4.10 HEALTH AND SAFETY

The evaluation of impacts on human health and safety is a component of the National Environmental Policy Act (NEPA) as it pertains to negative and beneficial consequences of a project on potentially affected communities. There are federal and state laws and regulations, such as the Clean Air Act, Clean Water Act, and various Alaska statutes that have been enacted to ensure protection of human health. Compliance with these laws and regulations is taken into consideration in the evaluation of health and safety impacts in an integrated manner; and in a more singular, medium-specific manner in individual sections such as Section 4.20, Air Quality; and Section 4.18, Water and Sediment Quality.

The health and safety evaluation identifies and ranks the project-related positive (beneficial) and negative (adverse) health and safety consequences for the project and alternatives. Health and safety are related and complementary concepts. In the context of evaluating the impacts of a project, "health" is broadly considered to represent a state of physical and mental well-being of communities; while "safety" is more narrowly interpreted as engineering design, operation, and handling of project infrastructure, equipment, and materials in a manner that seeks to reduce hazards and prevent the occurrence of incidents and accidents (IFC 2007). It is also important to note that regulatory programs, agencies, and compliance procedures may be overlapping or very different for the health versus the safety aspects of a project. For example, the Occupational Safety and Health Administration (OSHA) regulations cover health and safety only for workers employed by the project that would have received required and applicable health and safety training by a competent and qualified person. OSHA would not cover untrained workers outside and not employed by the project or the general public.

Scoping comments expressed that the Environmental Impact Statement (EIS) consider or include a Health Risk Assessment or Health Impact Assessment (HIA) to determine the direct, indirect, and cumulative impacts to health; public health concerns related to infrastructure development in rural communities; cancer and non-cancer health effects associated with air toxins and identification of sensitive receptor populations that may be exposed to these emissions; increased risks of accidents and injuries; exposure to hazardous materials; impacts on food nutrition and subsistence (real or perceived); increased potential for infectious diseases, risks to health and human services from population-stressed infrastructure and services; and social and psychological impacts.

This section presents the health and safety evaluation completed for the project for potentially affected communities "outside the fence," a discussion on safety for project workers "inside the fence," and cumulative effects. The detailed health and safety evaluation for potentially affected communities is provided in Appendix K4.10. In this section and Appendix K4.10, health is described in a manner that is consistent with the State of Alaska's guidelines for Health Impact Assessment (ADHSS 2015); safety is discussed in the context of relevant regulatory requirements under OSHA, the Mine Safety and Health Act (MSHA), and other types of hazard assessment and prevention.

4.10.1 Summary of Key Issues

Table 4.10-1 presents a summary of key issues, which includes Health Effect Categories (HECs) that received a ranking of Category 2 or greater.

Table 4.10-1: Summary of Key Issues for Health and Safety

Impact-Causing Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
All Project Components	Increase in household incomes, employment, and education attainment (+ Category 3 during construction and operations). Decrease in food cost relative to income (+ Category 2).	Same as Alternative 1a. The Summer-Only Ferry Operations Variant would lower the cost of living and increase employment opportunities, but not by as much as Alternative 1a and Alternative 1 because of seasonal versus year-round employment.	Same as Alternative 1a. The Summer-Only Ferry Operations Variant under Alternative 2 would be the same as Alternative 1 Summer-Only Ferry Operations Variant, although impacts would shift more towards Pedro Bay instead of Kokhanok.	Same as Alternative 1a. The Concentrate Pipeline Variant would have overall decreased employment.
	Increase and decrease in psychosocial stress (± Category 3 during construction and operations; ± Category 2 during closure). Increase and decrease in family stress and stability (± Category 2 during operations and closure). Increase and decrease in unintentional injury (e.g., falls, cuts, poisoning) (± Category 2). Increase and decrease in access to, quantity of, and quality of subsistence resources (± Category 2 to 3 depending on component and phase). Decrease or increase in food security (± Category 2). Increase or decrease in cancer, respiratory, and cardio-vascular morbidity and mortality rates due to change in diet, nutrition, and physical activity (± Category 2).			
	Decrease in household incomes, employment, and education attainment (- Category 2 during closure). Increase in intentional injury (suicide) (- Category 2). Increased risk of exposure to hazardous chemicals in abiotic media and to bioaccumulated chemicals in subsistence foods (- Category 2 during operations and closure, and during construction for mine site). Decreased access to healthcare and safety services due to emergency situations and overwhelming local and regional healthcare capacities (- Category 2).			
Transportation Corridor	Increase in unintentional accidents and injuries morbidity and mortality rates due to air, surface, and water transportation, particularly regarding winter access across Iliamna Lake from the ice-breaking ferry. Pebble Limited Partnership would put some measures in place to minimize impacts, such as trail marking and crossings.	Impacts would be similar to Alternative 1a for the port and port access road. The Kokhanok East Ferry Terminal Variant would include access to Sid Larson Bay without crossing the ferry route. The Summer-Only Ferry Operations Variant would eliminate the potential hazards to snowmachine winter lake crossings, but increase summer lake and road traffic (- Category 2).	Impacts would be similar to Alternative 1a, except that the routes and closest communities affected would be around Pedro Bay instead of Kokhanok. The Summer-Only Ferry Operations Variant could increase the likelihood of surface transportation accidents and injuries along Williamsport-Pile Bay Road from an increase in truck traffic if mitigation measures are not taken to meet the increased mine-related and public summer capacity (- Category 2).	Impacts would be similar to the other alternatives, except that the elimination of the ferry on Iliamna Lake would shift project-related transportation impacts to the area around Pedro Bay, rather than around Kokhanok. Impacts from the port at Diamond Point would be the same or similar to those as Amakdedori port. The Concentrate Pipeline Variant impacts would remain the same as under Alternative 1a because the effluent would be treated to meet Alaska water quality criteria prior to discharge (- Category 2).
Transportation Corridor and Natural Gas Pipeline	Increase in sexually transmitted infection rates (- Category 2 during construction) and in infectious (respiratory) disease morbidity and mortality rates (- Category 2 during construction).			

4.10.2 Health Impacts Methodology

The Alaska Department of Health and Social Services (ADHSS) defines health as "the reduction in mortality, morbidity and disability due to detectable disease or disorder and an increase in the perceived level of health" (ADHSS 2015). Because health is a multi-dimensional concept with physical, mental, and social aspects, the project may affect aspects of health at a localized or individual level, a community level, a regional level, or a statewide level, depending on the nature and extent of the effect. Potential impacts include:

- Potential for increases and/or decreases in household incomes, employment rates, education attainment, stress and family stability, food costs, food security, and access and quantity of subsistence resources
- Potential for increases and/or decreases of unintentional accidents and injuries, intentional injury (suicide rate), infectious diseases, and non-communicable and chronic diseases, as well as access to healthcare
- Potential for increases and/or decreases in illnesses or exacerbation of illnesses due to potential direct or indirect exposure to hazardous materials associated with the project

Human health impacts were evaluated in accordance with NEPA practice, and generally followed the ADHSS methodology. The terminology used for descriptions and rankings of health impacts in this section and Appendix K4.10 generally correspond to the terms and ratings used in the ADHSS HIA guidance. This guidance uses the concept of HECs. An HEC groups similar health effects so that they can be discussed and evaluated more easily and efficiently. A health effect can be a health outcome (e.g., a documented health event, such as a clinic visit, the birth of an infant, incidence of a disease) or a health determinant (a social, environmental, or economic reality that influences health outcomes, such as education level, income, or access to healthcare). By assessing both determinants and outcomes, an evaluation of health status, health needs, health impacts, and mitigation/monitoring recommendations (if warranted) can be developed that are based on a good understanding of the project and its connections with the affected communities.

A characteristic of this guidance is that the individual dimensions of health impacts (i.e., nature of health effect, duration, magnitude, extent, and likelihood) are each given their own descriptive terms for the estimated relative degree of occurrence and a final consolidated health impact rating for each health metric or HEC that is numerical (Category 1 through 4). The guidance suggests that impact ratings of 2 or higher may markedly increase or decrease illness and injury rates, and may warrant interventions, if negative (ADHSS 2015).

In accordance with NEPA practice and ADHSS (2015), the scope of the health and safety evaluation is limited to potentially affected communities "outside of the fence," (outside the mine site and other mine-related components, including material sites). Accordingly, the health and safety evaluation does not include a direct analysis of the anticipated workforce safety and health issues ("inside the fence"), because the project would be governed by the OSHA and MSHA regulations in the areas where project activities would occur. However, this evaluation does consider "crossover issues," such as health impacts where workers may be housed in work camps, or where workforce behaviors result in interactions/overlap with the affected communities. Additionally, the US Army Corps of Engineers cannot commit that the Pebble Limited Partnership (PLP) would comply with MSHA, OSHA, and other regulations.

The analysis of potential consequences to human health for the affected communities using ADHSS (2015) criteria is consistent with the principles of analysis in accordance with NEPA and uses four steps. The first step is to determine the impact score, which takes into consideration

four impact dimensions: severity of potential health effects (which can be positive or negative and considers the need for intervention if the impact is negative), duration, magnitude, and extent of the impact (Table 4.10-2). Each component of the impact dimension is assigned a score of 0, 1, 2, or 3 to derive the overall impact rating score.

Table 4.10-2: Step 1—Impact Dimensions

Step 1				
Impact Rating Score	**A—Health Effect (±)**	**B—Duration**	**C—Magnitude**	**D—Extent**
0	Effect is not perceptible	Less than 1 month	Minor	Individual cases
1	(±) minor benefits or risks to injury or illness patterns (no intervention needed)	Short-term: 1 to 12 months	Those impacted would: 1) be able to adapt to the impact with ease and maintain pre-impact level of health; or 2) see noticeable but limited and localized improvements to health conditions.	Local: small, limited impact to households
2	(±) moderate benefits or risks to illness or injury patterns (intervention needed, if negative)	Medium-term: 1 to 6 years	Those impacted would: 1) be able to adapt to the health impact with some difficulty, and would maintain pre-impact level of health with support; or 2) experience beneficial impacts to health for specific populations; some maintenance may still be required.	Entire Potentially Affected Communities; village level
3	(±) severe benefits or risks: marked change in mortality and morbidity patterns (intervention needed, if negative)	Long-term: more than 6 years/life of project and beyond	Those impacted would: 1) not be able to adapt to the health impact or to maintain pre-impact level of health; or 2) see noticeable major improvements in health and overall quality of life.	Extends beyond Potentially Affected Communities; regional and statewide levels

Source: ADHSS 2015

Next, the severity and likelihood of each type of impact is evaluated, and those ratings are used to develop an overall significance impact rating category of 1, 2, 3, or 4 (Table 4.10-3). Recommended actions for negative impacts are listed by category below:

- Category 1: Actions to reduce negative impacts are not needed.
- Category 2: Recommend that decision-makers assess whether actions to reduce negative impacts would be helpful for negative impacts.
- Category 3: Recommend that decision-makers develop and implement actions to reduce negative impacts.
- Category 4: Strongly recommend that decision-makers develop and implement actions to reduce negative impacts.

Table 4.10-3: Steps 2, 3, and 4—Likelihood and Overall Impact Ratings

Step 2	Step 3						
Impact Severity Level (Sum Scores from Step 1 to choose range)	Likelihood Rating						
	Extremely Unlikely (<1%)	Very Unlikely (1-10%)	Unlikely (10-33%)	About as likely as Not (33-66%)	Likely (66-90%)	Very Likely (90-99%)	Virtually Certain (>99%)
1 to 3	♦	♦	♦	♦	♦♦	♦♦	♦♦
4 to 6	♦	♦	♦	♦♦	♦♦	♦♦	♦♦♦
7 to 9	♦♦	♦♦	♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦♦
10 to 12	♦♦♦	♦♦♦	♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦
Step 4	**Impact Rating**						
	Category 1 = ♦	Category 2 = ♦♦	Category 3 = ♦♦♦	Category 4 = ♦♦♦♦			

Source: ADHSS 2015

For each alternative, the consequences of the project activities, both beneficial and adverse, are described with regard to relevant issues and concerns associated with the eight HECs described in the HIA guidance (ADHSS 2015) and Section 3.10, Health and Safety:

- **HEC 1: Social Determinants of Health**, evaluated potential impacts to household incomes, employment and education attainment, as well as potential impacts to psychosocial stress of individuals, and to family stress and stability.
- **HEC 2: Accidents and Unintentional Injuries**, covered potential impacts to rates of accidents and unintentional injuries (e.g., transportation accidents, falls, fires, drownings, food poisoning).
- **HEC 3: Exposure to Potentially Hazardous Materials**, evaluated the potential for increases and decreases in illness, or exacerbation of illnesses commonly associated with exposure to site-related chemicals of potential concern through inhalation, physical (dermal) contact, and direct or indirect ingestion (e.g., incidental soil ingestion or ingestion of impacted subsistence foods).
- **HEC 4: Food, Nutrition, and Subsistence Activity**, evaluated the potential impacts on food costs, food security, and impacts to access to and quantity of subsistence resources (real or perceived).
- **HEC 5: Infectious Diseases**, covered the potential impacts on rates of infectious diseases, including sexually transmitted infections, to the affected communities, as well as workers living at the on-site camp.
- **HEC 6: Water and Sanitation**, evaluated the potential impacts of increases in morbidity and mortality rates due to the availability and quality of water and sanitation services.
- **HEC 7: Non-Communicable and Chronic Diseases**, covered the potential impacts of increases in non-communicable and chronic morbidity, as well as mortality rates (e.g., cancer, cardiovascular, and respiratory).
- **HEC 8: Health Services and Infrastructure and Capacity**, evaluated the potential impacts on access to routine healthcare, as well as potential impacts to healthcare from large-scale emergency situations and overwhelming local and regional healthcare capacities.

The health and safety evaluation performed for the project falls between a “desktop” HIA (qualitative and brief assessment) and a “rapid appraisal” HIA (more in-depth than desktop) as defined in the HIA guidance (ADHSS 2015), using available or accessible health information, limited stakeholder engagement, and key informant information, but without conducting new field surveys. Although all project components (mine, transportation corridor, port, and natural gas pipeline) were considered, the project was primarily analyzed as a whole because effects could not be attributed to a single component (there was overlap of affected communities for multiple components). Finally, the health consequences are summarized by HEC for each alternative as a whole, and expressed as Category 1, 2, 3, or 4. ADHSS does not provide narrative descriptions for these numeric impact category rankings, and only suggests that they be used to propose recommendations for actions. Appendix K4.10 presents the detailed health and safety evaluation “outside the fence” for the potentially affected communities and worker crossover issues with discussion of consequences per HEC, as well as associated uncertainties.

For the purposes of this evaluation, the EIS analysis area is defined as an area that may be affected by physical releases to the environment from project-related activities, or changes in economic, subsistence, and health resources and activities. Overall, it includes eight communities in the Lake and Peninsula Borough (LPB), seven communities in the Dillingham Census Area, three communities in the Kenai Peninsula Borough, two communities in Bristol Bay, as well as the surrounding regions and the Municipality of Anchorage. Not all communities are assessed for all health effects because some effects may be more relevant to some communities than others. A complete listing of the communities in the EIS analysis area, and the HECs for which they are evaluated, is provided in Section 3.10, Health and Safety.

4.10.3 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, 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.

The purpose of the health and safety evaluation is to assess the impacts of the project and its alternatives against baseline conditions, as represented by the No Action Alternative. The current baseline condition is assumed as a reasonable proxy to qualitatively evaluate the future in the No Action Alternative. As a result, no quantitative discussion (i.e., rating) is presented for this alternative. Although there may be some uncertainty associated with the many factors and variables that could impact the health of communities in the EIS analysis area in the future, current trends can be assumed to continue in the absence of the project.

The No Action Alternative would have direct impacts related to the PLP exploration activities, as discussed in Section 4.3, Needs and Welfare of the People–Socioeconomics. PLP exploration-

related employment and income, which were realized in the Bristol Bay region over the previous decade, have ceased. The PLP employed around 100 to 150 local community members annually at the site during the pre-development phase of the project, which ended in 2012 (Loeffler and Schmidt 2017). Since then, PLP has had a minimal number of workers at the site for exploration and maintenance activities. The exploratory phase of the project revealed that the income earned by residents employed by the project was an important part of the total income earned in local communities, especially those communities close to the mine site; and the income earned by residents close to the mine was greater than the income earned for commercial fishing, indicating that even the limited employment during the exploratory phase had large impacts on the communities. In communities that were further from the mine site, commercial fishing was a larger part of total income. Overall, the current number of direct and indirect jobs would remain roughly the same, and there would be no impact to the regional economy.

Human health impacts associated with the loss of employment opportunities (and subsequent decrease in median household income) primarily concern potential impacts on social determinants of health (SDH) (e.g., income, psychosocial stress, substance abuse, violent crime, and family stress and stability). Changes in SDH, if any, would be relatively small in magnitude, relative to the baseline, and would largely be confined to the communities closest to the mine site (Nondalton, Iliamna, and Newhalen). There would be no impact to more distant communities in the lower Bristol Bay watershed, such as Dillingham, other than removing uncertainty about the fate of this project. Other health factors would likely be similar to current conditions (baseline), such as potential rates of accidents and injuries, communicable and non-communicable diseases, exposure to hazardous constituents, and access to healthcare services.

Health impacts from the No Action Alternative would not be perceptible, or those impacted would be able to adapt to the impact with ease and not require medical intervention. Direct effects would be largely similar to baseline levels of health. Current health conditions and trends, as described in Section 3.10, Health and Safety, would continue in the EIS analysis area.

4.10.4 Alternative 1a

This section presents the environmental consequences to health and safety for Alternative 1a. The health and safety evaluation includes potential impacts (both beneficial and adverse) to the affected communities from the project during all three phases (construction, operation, and closure). The communities potentially affected by the project range from small, remote rural communities to larger regional and urban centers, as discussed in Section 3.10, Health and Safety. The eight communities identified in the LPB would be most closely affected by multiple project components. In addition, three Nushagak/Bristol Bay communities in the Dillingham Census Area were also identified as potentially affected by project components. As noted in Section 4.3, Needs and Welfare of the People—Socioeconomics, the Kenai Peninsula Borough and Anchorage would also be potentially affected economically by all components of the project, but at a relatively minor level due to their larger populations. In addition, more communities have been identified as using the EIS analysis area for subsistence; therefore, these communities could also be potentially affected by all of the components of the project (see Section 3.9, Subsistence). The consequences for all project components would be expected to be more noticeable in smaller, rural communities, and less perceptible in Anchorage.

A summary of the impact ratings for the HECs under Alternative 1a is presented in Table 4.10-4. Human health impacts resulting from Alternative 1a would be more noticeable in smaller, rural communities and less perceptible in the Municipality of Anchorage, as discussed in Section 3.3, Needs and Welfare of the People—Socioeconomics; and Section 4.4, Environmental Justice. Appendix K4.10 presents the detailed discussion of consequences per HEC, as well as associated uncertainties.

Table 4.10-4: Summary of Alternative 1a Impact Levels by HEC

Health Effects Categories[1]	Summary Impact Category	Beneficial (+)or Adverse (-) Rating
HEC 1: Social Determinants of Health		
Increase in household incomes, employment, and education attainment	2 to 3	±
Psychosocial stress (substance abuse, crime, mental health, and suicide)	2 to 3	±
Family stress and instability	1 to 2	±
HEC 2: Accidents and Injuries		
Increase in unintentional accidents and injuries, morbidity, and mortality rates due to transportation/navigation	2	-
Increase in other unintentional injury (falls, poisoning, etc.)	2	±
Increase in Intentional Injury (suicide rate)	2	-
HEC 3: Exposure to Potentially Hazardous Materials		
Air quality impacts	1 to 2	-
Surface water and sediment impacts	1 to 2	-
Groundwater impacts	1 to 2	-
Soil impacts	1 to 2	-
Bioaccumulated chemicals in subsistence foods	1 to 2	-
HEC 4: Food, Nutrition, and Subsistence Activity		
Decrease in food costs relative to income	2	+
Access to and quantity of subsistence resources	2 to 3	±
Decrease or increase in food security	2	±
HEC 5: Infectious Disease		
Increase in rates of sexually transmitted infections (gonorrhea, chlamydia, etc.)	1 to 2	-
Increase in rates of respiratory disease morbidity and mortality (influenza, pneumonia, etc.)	1 to 2	-
Increase in rates of foodborne illness and zoonotic disease	1	-
HEC 6: Water and Sanitation		
Increase in morbidity and mortality rates due to the availability and quality of water and sanitation facilities	1	-
HEC 7: Non-communicable and Chronic Disease		
Increase or decrease in cancer, respiratory, and cardiovascular morbidity rates due to changes in diet, nutrition, and physical activity	2	±
Increase in cancer, respiratory, and cardiovascular morbidity and mortality rates due to exposure from hazardous chemicals	1	-
HEC 8: Healthcare and Safety Services Infrastructure and Capacity		
Access to routine healthcare and safety services	1	±
Access to healthcare and safety services due to large-scale emergency situations and overwhelming local and regional capacities	2	-

Note:
HEC = Health Effect Category

This section does not independently evaluate the human health impacts from potential spills or failures because evaluations of potential impacts are provided in Section 4.27, Spill Risk. The potential health impacts from exposure to chemicals due to a spill or failure are of low likelihood, and are typically short-term, acute exposures, but may also lead to chronic exposure, depending on the nature, duration, migration testing, and monitoring of the spill. The following text summarizes the health and safety evaluation included in Section 4.27, Spill Risk. Hypothetical spills of diesel fuel, natural gas, copper-gold ore concentrate, chemical reagents, bulk and pyritic tailings, and untreated contact water are assessed using estimates of release rates, volume, and likelihood of occurrence, based on their spill potential and potential spill consequences (see Section 4.27, Spill Risk). Project design features, Standard Permit Conditions, and best management practices would be implemented for reducing impacts from potential spills (see Chapter 5, Mitigation). Health impacts related to spills may include psychosocial stress and anxiety regarding the possible or actual occurrence of spills; potential temporary releases of hazardous chemicals to air, water, and soil; and possible exposures to chemicals by subsistence resources that are ultimately consumed by humans. Planned and recommended measures to address these potential impacts include prompt measures for spill containment, rapid community outreach and notifications, and testing and monitoring of environmental media such as air, water, and subsistence food resources. Additional details are provided in Section 4.27, Spill Risk.

Overall, the economic and health benefits of improvements in economic status are expected to be substantial for the residents of the affected communities. Project-related economic benefits are rated Category 3 (construction and operations phases), and would be expected to result in benefits to many supplementary aspects of human health and well-being of residents, including increased income, employment, and educational attainment due to increased income. Economic benefits would likely have positive effects on helping to stem the current trend of out-migration, increasing or maintaining the number of schools in the region, and other indirect economic benefits (e.g., taxes, sales/revenue, and other fiscal effects to the regional and local communities). The benefits would be more apparent in the small, rural communities closest to the mine site (LPB communities), where even small changes in their economies could have a measurable impact on their overall health and well-being. Impacts on psychosocial stress (construction and operations); and access to, quantity of, and quality of subsistence resources (mine site construction and operations for all components) were rated Category 3 for both positive and negative effects.

Benefits that are rated as Category 2 include reduced food costs relative to income for those members of the community who would realize economic benefits from the project. Negative health consequences rated as Category 2 may be related to cessation of economic benefits (at mine closure) due to job losses and decreased income; potential transportation-related accidents and injuries for all phases (due to accidents by air, water, and surface transportation); intentional injuries (suicide); increased risk of exposure to potentially hazardous chemicals in the air, soil, surface water, groundwater, and bioaccumulated[1] in subsistence foods (during operations and closure); increase in sexually transmitted infections (during construction); decreased access to healthcare in emergency situations if adequate project emergency planning and periodic monitoring of the adequacy of emergency preparedness services is not maintained, and increased infectious (respiratory) diseases rates (during transportation infrastructure and pipeline construction) from proximity and likely increased interaction with the affected communities. Impacts on psychosocial stress (at mine closure); family stress and stability (during operations and closure); other unintentional injuries (e.g., falls, poisoning); access to, quantity of, and quality of subsistence resources; food security; and impacts on rates of non-communicable diseases due

[1] Bioaccumulation is the accumulation over time of a substance, and especially a contaminant (such as a pesticide or heavy metal), in a living organism.

to changes in diet, nutrition, and activity are also rated Category 2 for both positive and negative effects. Intentional injuries are rated as Category 2, primarily because of the severity of the consequence, although it is considered very unlikely to occur, relative to baseline conditions. Other potential impacts were rated Category 1.

Alternative 1a, as a whole, is rated as a Category 2 for both adverse and beneficial potential impacts. These effects determinations take into account the implementation of impact-reducing design features proposed by PLP, and also the Standard Permit Conditions and best management practices that would be implemented (see Chapter 5, Mitigation).

4.10.4.1 Safety

Safety requirements are a condition of obtaining regulatory permits and approvals to construct, operate, and close the project. Safety issues are typically addressed under state and federal regulatory programs designed to ensure physical safety pertaining to engineering design and structural integrity of the project components and infrastructure and safe storage, use, transportation, and disposal of materials, product, and waste streams. It also includes operational safety for workers, and the safety of visitors to the facility and the general public in the vicinity.

The project would be governed by relevant safety regulations in the areas where project activities would occur (all project components). For this project, relevant safety requirements would be followed and compliance would be achieved with the regulations of the MSHA, OSHA, Alaska Department of Transportation and Public Facilities (ADOT&PF), and other relevant regulatory programs. The project would provide safety training for all employees by a competent and qualified person, and health and safety plans would be developed, implemented, and followed to address worker exposures and safety. No subsistence, recreational, or transportation access would be allowed beyond the mine site safety boundary. The boundary would be reduced during the post-closure phase of the project.

As noted earlier, potential project impacts to the safety of the potentially affected communities “outside the fence” were included with the health and safety evaluation in Appendix K4.10 (e.g., impacts to transportation health and safety under HEC 2, and health and safety services under HEC 8).

Pipeline Reliability and Safety

The pipeline and related appurtenances would be designed, constructed, and operated in accordance with the applicable requirements of 49 Code of Federal Regulations Part 192 for subsurface pipelines. PLP would incorporate pig launching and receiving facilities (receipt, midpoint, and delivery site), main line valves, cathodic protection, leak detection, external coating, and supervisory control into the pipeline system. Periodic inspections of the pipeline facilities would be conducted to verify site security.

If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, PLP would have to reduce the maximum allowable operating pressure or replace the segment with pipe of sufficient grade and wall thickness, if required, to comply with the US Department of Transportation code of regulations for the new class location.

Although pipeline wall thickness would comply with the requirements for the designated line class, additional measures may be required in areas where geotechnical hazards are present unless a system-specific special permit was granted by the Pipeline and Hazardous Materials Safety Administration. Geotechnical hazards include areas prone to thaw settlement, frost heave, and fault zones. The pipeline would be designed to withstand the stress that could occur during a seismic event, including liquefaction. Similarly, a greater wall thickness may be required for pipe

that would be laid in areas requiring additional strength during pressure testing because of large elevation changes or requiring buoyancy control in wetlands.

There is a low likelihood of pipe damage from liquefaction, and there would be no active fault crossing effects.

4.10.5 Alternative 1

Impacts from the project would be the same as or similar to Alternative 1a with few exceptions. The area of Iliamna Lake used for the ferry would be different and the route would be slightly shorter, because the ferry would travel to the north ferry terminal instead of the Eagle Bay ferry terminal. The mine access road alignment would route from the north ferry terminal to the mine site, with a spur road to Iliamna, and the port access road would be the same as Alternative 1a. This alternative's natural gas pipeline alignment would follow the transportation corridor for its entirety, and have a slightly shorter route across Iliamna Lake; however, impacts would be the same as Alternative 1a. Impacts from the Amakdedori port would be the same as Alternative 1a. Socioeconomic impacts under this Alternative would be similar to impacts under Alternative 1a.

The HEC for which Alternative 1 consequences may be slightly different from Alternative 1a is HEC 2: Accidents and Injuries due to transportation because the mine access road alignment is different, including a slightly shorter ferry route and pipeline crossing of Iliamna Lake. However, even given the slight differences noted above, the overall transportation operational aspects would be the same or similar (i.e., number of trucks, year-round operation, similar use of roads/ crossings, and similar distance to communities); therefore, the transportation-related accidents and injury summary impact to human health would remain the same, and would be Category 2 for all phases and transportation types (see Appendix K4.10).

Alternative 1 would have the same impacts to safety as Alternative 1a.

4.10.5.1 Alternative 1—Kokhanok East Ferry Terminal Variant

Under this variant, the creation of an alternate winter travel route along the Kokhanok east spur road with an access point to the lake east of the terminal would mitigate impacts from the ice-breaking ferry, but may add travel time, distance, and fuel costs. Navigation on Iliamna Lake at the Kokhanok east ferry terminal site would be more sheltered from wind and waves, but would contain more navigational hazards such as shallow water and a longer ferry route (HEC 2).

Despite these differences, the Kokhanok East Ferry Terminal Variant would have the same overall impact levels by HEC as described above in Alternative 1 for health and safety impacts.

4.10.5.2 Alternative 1—Summer-Only Ferry Operations Variant

The Summer-Only Ferry Operations Variant would lower the income earned by community members in the EIS analysis area. Overall, the high cost of living for the communities near the transportation corridor would still be lowered under this variant, but not to the extent of the proposed year-round ferry operations (HEC 1). There would not be an impact to winter transportation across the lake, eliminating those impacts (HEC 4). Truck and ferry trips would double in the summer, meaning winter snowmachine traffic across the lake would not be interrupted by an ice-breaking ferry, but vessels on the lake in the summer would experience double the ferry traffic (HEC 2).

Despite these differences, this variant would have the same overall impact levels by HEC as described above in Alternative 1 for health and safety impacts.

4.10.5.3 Alternative 1—Pile-Supported Dock Variant

The Pile-Supported Dock Variant would have the same impact levels by HEC as described above in Alternative 1 for health and safety impacts (see Appendix K4.10).

4.10.6 Alternative 2—North Road and Ferry

Impacts to health and safety from the project would be the same as or similar to Alternative 1a with few exceptions. The area of Iliamna Lake used for the ferry would be different, because it encompasses the areas at the northern end of the lake around Pedro Bay (as opposed to Kokhanok). This alternative's natural gas pipeline alignment would follow the north road alignment, and not cross Iliamna Lake; therefore, there would be no hazards or impacts at Iliamna Lake during construction of the pipeline, as would occur under Alternative 1a. Impacts from the port at Diamond Point port would be the same as or similar to those for Amakdedori port.

Overall, the HEC for which Alternative 2 consequences may be slightly different from Alternative 1a is HEC 2: Accidents and Injuries due to transportation. However, even given the differences noted above, the transportation-related accidents and injury summary impact to human health would remain the same, and would be Category 2 for all phases and transportation types (see Appendix K4.10).

Alternative 2 would have the same impacts to safety as Alternative 1a.

4.10.6.1 Alternative 2—Summer-Only Ferry Operations Variant

Under the Summer-Only Ferry Operations Variant, transportation impacts on the lake would be eliminated during the winter, but double during the summer. The likelihood of accidents and injuries for surface transportation may increase under this variant, because traffic on Williamsport-Pile Bay Road would include doubled mine-related summer traffic, and continuing or increasing levels of public boat portage. The potential for a greater likelihood of accidents would be reduced if the road was built to handle this increased summer capacity (HEC 2).

Despite these differences, this variant would have the same impact levels by HEC as described above in Alternative 2 for health and safety impacts.

4.10.6.2 Alternative 2—Pile-Supported Dock Variant

The Pile-Supported Dock Variant would have the same impact levels by HEC as described above in Alternative 2 for health and safety impacts.

4.10.6.3 Alternative 2—Newhalen River North Crossing Variant

The Newhalen River North Crossing Variant would have the same impact levels by HEC as described above in Alternative 2 for health and safety impacts.

4.10.7 Alternative 3—North Road Only

Impacts to health and safety from the project would be the same as or similar to Alternative 1a with few exceptions. The use of Iliamna Lake for a ferry would be eliminated, shifting project-related transportation impacts to the area around Pedro Bay, rather than around Kokhanok. Impacts from the port at Diamond Point would be the same as or similar to those for Amakdedori port. For the region as a whole, the impacts on the cost of living for Alternative 3 would be largely the same as the impacts of Alternative 1a, and would likely lower the high cost of living for the communities near the transportation corridor, similar to Alternative 2. However, because of the different alignments of the transportation corridor and natural gas pipeline, Kokhanok would likely

experience less of a benefit, while Pedro Bay would likely experience more of a benefit over the long term.

Similar to Alternative 2, the HEC for which Alternative 3 consequences may be slightly different from other alternatives is HEC 2: Accidents and Injuries due to transportation. However, even given the differences noted above, the transportation-related accidents and injury summary impact to human health would remain the same, and would be Category 2 for all phases and transportation types (see Appendix K4.10).

Alternative 3 would have the same impacts to safety as Alternative 1a.

4.10.7.1 Alternative 3—Concentrate Pipeline Variant

The Concentrate Pipeline Variant would build a concentrate slurry pipeline from the mine to the port, and include a dewatering and treatment plant at Diamond Point so that the slurry water could be discharged at the port, or returned to the mine site for reuse, by constructing a second pipeline. Potential hazardous materials impacts would remain the same as under Alternative 1a, because the effluent would be treated to meet the Alaska water quality criteria prior to discharge (HEC 3). This variant would likely decrease employment of truck operators and increase employment at the water treatment plant and dewatering facility, but with lower overall employment (HEC 1).

Despite these differences, this variant would have the same impact levels by HEC as described above in Alternative 3 for health and safety impacts.

4.10.8 Cumulative Effects

Impacts to health and safety would include those related to negative and beneficial consequences to human health. As described above, “health” is broadly considered to represent a state of physical and mental well-being of communities; while “safety” is more narrowly interpreted as engineering design, operation, and handling of project infrastructure, equipment, and materials in a manner that seeks to reduce hazards and prevent the occurrence of incidents and accidents (IFC 2007). The cumulative effects analysis area for Health and Safety encompasses the same area used for evaluation of direct and indirect effects. For the purposes of this evaluation, the EIS analysis area is defined as an area that may be affected by physical releases to the environment from project-related activities, or changes in economic, subsistence, and health resources and activities. Overall, it includes eight communities in the LPB, seven communities in the Dillingham Census Area, three communities in the Kenai Peninsula Borough, two communities in Bristol Bay, as well as the surrounding regions and the Municipality of Anchorage. Not all communities are assessed for all health effects, because some effects may be more relevant to some communities than others. A complete listing of the communities in the EIS analysis area and the HECs evaluated is provided in Section 3.10, Health and Safety.

Potential cumulative impacts to health and safety include impacts to transportation (e.g., increase in Cook Inlet and Iliamna Lake vessel traffic, Williamsport-Pile Bay Road), water and soil quality (e.g., other sources of contamination), socioeconomics (e.g., increased household income from other employment opportunities), and subsistence (e.g., real or perceived impacts on cultural resources and disturbance of wildlife). In addition, based on these categories, there would be contributions to cumulative psychosocial stress at the family, community, and regional levels from concerns about additional development activities.

Past, present, and reasonably foreseeable future actions (RFFAs) in the cumulative impact study area have the potential to contribute cumulatively to impacts on health and safety. These potential future actions are similar to the proposed alternatives in that each may result in direct and indirect effects to the project-affected communities. To varying degrees, all the RFFAs identified in

Section 4.1, Introduction to Environmental Consequences, have the potential to impact cumulative health and safety.

4.10.8.1 Past and Present Actions

Past and present actions have contributed to the current state of baseline health status in the affected communities. They have the most noticeable impacts affecting health and safety in the areas relating to socioeconomics, subsistence, and transportation. Past and present actions that have contributed to the existing socioeconomic conditions of potentially affected communities include natural resource extraction, commercial and subsistence fishing activities, commercial recreation and tourism, community development and infrastructure, mining exploration activities, and the construction and operation of the Williamsport-Pile Bay Road, as discussed.

Commercial fishing has been the mainstay of the regional economy, although there are geographic differences in the distribution of benefits. These benefits and associated psychosocial stress have varied over time based on factors such as run size and fish price. Subsistence is a cultural and economic foundation of the region and its communities, and has seen cycles in availability of and access to resources, which results in beneficial and adverse health impacts. Community and transportation improvements have improved the quality of life through increased access to education and social services, and lowering the cost of living to a degree. Construction of the Williamsport-Pile Bay Road has decreased the cost of transported goods for some communities such as Pedro Bay, and facilitated transport of commercial and personal goods from Cook Inlet into the region. Mineral exploration has provided seasonal employment opportunities, but also created aircraft and ground noise, and restricted access to subsistence resources on a site-specific basis. Concerns regarding development of mineral resources in the Bristol Bay watershed, and potential impacts on environment, commercial fishing, and subsistence, have created a substantial amount of discussion and psychosocial stress. At the same time, the limited number of jobs and economic opportunities, particularly in Iliamna Lake communities, has contributed to outmigration, population declines, and closing of some local schools. This also contributes to the psychosocial stress in the region.

Finally, past and present actions may be perceived to have the potential to add to the cumulative health impacts relating to exposure to hazardous materials for nearby communities. However, pre-existing contaminated sites are relatively limited and under regulatory oversight, as are contaminants associated with mining exploration activities. Therefore, the potential for hazardous chemicals–related impacts to affected communities is expected to be low.

4.10.8.2 Reasonably Foreseeable Future Actions

RFFAs in the EIS analysis area closest to the project have the greatest potential to impact health and safety to the aforementioned affected communities, discussed below in Table 4.10-5.

The No Action Alternative would not contribute to cumulative effects on the regional and state economy, infrastructure, cost of living, and population characteristics; nor would it contribute to cumulative effects associated with changes to resource availability, access to resources, or competition for subsistence resources. Although there may be fewer local employment opportunities associated with future exploration of the Pebble Project, exploration activities could continue at a reduced level, and result in less income to support households and subsistence activities and maintain the current level of health. However, these could be offset by exploration of other nearby mineral deposits. The No Action Alternative would not contribute to cumulative effects on community health.

Collectively, the project alternatives and the RFFAs that contribute to cumulative effects on health and safety are summarized in Table 4.10-5.

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Pebble Project expansion scenario	**Mine Site:** Pebble Project expansion scenario would extend the life of the project to 78 years to recover more of the estimated reserves. The following evaluation is limited to generalized impacts of the buildout scenario. The scenario would increase the geographic area affected by the project by combining project elements of Alternatives 1 and 3. Under Alternative 1a, project expansion would continue to use the existing natural gas pipeline; and would construct an access road and concentrate/diesel pipelines to a new port at Iniskin Bay. This has the potential to impact the cumulative impacts to subsistence resource availability, and access to resources, competition, and sociocultural dimensions of subsistence, as discussed in Section 4.9, Subsistence. It would also have the potential to result in increased health impacts over this larger geographic area, especially from increased duration of impacts, and possibly increased releases and affected community exposure to potentially hazardous materials. The health impacts of the expanded development would likely not only affect the four HECs considered most relevant to Alternative 1a (SDH, Accidents and Injuries, Exposure to Hazardous Materials, Diet/Nutrition/Subsistence), but could also result in impacts to the remaining HECs (Water and Sanitation, Infectious Diseases, Noncommunicable Diseases, and Healthcare Infrastructure). Direct exposure of the affected communities to hazardous materials may not be noticeably altered by the expansion scenario if the cumulative magnitude of all emissions and releases to air, soil, and water are less than the appropriate screening levels for human health	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** Similar to Alternative 1a, except that the portion of the access road from the north ferry terminal to the existing Iliamna area road system would not already be constructed. The north access road and concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment and extended to a new deepwater port site at Iniskin Bay. **Magnitude:** The magnitude would be similar to that under Alternative 1a. **Duration/Extent:** The duration/extent of cumulative impacts to health and safety would be similar to those under Alternative 1a, although they would affect a larger area. **Contribution:** The contribution to cumulative effects would be slightly more than that under Alternative 1a, Alternative 2, and Alternative 3.	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** Similar to Alternative 1a. Concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment and extended to a new deepwater port site at Iniskin Bay. **Magnitude:** Expanded mine site development and associated contributions to cumulative health, and contributing factors such as socioeconomics, subsistence, and transportation and navigation impacts to the region, would be similar to but less than those under Alternative 1a in magnitude. Under Alternative 2, project expansion would continue to use the existing Diamond Point port facility; would use the same natural gas pipeline; and would connect the access road between ferry terminals, and build the concentrate and diesel pipelines to a new port in Iniskin Bay. Cumulative impacts from Alternative 2, combined with the Pebble Project expanded development scenario, would likely result in tradeoffs regarding local employment	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** Overall 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. **Magnitude:** Expanded mine site development and associated contributions to cumulative health, and contributing factors such as socioeconomics, subsistence, and transportation and navigation impacts, would be similar to those under the other alternatives. Because the Pebble Project expanded development scenario would use the north access road system that would already be built under Alternative 3 and not include any ferry operations, cumulative impacts from Alternative 3, combined with the expanded development scenario would likely result in tradeoffs regarding local employment opportunities compared to Alternative 1a; negative impacts to subsistence resource availability and

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	(refer to Section 4.14, Soils; Section 4.18, Water and Sediment Quality; and Section 4.20, Air Quality). Project area communities with pre-existing industrial pollutants and contaminated sites have the potential to add to the cumulative health impacts from exposure to potentially hazardous materials in communities where PLP proposes construction and operations support activities. If the Pebble Project expanded development scenario were pursued, a separate EIS would be required, which may include mitigation measures expected to minimize or mitigate exposure because it would include common BMPs and industry standards that are designed to reduce impacts to the environment. In addition, PLP would be required to operate the mine in compliance with all federal, state, and local requirements, including all mitigation and monitoring requirements identified through the NEPA and permitting processes. The cumulative impacts would be long term over extended operations and decrease in magnitude as closure is implemented. **Other Facilities:** A north access road and concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment to a new deepwater port site at Iniskin Bay. The road additions and improvements would increase both the area of disturbance and availability of local access for subsistence resources (see Section 4.9, Subsistence), which in turn affect associated diet and nutrition trends, as well as cultural identity and mental health. However, continued exposure of wild foods that might be exposed to bioaccumulative metals from project activities could increase human exposure to hazardous chemicals in the long term, and may		opportunities compared to Alternative 1a; but negative impacts to subsistence resource availability, access to resources, and competition for resources would be of lesser magnitude than those under Alternative 1a (see Section 4.3, Needs and Welfare of the People–Socioeconomics; Section 4.9, Subsistence; and Section 4.12, Transportation and Navigation). Under this scenario, Kokhanok would not experience positive effects associated with a road connection to Cook Inlet. **Duration/Extent:** The duration/extent of cumulative impacts to health and safety would be similar to those under Alternative 1a, although to an extent affecting a smaller amount of acreage because the Amakdedori port and connecting transportation infrastructure would not be built. **Contribution:** The contribution to cumulative impacts would be similar to that under Alternative 1a, without the potential effects associated with operating two road access corridors.	access to resources would be less than those under the other alternatives (see Section 4.9, Subsistence). Cumulative tax generation and cost-of-living benefits would be similar to those under Alternative 2, because employment opportunities associated with truck traffic would be lower, and the facilities would not generate additional taxable income (Section 4.3, Needs and Welfare of the People–Socioeconomics). Impacts to health would be similar to those under the other alternatives. **Duration/Extent**: The duration/extent of cumulative impacts to health and safety would be similar to those under the other alternatives. **Contribution:** The contribution to cumulative impacts would be similar to that under the other alternatives.

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	benefit from surveys and monitoring efforts to confirm that exposures are limited. **Magnitude:** No major cumulative impacts would be expected for health-related impacts in the area of Water and Sanitation, Infectious Diseases, and Healthcare Infrastructure and Access as long as the expansion continued to ensure self-sufficient, on-site water supplies, worker housing, infectious disease education, treatment, training, and monitoring programs; and operated their own health clinics and healthcare facilities. Cumulative impacts on non-communicable diseases such as incidence of morbidity and mortality due to cancer, lifestyle behavioral factors (including mental health), and non-infectious non-cancer diseases might decrease further in those segments of the local population that enjoy long-term increases in income and quality of life, but may increase among those who may be excluded from project benefits, or whose lifestyles are altered in the direction of less activity or less nutritious diets, or perceive or experience negative impacts to their subsistence lifestyle and have increased concerns about exposure to project-related hazardous chemical exposure (to the environment, wildlife, and human population, including sensitive subpopulations). **Duration/Extent:** The expansion would continue, and likely increase, the beneficial and adverse socioeconomic impacts that would be realized from the project through the 78-year expansion period. Pedro Bay would experience greater socioeconomic impacts under the expanded development scenario than if just the project were implemented alone (see Section 4.3, Needs and Welfare of the People—Socioeconomics). Health benefits related to a longer period of increased			

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	income and employment for the local communities may result in multi-generational improvements in educational attainment, and increased access to affordable healthcare, as well as possible expansion of healthcare facilities, due to increased public revenues. However, psychosocial stress related to further mineral development and anxiety regarding the health of the salmon runs and environmental degradation may be intensified. Maintaining cultural ties within families and to the land could be more difficult, depending on access accommodation to areas of traditional subsistence use and flexibility of employment to pursue subsistence activities. **Contribution:** The potential for additional surface and water-related accidents and injuries would increase, because the expansion would also create additional annual vessel and truck traffic over an extended period of time, particularly in Iniskin Bay and Cook Inlet. The access road to Diamond Point, if open to non-mining traffic, could be beneficial for business, but would increase traffic overall through the Williamsport-Pile Bay Road corridor, and could be permanent. Construction of the diesel and concentrate pipelines and access road to a deepwater port in Iniskin Bay would increase the magnitude, duration, and extent of transportation impacts (see Section 4.12, Transportation and Navigation). These additional infrastructure elements have the potential to have positive impacts for the affected communities (e.g., road improvements and increased safety), as well as negative impacts related to accidents and injuries based on the level of public access and interaction. The ferry would cease operations at year 20, and the concentrate pipeline would			

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	reduce truck traffic associated with shipment of copper/gold concentrate, reducing transportation and subsistence impacts associated with those project components.			
Other Mineral Exploration Projects	**Magnitude:** Mining exploration activities would include additional borehole drilling, road and pad construction, and development of temporary camp facilities. Impacts to health and safety would be similar to those described for the Pebble Project expanded development scenario, except at a smaller and site-specific scale. **Duration/Extent:** Exploration activities typically occur at a discrete location for one season, although a multi-year program could expand the geographic area affected within a specific mineral prospect. Section 4.1, Introduction to Environmental Consequences, identifies seven mineral prospects in the EIS analysis area where exploratory drilling is anticipated (four of which are relatively close to the Pebble Project). **Contribution:** This contributes to cumulative effects of health and safety. Additional helicopter traffic could contribute to concerns about impacts on subsistence and stress among local residents. Assuming compliance with permit requirements, contributions to negative effects to health and safety would be minimal.	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.
Oil and Gas Exploration and Development	**Magnitude:** Onshore oil and gas exploration activities could involve seismic and other forms of geophysical exploration, and in limited cases exploratory drilling. These activities could have both positive and negative effects on health and safety, but to a lesser extent than the Pebble Project expanded development scenario due to a shorter duration.	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	Duration/Extent: Seismic exploration and exploratory drilling are typically single-season, temporary activities. The location of previous activities are to the south of King Salmon, and would have minimal contributions to health and safety in the immediate project area. **Contribution:** Onshore oil and gas exploration activities would be required to minimize surface disturbance; this would occur in the analysis area, but distant from the project. The project would have minimal contribution to cumulative effects.			
Road Improvement and Community Development Projects	**Magnitude:** Road improvement projects would take place in the vicinity of communities and have impacts through grading, filling, and potential increased erosion. 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. These improvements would improve overland routes in the region (access to Nondalton) and inter-regionally from Cook Inlet to Iliamna Lake. These in turn could reduce the cost of living through reduced transportation costs of goods. Impacts on health would be affected by impacts on other contributing factors, such as transportation, socioeconomics, and subsistence. These improvements could have positive cumulative effects on ease of transportation with Alternative 1a (e.g., road improvement and overall increased safety), but may also result in increased traffic in certain areas. This may result in increases in accidents and injuries related to surface transportation. Cumulative impacts would	Similar to Alternative 1a and Alternative 2; greater than Alternative 3.	Cumulative effects of these activities would be similar to those discussed under Alternative 1a, except that the north access road and road to Nondalton could connect with the pipeline corridor, creating an overland access route for Iliamna, Newhalen, and Nondalton to Pedro Bay and Cook Inlet. The magnitude, geographic extent, and duration of cumulative impacts in Alternative 2 would be greater than in Alternative 1a, as discussed in Section 4.12, Transportation and Navigation. The footprint of the Diamond Point rock quarry coincides with the Diamond Point port footprint in Alternatives 2 and 3. Cumulative impacts would likely be less under Alternative 2, due to	Overall, cumulative health effects of these activities would be similar to those discussed under Alternative 2, but less than those under Alternative 1a and Alternative 1.

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	also occur associated with surface transportation between the communities for subsistence and recreational uses, in addition to the ongoing LPB, rural Alaska Village Grant Program, and other village projects. These transportation projects would increase access to the area, which could improve access to subsistence resources, but also introduce additional disturbance to and competition for resources, affecting all communities in the cumulative effects analysis area. The projects could also create small-scale construction and operations employment opportunities, improve services, and potentially lower the cost of living. Community construction projects are a particularly important source of seasonal employment and income for small communities. One of the net effects of increased access and interaction among these communities is that the smaller, more rural and remote communities may become more socially and culturally connected with other communities, with consequent positive and negative impacts on SDH. The proposed Diamond Point rock quarry has potential to contribute both positive and negative impacts on health and safety. **Duration/Extent:** Disturbance from road construction would typically occur over a single construction season. The geographic extent would be limited to the vicinity of communities and Diamond Point. **Contribution:** The scheduling of the project implementation could affect the magnitude of impacts to health and other factors. If these projects were implemented, the magnitude of adverse effects on transportation could increase the rates of accidents and injuries; however, if the		commonly shared project footprints with the quarry site.	

Table 4.10-5 Contribution to Cumulative Effects on Health and Safety

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	project improvements occurred before or after the construction phase of Alternative 1a, the magnitude would be far less, and the duration would be unchanged. The socioeconomic impacts would be anticipated to be greater if the project is implemented, which could increase development as support-related businesses take advantage of the additional opportunities provided by the mine. Subsistence impacts from these other projects would have effects similar to those of the project, but would be of lesser magnitude and geographic extent. The impacts to health and safety would be similar to those under Alternative 1a, with a similar mix of positive and negative impacts, but of lower magnitude and spatial extent.			
Summary of Project contribution to Cumulative Effects	Overall, the health impacts of the expanded project may be summarized as extending spatially to a larger affected population, with both positive and negative effects lasting for longer duration in comparison to Alternative 1a without expansion.	Similar to Alternative 1a.	Similar to Alternative 1a, although there would not be the positive and adverse effects associated with operating two port-access road systems under the expanded mine scenario.	Similar to Alternative 1a, although there would not be the positive and adverse effects associated with operating two port-access road systems under the expanded mine scenario.

Notes:
BMP = best management practice
EIS = Environmental Impact Statement
HEC = Health Effect Category
LPB = Lake and Peninsula Borough
NEPA = National Environmental Policy Act
PLP = Pebble Limited Partnership
SDH = social determinants of health