective (which is the scale for climate change), the net change in GHGs resulting from RFFA impacts would be extremely small; less than 0.006 percent.

4.20.9.1 Long-term Past and Present Actions

The past and present actions that have influenced air quality in the analysis area are discussed in the context of background concentrations in greater length in Section 3.20, Air Quality. Although there are several oil and gas facilities on the Kenai Peninsula and in upper Cook Inlet, the immediate project area is relatively undeveloped and currently consists of a small number of towns, villages, and roads. Present activities include mining exploration and non-mining related projects, such as transportation, oil and gas exploration, and community development actions. All project components would be in remote areas of Alaska characterized as attainment/unclassified areas for air quality. Actions that are currently affecting air quality (or have in the past) in the analysis area are minimal.

4.20.9.2 Reasonably Foreseeable Future Actions

RFFAs in the cumulative impact study area have the potential to contribute cumulatively to impacts on air quality. Section 4.1, Introduction to Environmental Consequences, describes the past, present, and RFFAs that may impact air quality. Relevant future actions for air quality impacts include mineral exploration and mining activities occurring in southwest Alaska; oil and gas exploration and development in Cook Inlet; surface, marine, and air transportation developments such as new roads, bridge rehabilitation, shipping and barging traffic, and port and airport improvement projects; and transmission upgrades, installations, and maintenance. The increase of air emissions may result in minimal and localized cumulative impacts.

All RFFAs are similar to the proposed project in how they impact air quality by emitting combustion-related air pollutant emissions from fuel-burning equipment; and with few exceptions (the Alaska Stand Alone Pipeline [ASAP] project, Alaska Liquefied Natural Gas [LNG], and oil and gas exploration and development), all are similar in that they have fugitive emissions from blasting, drilling, vehicle traffic on unpaved roads, and material handling. The following RFFAs identified in Section 4.1, Introduction to Environmental Consequences, were carried forward in this analysis, based on their potential to impact air quality in the analysis area: Pebble Project expansion scenario; mining exploration activities for Pebble South/PEB, Big Chunk South, Big Chunk North, Fog Lake, Groundhog, Shotgun, and Jackson Tract mineral prospects; Donlin Gold; ASAP; Alaska LNG; Drift River Oil Pipeline; Cook Inlet Oil and Gas exploration and production including the proposed Hilcorp Seaview Project; onshore Alaska Peninsula oil and gas exportation; Lake and Peninsula Borough (LPB) transportation, energy, and infrastructure projects; onshore oil and gas development; road improvements; villages and communities in the project area; and the continued development of the Diamond Point Rock Quarry.

The No Action Alternative would not contribute to cumulative effects on air quality.

The contributions to cumulative effects on air quality are summarized by alternative in Table 4.20-2.

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Pebble Project Expansion Scenario	**Mine Site:** The mine site footprint would have a larger open pit and new facilities to manage water, store tailings and waste rock, and increase daily processing throughput. Construction of the additional facilities, pipelines, and roads would generate fugitive and mobile emissions from the construction-related sources. The mine operations activities would continue to generate emissions from fugitive, stationary, and mobile sources. The power plant would be expanded 25 percent to generate 375 megawatts. The Pebble Project expansion scenario and associated development would be similar for all alternatives. **Other Facilities:** A north access road, concentrate pipeline, and diesel pipeline would be constructed along the Alternative 3 road alignment and extended to a new deepwater port site at Iniskin Bay. Pipeline construction would potentially have additional limited impacts on air quality from trenching activities. An additional compressor station would be added to the Amakdedori port site. **Magnitude:** Over the 78-year life of the Pebble Project expansion scenario, the project footprint would impact a larger area than Alternative 1a (see Section 4.1, Introduction to Environmental Consequences). Even though the daily throughput process would increase with the expansion, it is not anticipated that the operations air quality impacts would meaningfully differ from those estimated for Alternative 1a for a given year, because the worst-case emissions scenario was analyzed for Alternative 1a. Given that similar activities would occur under the expansion as with the project, fugitive, mobile, and stationary air quality impacts during	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** Similar to Alternative 1a, except that the mine access road would not be constructed. The north access road and diesel and concentrate pipelines would be constructed along the Alternative 3 road alignment and extended to a new deepwater port site at Iniskin Bay. **Magnitude:** The magnitude of cumulative impacts to air quality would be similar to those of Alternative 1a, because the expansion footprint and operations under Alternative 1 would be similar regardless of the project alternative. Fugitive, mobile, and stationary air quality impacts during construction, operations, and closure from Pebble Project expansion would be similar to Alternative 1a for a given year. **Duration/Extent:** The duration and extent of cumulative impacts to air quality would be similar to Alternative 1a, except that they would extend to both	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** The north access road would be extended east from the Eagle Bay ferry terminal to Iniskin Peninsula. Concentrate and diesel pipelines would be constructed along the Alternative 3 north access road alignment and extended to a new deepwater port site at Iniskin Bay. An additional compressor station would be constructed at the Diamond Point port site. **Magnitude:** The magnitude of cumulative impacts to air quality would be similar or less than the magnitude of the expansion under Alternative 1a because the expansion footprint is smaller under Alternative 2, and operations activities are similar regardless of the project alternative. Fugitive, mobile, and stationary air quality impacts during construction, operations, and closure from Pebble Project expansion would be similar to or slightly less than Alternative 1a for a given year.	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** Overall Pebble Project expansion would use the existing north access road; concentrate and diesel pipelines would be constructed along the existing road alignment and extended to a new deepwater port site at Iniskin Bay. An additional compressor station would be constructed at the Diamond Point port site. **Magnitude:** The magnitude of cumulative impacts to air quality would be similar or less than the magnitude of the expansion under Alternative 1a because the expansion footprint is smaller under Alternative 3, and operations activities are similar regardless of the project alternative. Fugitive, mobile, and stationary air quality impacts during construction, operations, and closure from Pebble Project expansion would be similar to or slightly less than Alternative 1a for a given year. **Duration/Extent:** With the exception of the north access road being

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	construction, operations, and closure from Pebble Project expansion would be similar to Alternative 1a for a given year. **Duration/Extent:** The Pebble Project expansion would result in similar duration and geographic extent of the air quality impacts described under Alternative 1a for a given year. However, with the mine and milling operations continuing for an additional 78 years, the minimal and localized air quality impact would continue until closure of the Pebble Project expansion. **Contribution:** Because the Pebble Project expansion would begin at the end of the operations phase of the project, overlapping activities between the project and the expansion leading to cumulative impacts would be largely limited to a small number of years when there are still emissions associated with the closure of the project and the expansion construction phase. During these limited years of overlap, the project would be ramping down and project emissions would be decreasing. At the same time, activities associated with the Pebble Project expansion would begin to increase over a period of years along with expansion emissions. Given the timing of the expansion and the proposed project, the potential for regional cumulative air quality impacts from the criteria pollutants and HAPs emissions would be minimal, and localized to the Pebble Project expansion activities. Because GHG emissions are long-term and globally transported in the atmosphere, GHG emissions from the project and RFFAs would have a global extent, and cumulatively would contribute to 0.006 percent of additional global GHG emissions.	the Alternative 1 and Alternative 3 corridors. **Contribution:** Similar to Alternative 1a.	**Duration/Extent:** The duration and extent of cumulative impacts to air quality would be similar to Alternative 1a but would not involve continued operation of the Amakdedori port and south access road. **Contribution:** Similar to Alternative 1a.	constructed, the duration and extent of cumulative impacts to air quality would be similar to Alternative 1a. **Contribution:** Similar to Alternative 1a.

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Other Mineral Exploration Projects	In addition to the Pebble Project expansion scenario, activities for other mineral exploration projects include mining exploration activities, including additional borehole drilling, road and mine construction, and development of temporary camp facilities. The proposed Donlin Gold Mine would be situated roughly 175 miles northwest of the Pebble Project expansion scenario. In general, RFFAs associated with mineral development are too far away to influence regional cumulative air quality impacts. **Magnitude:** Mineral exploration activities would result in minimal changes to air quality because of their small scale and seasonal basis. The increase of air emissions from any individual project would only result in localized impacts. Regional impacts in the vicinity of the project would be minimal, and local to the mineral RFFAs themselves. **Duration/Extent:** Impacts from these RFFAs would continue until activities cease, and would be local in extent. Exploration activities typically occur at a discrete location for one season, although a multi-year program could expand the geographic area affected for a specific mineral prospect (see Section 4.1, Introduction to Environmental Consequences, Table 4.1-1, which identifies seven mineral prospects in the analysis area where exploratory drilling is anticipated [four are less than 25 miles from the project]). **Contribution:** Given the distance between the mineral RFFAs and the project components and that the majority of the mineral RFFAs are only foreseeable for exploration, the potential for regional cumulative air quality impacts would be minimal. Even when combined with the RFFAs in	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	Table 4.1-1, emissions from the Donlin Gold Mine project would be too dispersed to result in cumulative effects on air quality. The regional cumulative impacts from the criteria pollutants and HAPs emissions in the vicinity of the project would be minimal, and local to the RFFAs themselves. Because GHG emissions are long-term and globally transported in the atmosphere, GHG emissions from the project and RFFAs would have a global extent, and would cumulatively contribute to 0.006 percent of additional global GHG emissions.			
Oil and Gas Exploration and Development	Onshore oil and gas exploration activities could involve road and pad construction, temporary camps, and in some cases exploratory drilling. The nearest portions of both the proposed Alaska LNG facility and ASAP project would be roughly 140 miles east of the Pebble mine site. Decommissioning of the Drift River terminal facilities would occur approximately 100 miles north of the Pebble Project, over the course of a couple of seasons, and could be completed prior to construction of the project. The proposed Hilcorp Seaview exploration and production site is well over 100 miles east of the Pebble mine site. **Magnitude:** The impacts to air quality would be temporary, and local to the RFFAs themselves. Offshore exploration in Cook Inlet would involve similar exploration activities; and if promising, exploratory drilling. The increase of air emissions from any individual project would only result in localized impacts, and would be unlikely to interact cumulatively on a regional scale. **Duration/Extent:** The impacts from these RFFAs would continue until activities cease, and would be localized in extent. Seismic exploration	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	and exploratory drilling are typically single season temporary activities. They could occur in the analysis area, but based on historic activity, would not be expected to be intensive. Construction of either the Alaska LNG or ASAP project would last approximately 4 years, with a shorter period of activity in the Cook Inlet area. Pipeline operations and any associated LNG export activities would be long-term and potentially coincide with Pebble Project expansion activities. Potential contributions to air quality impacts from decommissioning Drift River facilities would be temporary and limited to the vicinity of decommissioning activities. **Contribution:** Oil and gas exploration and development activities would occur regionally, but would be distant from the project. Even when combined with the RFFAs in Section 4.1, Introduction to Environmental Consequences, Table 4.1-1, the projects are too far away and emissions are too dispersed to result in cumulative effects on air quality. An example of this is the Hilcorp Seaview exploration and production site, more than 100 miles from the Pebble mine site, and too far away to be considered important to a cumulative impact analysis. The regional cumulative impacts from the criteria pollutants and HAPs emissions in the vicinity of the RFFAs would be minimal, and local to the RFFAs themselves. Because GHG emissions are long-term and globally transported in the atmosphere, GHG emissions from the project and RFFAs would have a global extent but would cumulatively contribute to 0.006 percent of additional global GHG emissions.			

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Road Improvement and Community Development Projects	Road improvements projects would take place in the vicinity of communities and have air quality impacts through construction activities and vehicle operations. Communities in the immediate vicinity of project facilities, such as Iliamna, Newhalen, and Kokhanok, would have the greatest contribution to cumulative effects. Some limited road upgrades could also occur in the vicinity of the natural gas pipeline starting point near Stariski Creek, or in support of mineral exploration previously discussed. Expansion of the Diamond Point Rock Quarry has the potential to increase air emissions in the analysis area. The estimated area that would be affected is approximately 140 acres (ADNR 2014a). **Magnitude:** The increase of air emissions from any individual project would only result in localized minimal impacts. **Duration/Extent:** Disturbance from road construction would typically occur over a single construction season. Geographic extent would be limited to the vicinity of communities and Diamond Point. **Contribution:** Road construction and other community improvement projects would occur in the analysis area. Even when combined with the RFFAs mentioned in Section 4.1, Introduction to Environmental Consequences, Table 4.1-1, the projects are too dispersed to result in cumulative effects on air quality. The regional and cumulative impacts from the criteria pollutants and HAPs emissions in the vicinity of the project would be minimal and local to the RFFAs themselves. Because GHG emissions are long-term and globally transported in the atmosphere,	Similar to Alternative 1a.	Cumulative impacts to air quality would likely be slightly less under Alternative 2 relative to Alternative 1a because of commonly shared project footprints with the quarry site at Diamond Point.	Cumulative impacts to air quality would likely be slightly less under Alternative 3 relative to Alternative 1a because of proximity to the quarry site at Diamond Point.

Table 4.20-2 Contribution to Cumulative Effects on Air Quality

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	GHG emissions from the project and RFFAs would have a global extent and would cumulatively contribute to 0.006 percent of additional global GHG emissions.			
Summary of Project Contribution to Cumulative Effects	Emissions from the project and RFFAs contribute to cumulative effects on air quality degradation through emission of criteria pollutants, HAPs, and GHGs. The project and RFFAs would have to comply with federal and state air quality standards. Overall, the cumulative impacts to air quality from the project, and RFFAs, would be expected to increase air emissions, including GHGs, in the region and the state. The increase of air emissions may result in minimal and localized cumulative impacts. In addition, because GHG emissions are long-term and globally transported in the atmosphere, GHG emissions from the project and RFFAs would have a global extent and would cumulatively contribute to 0.006 percent of additional global GHG emissions.	Similar to Alternative 1a. The increase of air emissions from the project and RFFAs may result in minimal and localized cumulative impacts.	Similar to Alternative 1a. The increase of air emissions from the project and RFFAs may result in minimal and localized cumulative impacts.	Similar to Alternative 1a. The increase of air emissions from the project and RFFAs may result in minimal and localized cumulative impacts.

Notes:
GHG = greenhouse gas
HAPs = hazardous air pollutants
LNG = Liquefied Natural Gas
RFFA = reasonably foreseeable future action