



The Economic Benefits of
**ALASKA'S
MINING INDUSTRY**

March 2018



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Prepared for:



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Executive Summary

Figure 1. Map of Alaska's Mining Activity, 2017



This study measures the economic impact of Alaska's mining industry, which includes exploration, mine development, and mineral production. The industry produces zinc, lead, copper, gold, silver, and coal, as well as construction materials, including rock, sand and gravel. New minerals, such as graphite and rare-earth elements, may expand the Alaska mining industry's offerings. Mining is a growing force in Alaska's economy, providing jobs for thousands of residents and millions of dollars of personal income statewide.

This study examines the direct, indirect, and induced economic impacts of the mining industry in 2016, with some references to 2017.

Key Findings

Mining Industry Expenditures

EXPLORATION

- Mineral exploration expenditures in Alaska in 2016 totaled approximately \$59 million. The preliminary estimate for spending in 2017 is \$110 million. Since 1981, \$3.5 billion has been spent in Alaska on mineral exploration programs.
- In 2016, there were 32 significant exploration projects in Alaska. Five operating mines accounted for 49 percent of 2016's exploration spending.
- Exploration occurred throughout Alaska, but most of the expenditures were focused on six advanced exploration projects: Graphite Creek (graphite), Livengood (gold), Palmer (copper, zinc, gold, and silver), Pebble (copper, gold, and molybdenum), and Upper Kobuk Mineral Projects (copper, zinc, gold, and silver).

DEVELOPMENT

- Since 1981, mining companies have invested \$6.2 billion in development of Alaska mining projects.
- In 2016, \$217 million was invested in eight mining projects in Alaska; the majority (\$196 million) occurred at existing operations, including Red Dog Operations, Fort Knox, Pogo, Greens Creek, and Kensington mines.

- One new project in the development stage – Donlin Gold – expects to complete its Environmental Impact Statement review and permitting process in 2018. In December 2017, Pebble initiated its permitting stage.
- The preliminary estimate for 2017 development spending is \$213 million.

PRODUCTION

- Six major mines are operating in Alaska. Greens Creek, Red Dog Operations, Fort Knox, Pogo, and Kensington are Alaska’s five major metal mines. Usibelli Coal Mine (UCM) is Alaska’s only operating coal mine.
- In 2016, approximately 236 placer gold mines in Alaska produced 51,800 ounces of gold. Just over half of Alaska’s active placer mines are in the Eastern Interior region.
- Approximately 120 sand and gravel operations, located throughout Alaska, reported at least \$17 million in production value on state lands.
- Zinc production accounts for 43 percent of mineral production value in Alaska. Gold ranks second (39 percent), followed by silver and lead (both 8 percent), coal (1 percent), and industrial minerals (rock, sand, and gravel) (1 percent).
- Alaska’s mines generated an estimated \$2.5 billion in total gross revenue in 2016.
- In 2016, \$1.5 billion worth of minerals were exported to world markets, representing 35 percent of Alaska’s total exports.

Mining Industry Employment

JOBS AND WAGES

- Alaska’s mining industry reported annual average employment of 2,788 workers in 2016, according to the Alaska Department of Labor and Workforce Development. These workers had an average annual wage of \$108,624 in 2016, more than double the state’s all-sector average wage of \$53,160.
- Total direct mining industry employment in Alaska averaged approximately 4,350 jobs in 2016 and \$390 million in annual wages. This includes workers engaged in production (metals, coal and construction materials), exploration activities, or mine development during 2016. This employment also includes self-employed miners (often found in placer mines). Employment in 2017 is estimated at 4,500 jobs, with \$404 million in total annual wages.
- A 2014 study found that Alaska’s placer mining industry accounted for approximately 1,200 seasonal jobs, with approximately \$40 million in earnings in 2013.
- Multiplier effects stemming from expenditures on goods and services account for additional employment and wages in Alaska. Including direct, indirect and induced employment, Alaska’s mining industry accounted for approximately 8,600 jobs and \$675 million in wages in 2016, and 9,000 jobs and \$700 million in annual wages in 2017.

ALASKA RESIDENT AND RURAL ALASKAN HIRE

- Approximately 79 percent of employees of Alaska’s operating mines are Alaska residents, based on W2 tax data from all six producing mines.
- Workers in Alaska’s mining industry live in all regions of the state. Rotation schedules allow Alaskans to live wherever they want while working at remote mines. Mines offer employment opportunities to residents of rural Alaska, where few other job opportunities exist.
- Mining employees live in least 55 communities throughout Alaska (not including placer gold, and rock, sand, and gravel production).

EMPLOYMENT OUTLOOK

- Several advanced exploration and new mine development projects could dramatically increase Alaska’s mining employment over the next several years if they enter full production:
 - Graphite Creek project, north of Nome, is expected to create 330 production jobs.
 - Livengood Gold project, just north of Fairbanks, will also create 330 mining jobs.
 - Donlin Gold project in Southwest Alaska is expected to require up to 1,200 workers during mine operations.
 - Pebble Project in Southwest Alaska would require an operations labor force of approximately 750.
 - Exploration programs at all producing mines may extend mine life and sustain (if not increase) employment.

Spending on Goods and Services

- Alaska’s six largest mines (Usibelli Coal, Greens Creek, Red Dog, Fort Knox, Pogo, and Kensington) and advanced exploration projects spent an estimated \$880 million in 2016 on a wide variety of goods and services in support of operations.
- Two-thirds (\$580 million) of this spending on goods and services occurred with approximately 600 Alaska vendors. This spending, combined with tax payments to state and local governments, creates the mining industry’s high multiplier effects in Alaska.

Local and State Government Payments

LOCAL GOVERNMENT

- Mining companies pay the largest share of local taxes in the Northwest Arctic Borough, Fairbanks North Star Borough, Denali Borough, and City & Borough of Juneau. In 2017, tax payments to local government totaled an estimated \$34 million.

- Fort Knox paid \$8.7 million in property taxes to the Fairbanks North Star Borough, making the mine the largest single property taxpayer in the Borough.
- Greens Creek Mine paid \$1.7 million and Kensington paid \$1.4 million in property taxes to the City & Borough of Juneau. These two mines are the two largest tax payers in the City & Borough of Juneau.
- Red Dog Operations paid \$14 million in payment in lieu of taxes (PILT) to the Northwest Arctic Borough in 2017, plus \$8 million in payments to the new Village Improvement Fund. Red Dog is the Borough's single largest source of revenue. The Borough has no sales tax or property tax revenues. Since 1989, Red Dog Operations has made more than \$199 million in PILTs, payments to the Northwest Arctic Borough School District, and payments to the Village Improvement Fund.
- Usibelli Coal Mine pays taxes to the Fairbanks North Star Borough, Matanuska-Susitna Borough, and Denali Borough.
- Several mining companies (including Bering Straits Native Corporation, Arctic Gold Mining, Nome Gold Corporation, and Alaska Gold Company) pay real property taxes to the City of Nome (approximately \$97,000 in 2017).
- In certain jurisdictions, mining companies pay sales tax on their local purchases of goods and services. For example, in 2016, Greens Creek Mine paid an estimated \$616,000 in sales taxes to the City & Borough of Juneau and Constantine (Palmer Project) paid approximately \$28,000 to the Haines Borough.
- Many local governments also receive revenue from locally-owned or leased rock quarries, and sand and gravel pits.

STATE GOVERNMENT

- The mining industry pays a wide variety of taxes, rent, royalties and fees to the State of Alaska, including \$42 million in mining license fees in State Fiscal Year (SFY)2017. In total, the mining industry paid the State of Alaska \$61 million in rents, royalties, and fees in SFY2017.
- A portion of Alaska's mining industry rents and royalty payments are earned on behalf of the Alaska Permanent Fund. If state leases were issued on or before December 1, 1979, 25 percent of these payments are earned for the Permanent Fund; after December 1, 1979, these earnings grow to 50 percent. In 2016, the Permanent Fund earned \$4.9 million from the mining industry and in 2017, \$5.2 million.
- Mining-related activity is an important source of revenue for the Alaska Railroad Corporation. In SFY2017, the railroad earned approximately \$21.2 million from movement of coal and rock, sand, and gravel (representing about 31 percent of the railroad's total revenue from freight).
- In SFY2017, the mining industry paid \$24.8 million to the Alaska Industrial Development and Export Authority for use of the DeLong Mountain Transportation System and the Skagway Ore Terminal.

- In SFY2017, the mining industry paid \$2.7 million to the Alaska Mental Health Trust for rents and royalty payments as well as purchases of construction materials sales from Trust lands.

Partnerships with Alaska Native Corporations

All Alaska Native Corporations (ANC) benefit from mining activity through jobs for shareholders, 7(i) and 7(j) royalty sharing payments (see below), or business partnerships.

ALASKA NATIVE AND SHAREHOLDER HIRE

- At Red Dog Operations, 55 percent of the year-round jobs are filled by NANA shareholders, including jobs with Teck Alaska, NANA Lynden and NMS.
- At Trilogy's Upper Kobuk Minerals Project, 59 percent of the employees and contractors were NANA shareholders in 2017.
- In 2016, 37 percent of the development jobs at Donlin Gold were filled by Alaska Native employees.

ROYALTY PAYMENTS

- Regional ANCs are mandated to annually redistribute 70 percent of net revenue earned on subsurface developments of their lands (also known as Section 7(i) payments) among all regional corporations. These Regional ANCs then distribute payments to their respective village corporations (also known as Section 7(j) payments).
 - As part of a lease agreement, Red Dog Operations pays a royalty to NANA that totaled \$247 million in 2017. Of the 2017 royalty payment, NANA redistributed \$156 million to all regional ANCs.
 - Since 1989, NANA has distributed \$1.1 billion (not including NANA's distributive share) to the other ANCSA corporations in Section 7(i) payments. Half of these Section 7(i) payments were then redistributed to each village corporation and to at-large shareholders in the form of a Section 7(j) payment.
 - While some royalties have already been paid to Calista Corporation (and lease payments to The Kuskokwim Corporation), the long-term benefit for Calista Corporation will come from royalties once Donlin Gold is in operation.

BUSINESS DEVELOPMENT OPPORTUNITIES

- Two NANA subsidiaries – NMS and NANA Lynden Logistics – play major roles in Red Dog Operations. Other subsidiaries, including NANA/Major Drilling, DOWL HKM, NANA Oilfield Services, NMS Security, NANA WorleyParsons, NANA/Pacific, NMS Training Systems, and NMS Staffing all provide services to Red Dog Operations and others in Alaska's mining industry.
- Chuilista Services, a subsidiary of Calista Corporation, was created to provide camp structures, equipment, and personnel in support of Donlin Gold development.

- The Pebble Partnership works directly with several village corporations, including Iliamna Development Corporation (IDC), a wholly owned for-profit subsidiary of Iliamna Natives Limited. IDC provides The Pebble Partnership with site support services, including food services, housekeeping, transportation, waste disposal (incinerator) and other services, as well as leased space and buildings.

Other Measures of Economic Impact

- Mining offers additional benefits to the Alaska economy, including:
 - Development of workforce skills that are often transferable to sectors of the economy other than mining.
 - Public and private infrastructure investment that has broad benefit beyond the primary use of a mining venture, including roads, docks, and electric transmission.
 - Charitable contributions to at least 385 nonprofit organizations throughout Alaska in 2016 totaling approximately \$4.6 million. Another \$300,000 went to many civic, business, and industry organizations in Alaska through sponsorships and membership fees in 2016.
 - Direct support for student performance (scholarships and internships) and endowments for faculty and research at the University of Alaska.

Alaska's Mineral Endowment and the Future of Mining in Alaska

- Although most of Alaska is unexplored, there are 7,200 known mineral occurrences, not including coal or industrial/construction materials deposits. With this resource potential along with rising base and precious metals prices, conditions are right for further growth in Alaska's mining industry. Alaska is an attractive target for mining industry exploration, as evidenced by the \$1.4 billion in exploration between 2010 and 2017.
- As owners of 44 million acres of privately-held land, much of which was selected for its mineral potential, ANCs and their shareholders are well positioned to play a key role in future development of the mining industry in Alaska. In partnership with the mining industry, most of Alaska's Regional ANCs continue to evaluate mineral development opportunities on their lands, with potential resources ranging from gravel operations to gold, silver, copper, nickel, lead, zinc, platinum, tungsten, manganese, strategic minerals, jade, limestone, and coal deposits.

Overall Summary

The table below highlights the economic impact of Alaska's mining industry in 2016 and 2017.

Table 1. Summary of Statewide Economic Impact of Alaska's Mining Industry

Category	Amount
Direct Jobs and Wages	
Estimated mining industry jobs in Alaska	4,350 (2016) 4,500 (2017)
Estimated mining industry wages in Alaska	\$390 million (2016) \$404 million (2017)
Total Jobs and Wages (Including Multiplier Impacts)	
Total jobs attributable to the Alaska mining industry	8,600 (2016) 9,000 (2017)
Total wages attributable to the Alaska mining industry	\$675 million (2016) \$700 million (2017)
Investment	
Exploration expenditures	\$59 million (2016) \$110 million (2017)
Total exploration investment in Alaska, 1981-2017	\$3.5 billion
Development expenditures	\$217 million (2016) \$213 million (2017)
Total development investment in Alaska, 1981-2017	\$6.2 billion
Production (2016)	
Number of placer mines	236
Estimated placer gold production	51,800 ounces
Number of sand and gravel operations	120
Value of Alaska's mineral exports	\$1.5 billion
Mineral exports percentage of Alaska's total exports	35 percent
Government Revenue	
Payments to State of Alaska	\$81 million (2016) \$109 million (2017)
Rents, royalties, and taxes (including mining license tax)	\$37 million (2016) \$61 million (2017)
AIDEA facilities user fees	\$24 million (2016) \$25 million (2017)
Mining commodity movement by Alaska Railroad	\$18 million (2016) \$21 million (2017)
Payments to local governments	\$23 million (2016) \$34 million (2017)
Payments to Alaska Mental Health Trust	\$3 million (both 2016 and 2017)
Native (ANCSA) Corporations	
7(i) payments to ANCSA Regional Corporations	\$111 million (2016) \$250 million (2017)

Study Purpose and Methodology

Purpose

This study measures the economic impact of Alaska's mining industry, which includes exploration, mine development, and mineral production. The industry produces zinc, lead, copper, gold, silver, coal, as well as construction materials, including rock, sand and gravel. New minerals, such as graphite and rare-earth elements (necessary for many of today's high-tech electronics), may expand Alaska's mining industry's offerings. Mining is a growing force in Alaska's economy, providing jobs for thousands of residents and millions of dollars of personal income statewide. This study examines the direct, indirect, and induced economic impacts of the mining industry in 2016, with 2017 estimates.

Methodology

To conduct the analysis, McDowell Group requested data on employment, resident hire, shareholder hire, vendor purchases and other operational spending, payments to local and state governments, and other activities from Alaska's major mining companies (including exploration companies). Data was also compiled from various public sources, including the Alaska Departments of Labor and Workforce Development (DOLWD), Natural Resources (DNR), Commerce, Community and Economic Development (DCCED), and the federal Bureau of Economic Analysis (BEA).

There is no comprehensive public source of data regarding mining employment and payroll. Sources of employment and payroll data include the BEA, DOLWD, and DNR's, Division of Geology and Geophysical Survey employment data. Each source has advantages and disadvantages. McDowell Group therefore supplements public employment data (annual average and W2 tax form data) and payroll information with data obtained directly from the individual companies.

IMPLAN™, a model for estimating the size and linkages of different types of economic activity, was used to help the study team assess the multiplier (so-called "ripple") effects of different types of industry spending on the statewide and regional economies. The report includes a discussion of multiplier effects along with estimates of how Alaska's mining industry indirectly affects employment and payroll statewide. Other measures of economic impacts are also discussed, for example the industry's payments to local and regional governments, state government, and to Alaska Native corporations.

The economic impact analysis is based on 2016 data; however, some preliminary 2017 information is also presented.

This report begins with an overview of the mining industry, including a description of the mining cycle, from exploration through site reclamation. A summary of Alaska's mine production activity and advanced exploration projects is also provided. All photos were provided by Alaska's mining companies and Alaska Miners Association.

FOR INFORMATIONAL PURPOSES ONLY

This report is written for informational purposes only and is current only as of the date of this report. The data in this report have not been independently audited and are not intended to be used, relied on or considered in making any legal, financial, or business decision. Data and analysis presented are subject to change at any time with or without notice. Similarly, the data in this report are not an official financial statement or disclosure by any of the mining companies and should be not deemed as such.

Overview of Alaska's Mining Industry

The mining industry and the minerals and metals it produces are essential to the average American's way of life. According to the Mineral Information Institute, nearly 6.6 billion tons of minerals and energy fuels were produced in 2017 to supply the needs of the U.S., an average of more than 40,600 pounds of minerals for each American.¹ Based on statistics from the U.S. Geological Survey, the average American will require 3.2 million pounds of minerals, metals and fuels during his or her lifetime.² Annually, the average person in America accounts for:

- 10,500 pounds of stone to make roads, buildings, bridges, and other construction uses;
- 7,500 pounds of sand and gravel to make concrete, asphalt, roads, blocks, and bricks;
- 12 pounds of copper in buildings, electrical and electronic parts, plumbing, and transportation;
- 11 pounds of lead for transportation, batteries, electrical, communications, and TV screens;
- 5 pounds of zinc to make paint, rubber, skin creams, rust resistant metals, and for use in nutrition and health care; and
- 4,500 pounds of coal to produce energy.

Mining is more than just extracting mineral resources from the earth. It involves reconnaissance exploration, prospect assessment, advanced exploration, pre-development engineering and environmental research, mine construction, production, final site reclamation and post-reclamation monitoring. This chapter describes the various phases of the mining cycle of activity and provides examples of Alaska projects in each phase of this cycle.

Reconnaissance Exploration and Advanced Exploration

The mining cycle begins with exploration. Reconnaissance exploration defines areas that are promising for a specific mineral and/or previously unrecognized mineral deposits with economic potential in a region. Following discovery comes more focused exploration, sometimes termed "target" or "advanced" exploration. During this process, the deposit is sampled to determine grade and tonnage and the probability of profitable mining. This is a complex stage of mineral resource development. Dozens of constantly changing economic, financial and technical forces influence mine feasibility. Low grades, small tonnages, metallurgical recovery, infrastructure or high costs may mean that a deposit never advances beyond the assessment stage. Alternatively, it may sit idle for many years until rising metal prices or technological advances help turn the project into a profitable venture.

In recent years, mineral exploration has become increasingly sophisticated. Reconnaissance exploration programs often begin with analysis of satellite or high altitude aerial photographs covering broad areas. Depending on the target minerals, airborne geophysical surveys may be employed over large tracts of land. Geochemistry also plays an important role in mineral exploration, whereby chemical analysis of stream sediment and soil samples allows mining companies to make a preliminary assessment of mineral potential without sampling the underlying bedrock.

¹ <https://mineralseducationcoalition.org/mining-minerals-information/mining-mineral-statistics/>

² Ibid.

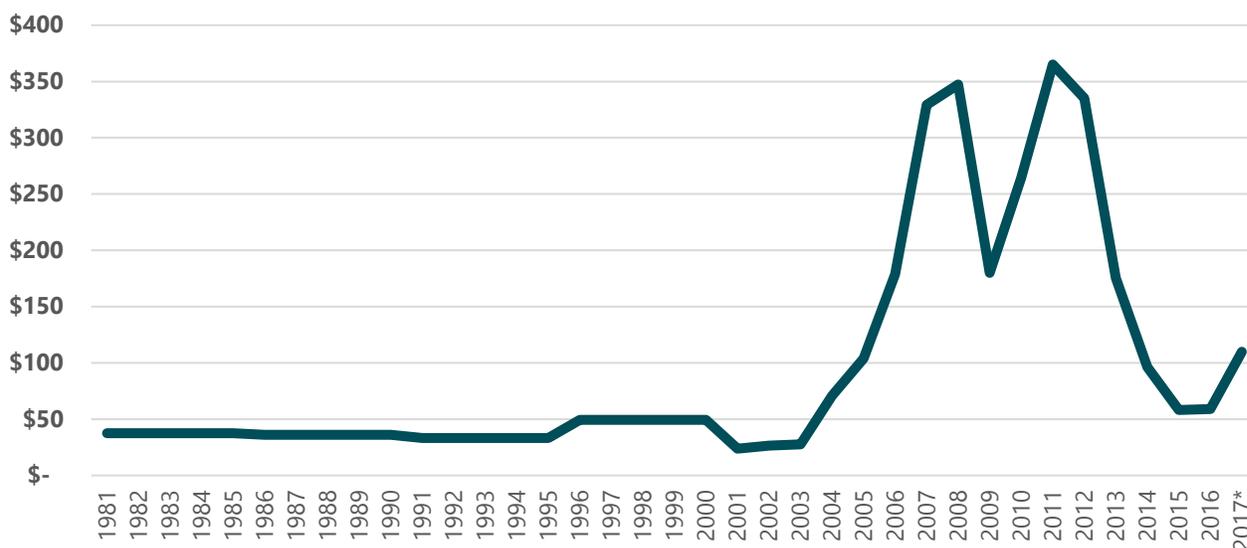
Following discovery, drilling, sampling, engineering, metallurgical analysis, financial analysis, and baseline environmental analysis are all part of the effort to determine if profitable and environmentally responsible mining is possible. Ore grade, tonnage, and mineral/metal prices are critical factors for mine feasibility, but so are costs. These include the cost of preparing the ore body for mining, building a mill (concentrator), mining a ton of ore, crushing, grinding, and refining a product from that ton of ore, and eventual shut-down and site reclamation. This assessment process addresses the full life-cycle of the mine. Modern mines are designed from the start to prepare for ultimate closure.



Exploration in Alaska

Exploration spending is again on the upswing in Alaska. According to the State of Alaska’s Division of Geological and Geophysical Surveys (DGGS), exploration expenditures in Alaska in 2016 totaled approximately \$58.9 million. The preliminary estimate for 2017 exploration expenditures is \$110 million. Since 1981, mining and exploration companies have spent \$3.5 billion in Alaska on mineral exploration programs.³ The global recession dried up funding for exploration programs after more robust years in the 2007 to 2012 period. With improving global economic conditions metal prices have recovered, and interest in exploration in Alaska has been renewed.

Figure 2. Exploration Expenditures in Alaska, 1981-2017, \$million



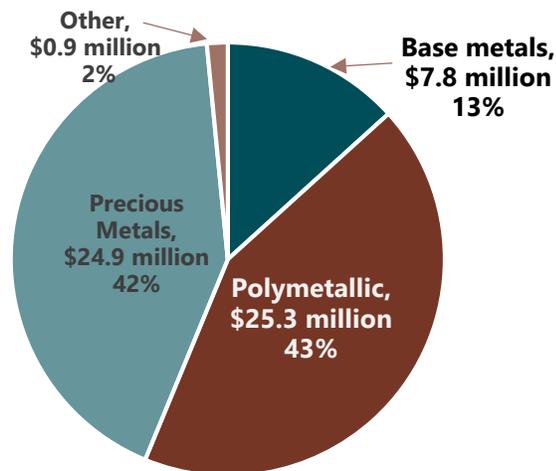
*Preliminary estimates.

Source: *Alaska’s Mineral Industry 2016*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys.

³ <http://dggs.alaska.gov/webpubs/dggs/sr/text/sr072.pdf> p. 3

In 2016, 32 individual exploration projects reported activity in Alaska (some companies managed multiple projects).⁴ Alaska's five operating mines spent \$28.6 million for exploration (or 49 percent of all exploration spending). Since 1989, Red Dog has spent approximately \$100 million in exploration of its deposits.⁵ Six other projects spent more than \$1 million each. Fourteen projects spent between \$100,000 and \$1 million. Most of this exploration funding came from Canadian and other international sources. Of the total \$58.9 million in exploration spending in 2016, \$25.3 million (43 percent) was spent exploring polymetallic (combination of different metals, \$24.9 million (42 percent) for precious metals (platinum, silver, and gold), \$7.8 million (13 percent) for base metals (copper, nickel, lead, and zinc), and just over \$900,000 for rare-earth elements, magnetite sands, gemstones, and graphite.

Figure 3. Exploration Spending in Alaska, by Commodity, 2016



Source: *Alaska's Mineral Industry 2016*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys.

ADVANCED EXPLORATION PROJECTS

There are four projects currently considered in the advanced exploration stage: Upper Kobuk, Graphite Creek, Livengood, and Palmer. Brief overviews of these four advanced exploration projects follow the map below.

Figure 4. Map of Alaska's Active Advanced Exploration Projects, 2017



⁴ *Ibid.*, p. 14

⁵ Email correspondence with Wayne Hall, Teck Alaska, January 30, 2018.

Upper Kobuk (Arctic and Bornite)

Trilogy's 2017 budget for the Upper Kobuk exploration program was \$17.1 million.

Arctic Project

The Arctic Project is Trilogy's most advanced exploration/pre-development effort in its Upper Kobuk Minerals Project and in the Ambler Mining District. Located approximately 20 miles northeast of Kobuk, 26 miles from Shungnak, and 40 miles east-northeast of Ambler, the Arctic Project includes 112,000 acres of State of Alaska mining claims and patented federal mining claims.

The Arctic deposit hosts 27 million metric tons of Indicated and Inferred resources containing copper, zinc, lead, gold, and silver. With an average copper grade of 3.2 percent and a copper-equivalent grade of 5.9 percent, the Arctic deposit is very high grade. The Arctic Preliminary Economic Analysis (PEA), completed by Tetra Tech in September 2013, found a surface mine and mill processing 10,000 tons of ore per day over a 12-year mine life could be economically feasible. The base case scenario assumes long-term metal prices of \$2.90/pound for copper, \$0.85/pound for zinc, \$0.90/pound for lead, \$22.70/ounce for silver, and \$1,300/ounce for gold. The PEA assumes an access road from the Dalton Highway constructed and financed much like Alaska Industrial Development and Export Authority's (AIDEA) Delong Mountain Transportation System. In 2017, the Bureau of Land Management (BLM) launched an Environmental Impact Statement (EIS) process for the Ambler Mining District Industrial Access Project (AMDIAP). While the AMDIAP EIS is being prepared, Trilogy hopes to complete a feasibility study for the Arctic deposit and carry out additional environmental baseline studies, as well as additional geotechnical and hydrologic modeling.

While the Arctic Project is the most advanced project in the Ambler district, the likelihood and timing of development are uncertain. Several key factors are at play, including completion of the AMDIAP road, some increase in copper prices, and advancing the Bornite project.

Bornite

Trilogy is also assessing the development potential of the Bornite deposit, located approximately 11 miles southwest of the Arctic Project. Bornite is on property owned by NANA Corporation. Though lower-grade than Arctic, Bornite is a larger deposit, with potential for both surface and underground mining. The Bornite resource has been estimated to include more than 180 million metric tons of Indicated and Inferred resources, including 41 million tons of Indicated resource containing 913 million pounds of copper and 142 million tons of Inferred resource containing 5.5 billion pounds of copper. With grades ranging from 1 percent to 2.5 percent, the Bornite deposit contains just under 6.5 billion pounds of copper. The Bornite deposit has been an exploration target for many years. Over the course of 21 exploration seasons since 1957, a total of 234 core holes were drilled, totaling 256,000 feet.

A preliminary economic analysis has not been prepared for Bornite, so little information is available on the potential scale of mining and concentrate production. However, it is evident that Bornite could play an important role supplementing or expanding the Arctic operation. Though the mineralogy of the Bornite and Arctic deposits differ (with different processing requirements), Bornite could provide mill feed and generate concentrate shipments for many years beyond the 12-year life modeled in the Arctic PEA.

Trilogy's largely seasonal employment in Alaska peaked in July 2016; 63 percent of the total workforce lived in the NANA region.

Graphite Creek

Graphite One Resources announced the results of its PEA in February 2017. The deposit contains an estimated 44 million metric tons of graphite mineralization at 7 percent graphite. An operation with a 40-year mine life would produce 60,000 metric tons per year of graphite concentrate at 95 percent graphite, once full production is reached in Year 6. At full production, the manufacturing plant is expected to convert 60,000 metric tons per year of concentrate into 41,850 metric ton per year of Coated Spherical Graphite (CSG) and 13,500 metric tons per year of purified graphite powders.

Projected capital cost estimates total \$363 million, including \$43 million at the mine, \$158 million for the processing plant, \$32 million for supporting infrastructure, and \$130 million for the manufacturing plant. Projected annual operating costs at full capacity are \$98.2 million. Estimated project employment includes 174 workers at the mine site, 95 workers in the processing plant, 102 workers in the manufacturing plant for a total of 371 workers.⁶ In 2017, the U.S. Geological Survey listed Graphite as one of 23 materials for which the U.S. is 100 percent import dependent and as a Critical Mineral Resource.⁷

Livengood Gold Project

Located 70 miles northeast of Fairbanks, the Livengood Gold Project is an advanced-stage exploration project aimed at developing a surface gold mine producing 52,600 tons of ore per day and 300,000 ounces of gold annually over a 23-year mine life. The latest estimates (2017) indicate the gold deposit contains 9.0 million ounces of proven & probable reserves and 11.5 million ounces of measured and indicated resources. A total of 783 drill holes totaling 717,435 feet define the resource.⁸

The Livengood Gold Project Pre-Feasibility Study (PFS), completed in October 2016, estimates the Livengood Gold Project mineral resource is 497 million measured metric tons at an average grade of 0.68 g/metric ton (10.84 million ounces) and 28.0 million indicated metric tons at an average grade of 0.69 g/metric ton (0.62 million ounces), for a total of 525.4 million metric tons at an average grade of 0.68 g/metric ton (11.5 million ounces). The PFS mine plan would provide sufficient ore to support an average annual production rate during Years 1-5 of 378,300 ounces per year and an annual production rate of approximately 294,100 ounces per year over an estimated 23-year mine life, producing a total of approximately 6.8 million ounces of gold.

At an optimal mine and mill production scale of 52,600 tons per day, this scale of operations would require approximately \$1.84 billion in initial capital (development) expenditures and an estimated \$2.7 billion spent over the life of the project. The mine expects to create 800 direct construction jobs for two years, peaking at 1,050 jobs. During production, it is estimated 331 direct operational jobs.⁹

⁶ <http://www.graphiteoneresources.com/projects/graphite-one-project-pea/overview/>

⁷ http://www.graphiteoneresources.com/news/news-display/index.php?content_id=267

⁸ <http://www.ithmines.com/livengood-gold-project/project-highlights/>

⁹ http://www.ithmines.com/resources/technical-reports/3661004_THM_NI43-101_Livengood_Gold_Project_PFS_2.pdf, p. 1-21.

The most recent economic analysis of the project indicates an “all-in sustaining cost” of \$1,263 per ounce of gold. With gold currently at approximately \$1,340 (as of January 12, 2018), consistently higher gold prices will be required to support investment in Livengood project development.

International Tower Hill Mines announced a budget of \$6.3 million to continue its exploration work in 2017.

Palmer

The Palmer Project is a joint venture partnership between Constantine (51 percent) and Dowa Metals & Mining Co., Ltd. (49 percent), with Constantine as operator. It is a high-grade copper-zinc deposit with the potential for underground mining. The mid-stage mineral exploration project is located adjacent to the Haines Highway, 37 miles northwest of Haines.



Nearly \$30 million has been invested in the project since Constantine began work in 2006. Work to date includes exploratory drilling and access road construction. Ongoing environmental and geotechnical studies are being conducted to establish a baseline for additional permits required for additional exploration drilling and road construction work.

Up from the 2016 budget of \$3.7 million, Constantine spent \$7.0 million on its 2017 program focused on 7,000 meters of drilling, airborne geophysical surveying, geological mapping, and prospecting work. Other work included additional road construction, engineering, environmental studies, and evaluation of a potential exploration drift.¹⁰ The current inferred resource estimate is 8.1 million metric tons with metal grades of 1.41 percent copper, 5.25 percent zinc, 0.32 g/ ton gold, and 31.7 g/ton silver. During the exploration season in 2017, Constantine had 20 seasonal employees in Alaska. Of its Alaska resident workers, 94 percent live in Haines.

¹⁰ <http://constantinemetals.com/projects/palmer/>

OTHER SELECTED EXPLORATION PROJECTS

Exploration occurs throughout Alaska. The table below details other active exploration by region, mine, and mining company, followed by brief project overviews.

Table 2. Other Active Exploration Projects, 2017

Project	Exploration Company	Prospect
Northern Region		
Lik	Zazu Metals Corp.	Zinc, lead, silver
Noatak	Teck Alaska	Zinc, lead, silver
Western Region		
Round Top	Western Alaska Copper & Gold	Copper, molybdenum, lead, zinc, silver
Eastern Interior Region		
Elephant Mountain	Endurance Gold Corporation	Gold
Shorty Creek	Freegold Ventures Ltd.	Copper, molybdenum
Circle-area claims	Kinross Gold Inc.	Gold
Tetlin	Peak Gold LLC	Gold, silver, copper
Red Mountain	White Rock Minerals	Polymetallic
Golden Zone	Avidian Gold Inc.	Gold, silver, copper
Honolulu	Honolulu Prospect Corp.	Silver, lead, zinc, copper, gold
Caribou Dome	Coventry Resources Ltd.	Copper
Stellar	Millrock Resources Inc.	Gold, copper
Fairbanks District		
Fort Knox and District	Fairbanks Gold Mining Inc.	Gold
Golden Summit	Freegold Ventures Ltd.	Gold
Treasure Creek	Treasure Creek Partnership	Gold
Amanita	Avidian Gold Inc.	Gold
Richardson District		
Richardson and Hilltop	Northern Empire Resources Corp.	Gold
Sam	Great American Minerals Exploration Inc.	Gold, silver
Goodpaster District		
Pogo area	Sumitomo Metal Mining Pogo LLC	Gold
Skippy, Fog	Stone Boy Inc.	Gold
LMS	Gold Reserve Inc.	Gold
Goodpaster	Millrock Resources Inc.	Gold
Southcentral Region		
Whistler	GoldMining Inc.	Copper, gold, silver
Willow Creek/Lucky Shot	Miranda Gold Corp. and Gold Torrent	Gold
Chisna	Millrock Resources	Copper, gold
Opal	Ben Porterfield	Gold
Ice Cape	Alaska Mental Health Trust Land Office	Heavy mineral concentrates
Southwestern Region		
Copper Joe	Kiska Metals Corp.	Copper
Alaska Peninsula		
Unga-Popov	Redstar Gold Corp.	Gold

Project	Exploration Company	Prospect
Southeastern Region		
Kensington/Jualin	Coeur Alaska Inc.	Gold
Herbert Gold	Grand Portage Resources Ltd.	Gold
Greens Creek Mine	Hecla Greens Creek Mining Company	Silver, gold, zinc, lead
Zarembo Island	Zarembo Minerals Co. LLC	Gold, silver, lead, zinc,
Niblack	Heatherdale	Copper, gold, silver, zinc
Bokan Mountain/Dotson Ridge	Ucore Rare Metals Inc.	Rare-earth-element

Sources: *Alaska's Mineral Industry 2016*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys. Various company websites.

SELECTED EXPLORATION PROJECTS – EASTERN INTERIOR ALASKA

Caribou Dome

Coventry Resources Ltd.'s Caribou Dome project is located about 155 miles north of Anchorage with road access from the Denali Highway. Two hunting lodges along the Denali Highway provide accommodation facilities, communications, logistics support, and supplies.¹¹ A 2016 drilling program identified high-grade copper mineralization with potential for surface mining. Coventry's exploration objective is to outline 5 to 10 million metric tons of resource with a grade of 2.5-4.0 percent copper. The 2016 drilling program included a total of 22 holes totaling approximately 28,000 feet. Results released to date include intersects of 3.5 meters at 11.5 percent copper and 4.3 meters at 5.2 percent copper. The sediment-hosted deposit exhibits characteristics like the very rich Kennicott copper deposit. Preliminary metallurgical testing including conventional floatation has produced concentrates of about 25 percent copper.

Coventry has undertaken a preliminary scoping study based on using the near surface material for a low capital cost, open-pit starter operation.¹² The estimated mineral resources is 2.8mt at 3.1 percent copper, containing 86,000 metric ton of copper.¹³

Elephant Mountain

The Elephant Mountain project is located 75 miles northwest of Fairbanks in the Rampart-Manley Hot Springs area. Endurance Gold Corporation is evaluating the prospect's potential as an occurrence similar to Fort Knox Mine and the Ryan Load and True North deposits near Fairbanks. In 2016, Endurance completed four drill holes totaling about 2,000 feet. An induced polarization survey was conducted in 2017.

Golden Summit

Freegold Ventures Limited's Golden Summit gold prospect is located about 18 miles northeast of Fairbanks and five miles from the Fort Knox Mine. The large relatively low-grade gold deposit has potential for development of a surface mine with heap leach and biooxidation gold extraction. At a cut-off grade of 0.3 grams per ton, the deposit includes 133 million tons of Indicated and Inferred resources.

¹¹ <http://www.polarx.com.au/caribou-dome-copper-project/>

¹² "Alaska 2017 Mining in Review," Alaska Business, November 2017, p. 51.

¹³ <http://www.polarx.com.au/caribou-dome-copper-project/>

A preliminary economic assessment (PEA) outlines a two-phase, 24-year open pit mine producing 10,000 tons per day, with peak annual gold production of 158,000 ounces and annual average production of 96,000 ounces, based on \$1,300 per ounce of gold. Oxide ore would be mined during the first phase of production, with sulfide ore mining starting in year 9. An initial investment of \$88 million would be required to initiate mining and heap leach operations. Another \$348 million capital investment would be required over the life of the project to mine and process the sulfide ore.¹⁴ Next steps for Freegold at Golden Summit are to expand through additional drilling the heap-leachable oxide resource.

Red Mountain

White Rock Minerals owns a potentially high-grade polymetallic (zinc-silver-lead-gold-copper) target in the Bonnifield Mining District about 60 miles south of Fairbanks. Previous drilling intercepted numerous zones of high-grade mineralization in two deposits, Dry Creek and West Tundra Flats. Intercepts over several meters of 15 to 24 percent zinc and 10 to 15 percent silver have been identified. In 2017, White Rock conducted surface geochemical sampling and ground geophysics over known conductivity targets to define drill targets for follow up.

SAM Project

Great American Minerals Exploration, Inc. (GAME) has the Monte Cristo and Uncle Sam prospects, now collectively called the SAM project, encompassing a broad area about 40 miles west of the Pogo Mine. Previous work noted an inferred resource containing 2.9 million ounces of gold and 51 million ounces of silver. The area includes shallow and heap-leachable oxide deposits, as well as deeper and richer sulfide deposits.

Shorty Creek

Freegold Ventures also has the Shorty Creek Project, an early stage project located about 75 miles northwest of Fairbanks. In 2016, Freegold conducted a drilling program, ground magnetics, and additional geochemical sampling to evaluate the resource potential of a porphyry copper-gold-molybdenum system.¹⁵ Though results of drilling in 2016 are encouraging, with one drill intersect of 45 meters grading 1.06 percent copper equivalent, no resource estimates have been made. Another drill hole found 93.5 meters grading 0.55 percent copper equivalent. In 2017, Freegold continued a core drilling program to define the characteristics of the deposit. If additional drilling proves promising, a preliminary economic analysis will be conducted.

Tetlin Project

In 2015 Royal Gold, Inc. and Contango Ore, Inc. formed a joint venture, Peak Gold, LLC, to advance the Tetlin Gold Project, located 200 miles from Fairbanks and 15 miles south of Tok. Just under 10 million tons of Indicated and Inferred resources with over 800,000 ounces of gold, with additional silver and copper values, have been identified to date. From 2009 through 2016, a total of \$40 million was spent studying the deposit, including \$11 million in 2016. Additional drilling was conducted in 2017.

¹⁴ https://www.freegoldventures.com/site/assets/files/1862/pea_goldensummit.pdf p. 1

¹⁵ https://www.freegoldventures.com/site/assets/files/1932/shorty_creek_report_2017-06012017.pdf , p. 6-7.

SELECTED EXPLORATION PROJECTS – SOUTHCENTRAL ALASKA

Willow Creek/Lucky Shot Project

The Lucky Shot Project, in the Willow Creek mining district, is located approximately 25 miles northeast of Willow. Lucky Shot is a low tonnage, high grade deposit with 265,000 tons of Measured, Indicated, and Inferred resource containing 157,000 ounces of gold. The project is a joint venture between Miranda Gold Corp and Gold Torrent, Inc. Initial planning has the small but very high-grade deposit being mined over a five-year period, potentially starting in 2018.

SELECTED EXPLORATION PROJECTS – SOUTHWESTERN ALASKA

Terra Gold

During 2016, WestMountain Gold, Inc. conducted surface mining and milling operations as part of its bulk-sampling program at Terra gold mine, located approximately 125 miles west-northwest of Anchorage. A landslide in September 2016 shut down the operation; however, prior to the slide 890 tons had been processed with another 1,470 tons of stockpiled material available. The identified mineral resources include 128,913 ounces of indicated resources and 811,286 ounces in estimated inferred resources.

SELECTED EXPLORATION PROJECTS – ALASKA PENINSULA

Unga-Popov

The Unga Gold Project covers portions of adjacent Unga and Popov Islands, approximately 550 miles southwest of Anchorage and about 8 miles from Sand Point. During the summer of 2016, Redstar completed an advanced drill targeting exploration program at the Shumagin Gold Zone, the Empire Ridge Gold Prospect, and Orange Mountain Gold Prospect which included geochemical sampling, detailed structural mapping, and reconnaissance mapping and surface bedrock sampling; exploring other known prospects within 240 square km district-scale property position; and expanding and extending known mineralization at the Shumagin high-grade gold zone. A follow-up geophysics program was started in April 2017, followed by a drilling program from May-June 2017.¹⁶

SELECTED EXPLORATION PROJECTS – SOUTHEASTERN ALASKA

Bokan Mountain-Dotson Ridge

The Bokan Mountain project is located about 37 miles southwest of Ketchikan. The project is owned by Ucore Rare Metals and contains rare earth elements. The 1,500-metric ton/day underground operation would include processing components – a material sorting and leaching process plant and an advanced separation process – to produce rare earth oxide (REO) concentrates.

¹⁶ <https://www.redstargold.com/projects/alaska/unga-project/>

According to the PEA conducted in 2013, the initial capital cost for the project is \$221.3 million, with an operating cost of \$636.0 million. The project would require two years of construction. Once in production, the mine would support 118 jobs.¹⁷ In 2016 and 2017, no exploration activity was reported.

Herbert Gold

Quaterra and Grande Portage Resources have formed a 35 percent/65 percent joint venture for the further exploration and development of the Herbert project. Grande Portage is the operator. The project is an early stage, partially drill-tested, high-grade, gold mineralized mesothermal quartz vein system in the historic Juneau Gold Belt of southeast Alaska. Consisting of 91 unpatented lode claims located 20 miles north of Juneau and 25 miles south of Couer Alaska's Kensington gold mine, the property covers five parallel vein structures exposed at the toe of a retreating glacier.¹⁸

A total of 127 diamond drill holes and four trenches have been investigated since 1986. A 2013 estimate of the deposit included an indicated resource of 821,100 metric tons grading 6.91 grams per metric ton gold (g/ton) containing 182,400 ounces of gold in the Deep Trench and Main veins. The Deep Trench and five veins that have had limited drill testing contain an inferred resource of 51,600 metric tons grading 7.73 g/ton gold for a total of 12,800 ounces of gold.

Niblack

The Niblack deposit supported historic underground mining operations from 1905 to 1908, producing about 20,000 tons of ore. Active exploration began again in the 1970s, with ramped up activity in 2005 when Niblack Mining Company acquired the historic gold producer, which is located 27 miles southwest of Ketchikan on Prince of Wales Island. In 2008, CBR Gold Corporation acquired the property and in 2009, Heatherdale Resources Ltd. (an affiliate of Hunter Dickinson) obtained the right to retain a 51 percent interest by expending \$15 million and an option to acquire up to a 70 percent interest by spending an additional \$10 million and completing a feasibility study.¹⁹ Before Heatherdale's involvement, prior operators spent \$41 million on the property. Since 2009, Heatherdale has spent \$43 million.

A 2011 resource estimate indicated grades 0.95 percent copper, 1.75 g/ton gold, 1.73 percent zinc, 29.52 g/ton silver and inferred grades 0.81 percent copper, 1.32 g/ton gold, 1.29 percent zinc, 20.10 g/ton silver.²⁰

The on-site infrastructure includes 1.5 miles of road, 3,300 feet of underground development, a water treatment plant, and a dock and barge camp. Preliminary economic assessments indicate Niblack may have a minimum 10-year mine life. No exploration activity was reported in 2016 or 2017.



¹⁷ <http://ucore.com/documents/PEA.pdf>

¹⁸ <https://www.quaterra.com/projects/herbert-gold-project/>

¹⁹ http://www.cbrgoldcorp.com/project_areas/united_states/niblack/

²⁰ http://www.niblackproject.com/s/About_Niblack.asp?ReportID=579360&_Type=About-Niblack&_Title=Niblack-Project-Status

Mine Development and Construction

Only a small proportion of mineral prospects ever becomes a mine. For those few prospects where detailed sampling indicates profit potential, the next step is mine permitting followed by mine development (construction). During development, the ore body is prepared for mining, an ore processing mill is constructed, and the support infrastructure (roads, electrical generation, marine facilities, etc.) is developed. In large-scale mine projects, hundreds of millions of dollars, sometimes billions of dollars, are invested and hundreds of workers employed over a period of several years to prepare the mine for production.

Ten or more years may elapse between discovery and development of a mineral deposit; 15 years is typical. For example, the Greens Creek Mine near Juneau was discovered in 1975 and went on-line in 1989. Some prospects see decades of intermittent assessment work conducted by a succession of different owners before final development occurs. New technology, expanded reserves, new mining models, and changing market conditions can make the difference between uneconomic deposits and successful mines. Large mining companies typically pursue multiple projects at different stages of development simultaneously.

Mine construction involves building a facility to separate the valuable metals from the surrounding rock (a mill or concentrating plant). These facilities typically include mechanical (crushing, grinding, gravity separation) and/or chemical purification processes. In some cases, a “concentrate” is produced that is shipped to a smelter where final processing into a metal product occurs. The Greens Creek Mine, for example, produces three types of concentrates containing silver, gold, zinc, and lead. These concentrates are shipped to several smelters around the world for final processing. Other mines produce a final or near-final metal product on site.

The mine construction effort also includes support facilities, which may involve transportation infrastructure (roads, docks, or airstrips, depending on the location of the mine), tailing disposal facilities, power generating plants if no outside power source is available, and office and lab structures for the mine’s managers, engineers, and geologists. For remote mines, facilities are required to house and feed the mine’s workforce.

Mine development includes the process of preparing the ore body for mining. For underground mines, development involves driving tunnels from the surface (adits), sinking shafts, driving access and ventilation raises, and accessing ore blocks with crosscuts and other tunnels. For surface mines, development may include stripping overburden and removing waste rock above the deposit. Mine development expenditures are also made to purchase equipment such as drills, loaders, trucks, etc.

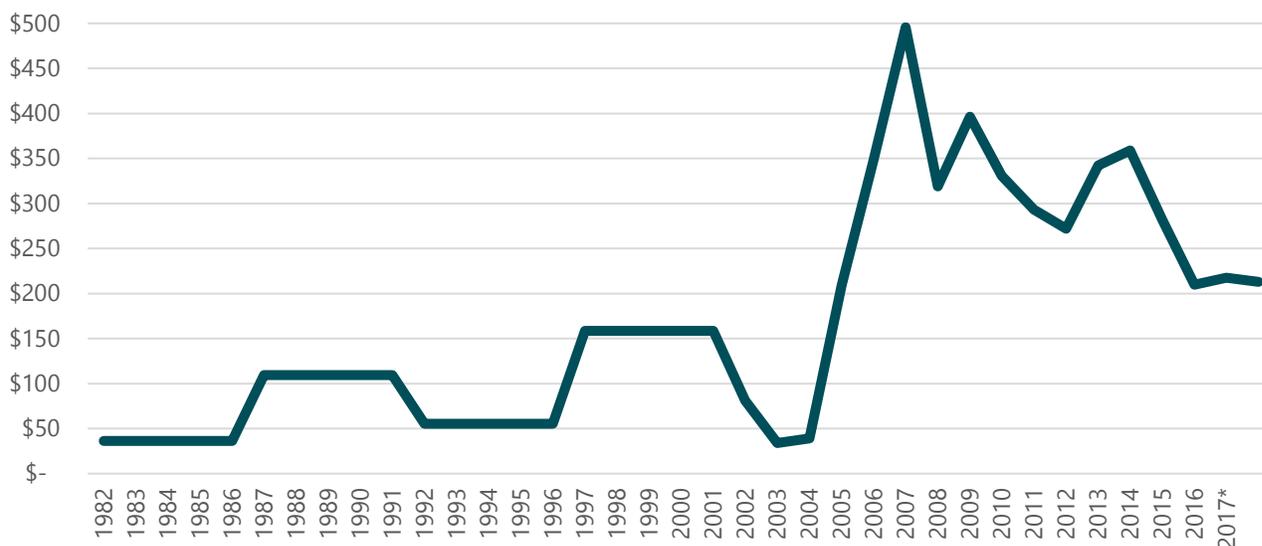
Major mine development can be especially costly in Alaska, where climate, lack of infrastructure, and vast distances pose special challenges. Mine development often continues after production has begun. For example, between 1988 and 2017, \$1.2 billion has been invested in initial and subsequent development of the Red Dog mine, some in mine expansion, but much of it in transportation infrastructure.²¹ Developing additional ore bodies, expanding mill facilities, and other investments may enhance or prolong mine operations.

²¹ Email correspondence with Wayne Hall, Teck Alaska, January 30, 2018. Does not include exploration expenditures.

Mine Development in Alaska

Investment in mine development can be variable year to year, depending on the extent to which new mines are constructed. Investment is more consistent for enhancements, improvements, or expansions of existing mines. Between 1981 and 2017, approximately \$6.2 billion has been spent on mine development in Alaska.

Figure 5. Development Expenditures in Alaska, 1981-2017, \$million



*Preliminary estimates

Source: *Alaska's Mineral Industry 2016*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys.

In 2016, eight mining projects invested approximately \$217.4 million in development in Alaska. Approximately \$133.2 million (or 61 percent of total development spending) was associated with precious metals mines (Fort Knox, Pogo, and Kensington). Ninety percent of total development spending (approximately \$195.8 million) was done by existing mines, including Red Dog, Fort Knox, Pogo, Kensington, and Greens Creek.²² The preliminary estimate for 2017 development expenditures is \$213.0 million.

EXISTING MINE DEVELOPMENT

Examples of major 2016 capital projects include:

- **Red Dog** – \$46.0 million for construction of a new lime slaker building, allowing for complete treatment of drainage water captured from the main waste stockpile and development of its Qanaiyaq deposit, a near-surface deposit located immediately south of the existing main pit.
- **Fort Knox** – \$37.4 million for ongoing infrastructure improvements and equipment.
- **Pogo** – \$6.9 million for ongoing improvements and new equipment.

²² <http://dggs.alaska.gov/webpubs/dggs/sr/text/sr072.pdf> p. 36.

- **Greens Creek** – \$14.0 million for expansion of the tailings facility, begun in 2015 after a lengthy permitting process. The total expansion has an estimated cost of \$44.0 million and will span three years.²³

NEW MINE DEVELOPMENT

Below is a map of Alaska’s new mining projects (Donlin Gold and Pebble) currently in the development phase.

Figure 6. Map of New Alaska Projects in Development



Donlin Gold

Donlin Gold is equally owned by NOVAGOLD and Barrick Gold U.S. Inc. The development project is located approximately 280 miles from Anchorage in Southwest Alaska, about 12 miles north of the Kuskokwim River near the community of Crooked Creek. Donlin Gold leases the sub-surface rights from Calista Corporation and the surface rights from Kuskokwim Corporation.

²³ Alaska Journal of Commerce, *Greens Creek, Kensington Mines Expanding Production*, July 22, 2015.

The project will be an open-pit gold mine, processing approximately 59,000 short tons of ore per day. Infrastructure plans call for a power-generation plant, water-treatment plant, access roads, housing, two ports, a 14-inch buried natural-gas-pipeline and an airstrip. During its 27+ year operational phase, it is estimated to produce an annual average of 1.3 million ounces of gold. Up to 3,000 jobs would be needed during construction, and up to 1,400 jobs during operations.



Currently, the project is in its permitting stage, including review of an Environmental Impact Statement (EIS) managed by the U.S. Army Corps of Engineers as the lead federal agency.

Pebble

Since 2002, more than \$750 million has been spent on the Pebble Project in southwestern Alaska to study a potential world-class copper deposit, carry out baseline environmental and socio-economic studies, and perform geotechnical work and project engineering. Over \$150 million of this investment was made in environmental and socioeconomic baseline research and analysis.²⁴

Currently, Northern Dynasty Minerals owns 100 percent of Pebble Project; however, in December 2017, Northern Dynasty Minerals entered into a framework agreement with First Quantum Minerals to pursue an ownership position of the Pebble Partnership, including a commitment to contribute \$37.5 million to the Partnership.

The current resource estimate includes 6.44 billion metric tons in the measured and indicated categories containing 57 billion pounds copper, 70 million ounces of gold, 3.4 billion pounds molybdenum and 344 million ounces silver; and 4.46 billion metric tons in the inferred category, containing 24.5 billion pounds copper, 37 million ounces gold, 2.2 billion pounds molybdenum and 170 million ounces silver. Palladium and rhenium also occur in the deposit.²⁵

In January 2018, the U.S. Army Corps of Engineers accepted Pebble Partnership's permit application to formally begin the permitting process under the National Environmental Policy Act (NEPA) review process and other permitting efforts associated with the project. The Pebble Partnership is proposing to develop the Pebble copper-gold-molybdenum porphyry deposit in southwest Alaska as an open pit mine, with associated on and off-site infrastructure, including:

- a 230-megawatt power plant located at the mine site;
- an 83-mile transportation corridor from the mine site to a port site on the west side of Cook Inlet;
- a permanent, year-round port facility near the mouth of Amakdedori Creek on Cook Inlet; and,
- a 188-mile natural gas pipeline from the Kenai Peninsula to the Pebble Project site.

Following four years of construction activity, the proposed Pebble mine will operate for a period of 20 years. This includes 14 years of mining using conventional drill-blast-shovel operations, followed by six years of milling

²⁴ <https://corporate.pebblepartnership.com/news-article.php?s=pebble-welcomes-a-new-partner>

²⁵ <https://www.northerndynastyminerals.com/pebble-project/project-overview/>

material from a low-grade ore (“LGO”) stockpile. The mining rate will average 90 million tons per year, with 58 million tons of mineralized material going through the mill each year (160,000 tons per day).

The Pebble Project will directly employ approximately 2,000 workers during its four-year construction phase, and approximately 750 workers during its 20-year operations phase.²⁶

Production (Mine Operations)

Following mine development and construction, production can begin. Depending on production rates, the size of the ore body and market conditions, the production phase of the mineral cycle can last from a few years to several decades and be longer or shorter than anticipated. Increasing metal prices, improved technology, lower cost of production, factors such as fuel or electric power can all add years to the life of a mine. Conversely, technical difficulties, falling metal prices, or increasing production costs can force temporary closure or prematurely end the life of a mine.



Mining Production in Alaska

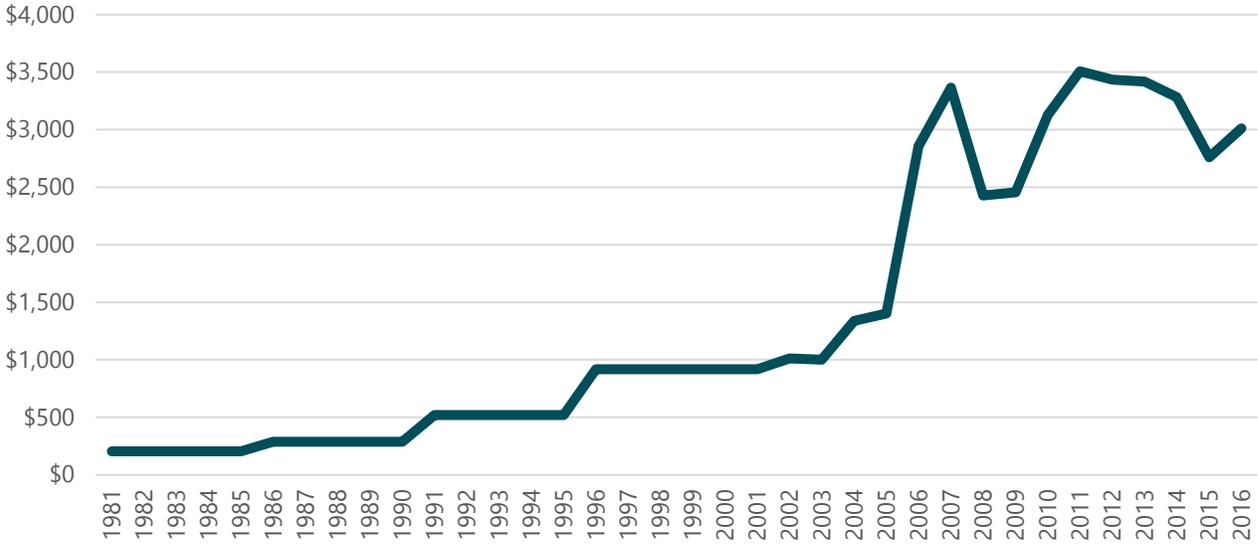
Between 1981 and 2016, the total value of Alaska’s mineral production was approximately \$49.0 billion.²⁷ This estimate is based on global prices for refined metal products. This estimate significantly overstates the revenue earned by mines as the value of Alaska’s production leaving the state is lower, because much of the metal is contained in concentrates rather than a refined form.

A more accurate estimate of revenue to the industry would be based on actual sales (stockpiling for sales, hedging by locking in the future selling prices, and the price at the time of sale accounting for deductions because of other valuable metals or impurities in the concentrate), including smelting and refining charges for the removal of impurities and transportation of the final product). Using this approach, in 2016, the estimated revenue to producers in Alaska was \$2.5 billion (compared to \$3.0 million in estimated production value).

²⁶ <https://corporate.pebblepartnership.com/news-article.php?s=plps-proposed-plan-features-reduced-footprint-and-increased-environmental-safeguards>

²⁷ <http://diggs.alaska.gov/webpubs/diggs/sr/text/sr072.pdf> p. 3.

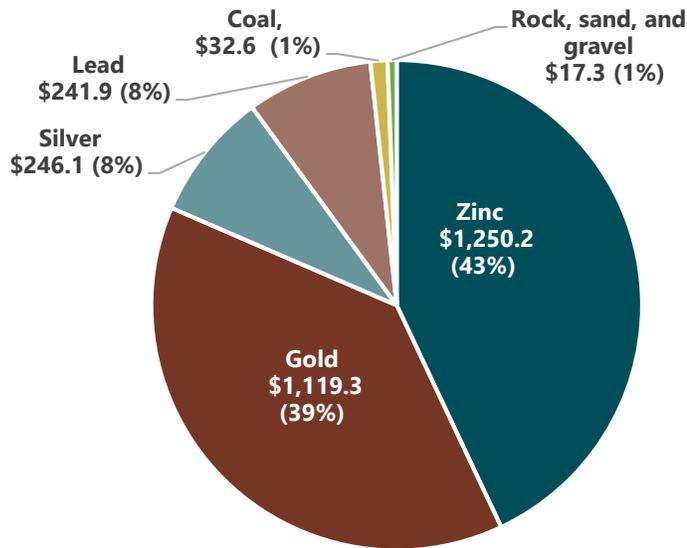
Figure 7. Estimated Mining Production Value in Alaska, 1981-2016 (\$million)



Note: These annual production values overstate the value of the commodity to Alaska producers as it is based on refined costs, rather than sales of concentrates that require additional processing once leaving the state.
 Source: *Alaska's Mineral Industry 2016*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys.

Zinc accounts for 43 percent of mineral production value in Alaska. Gold ranks second (39 percent), followed by silver and lead (both 8 percent), coal (1 percent), and industrial minerals (rock, sand, and gravel) (1 percent).

Figure 8. Mining Production Value in Alaska, by Commodity, 2016 (\$million)

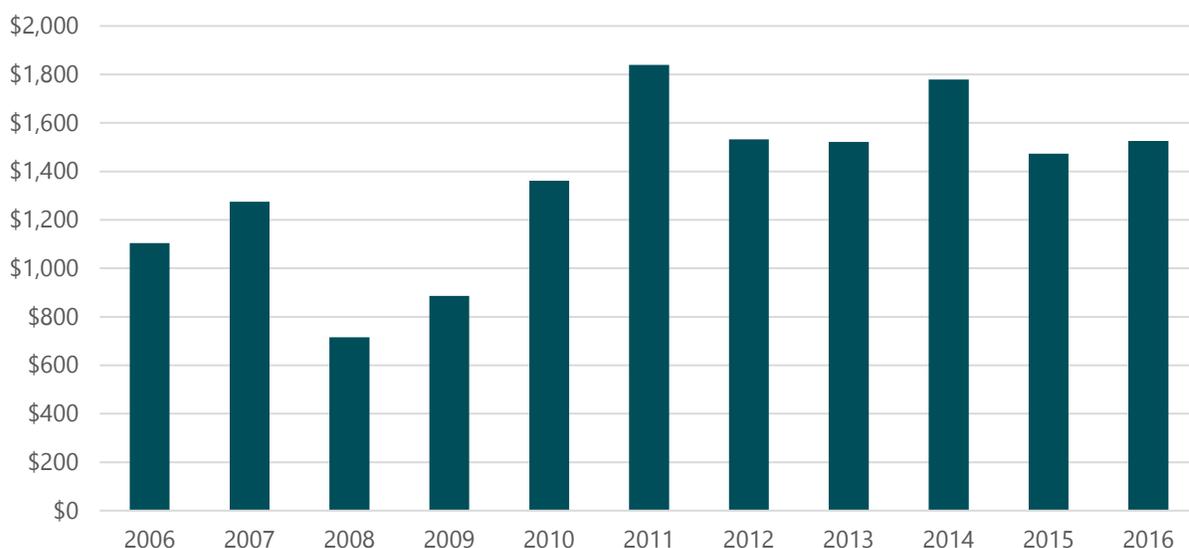


Source: *Alaska's Mineral Industry 2016*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys.

EXPORTS OF ALASKA'S MINERALS AND ORES

In 2016, mineral and ore exports totaled \$1.5 billion, or 35.1 percent of Alaska's total exports (\$4.3 billion). Approximately \$146 million of this total (9.6 percent) was copper ore concentrates from Canada exported through Alaska Industrial Development & Export Authority (AIDEA)-owned Skagway Ore Terminal.

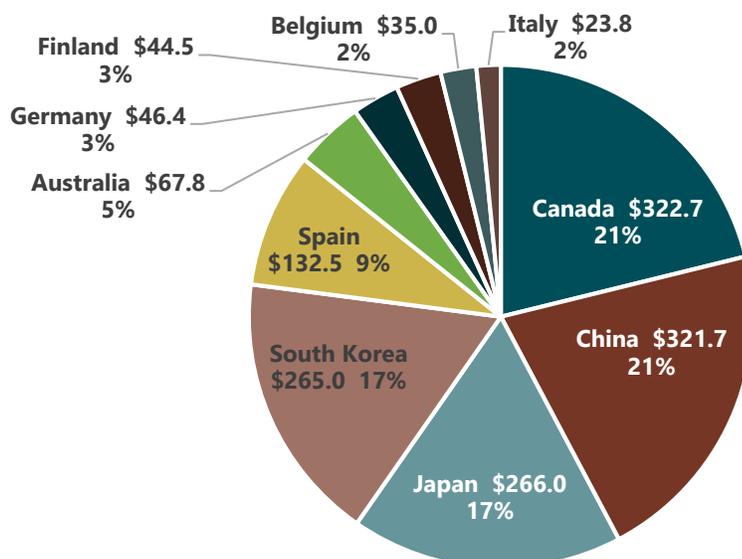
Figure 9. Value of Alaska's Minerals and Ores Exports, 2006-2016



Source: International Trade Administration, U.S. Department of Commerce

Canada is the largest market for Alaska's exported minerals and ores (\$322.7 million), followed closely by China (\$321.7 million). Japan (\$266.0 million), Korea (\$265.0 million), and Spain (\$132.5 million) round out the top five export markets.

Figure 10. Alaska's Minerals and Ores Export Markets, 2016



Source: International Trade Administration, U.S. Department of Commerce

In 2016, Alaska had six major mines in operation, including Greens Creek, Fort Knox, Kensington, Pogo, Red Dog, and Usibelli Coal, along with approximately 236 other placer mines, and multiple rock quarries, and sand and gravel pits.

Figure 11. Map of Alaska’s Major Producing Mines, 2017



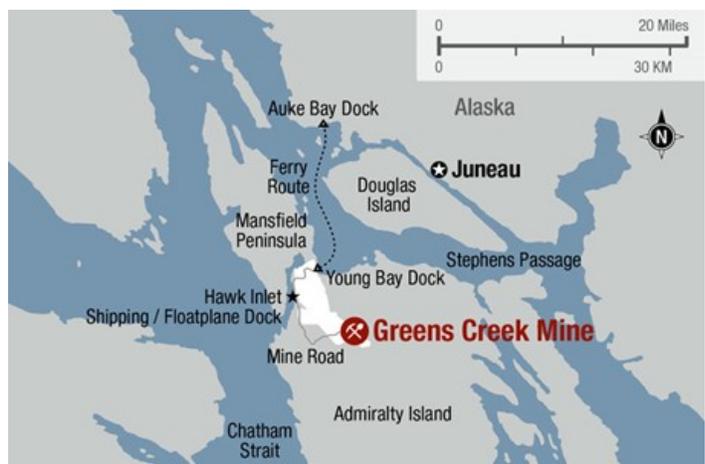
Alaska Producing Mines

LARGE METAL MINES

Greens Creek

Greens Creek Mine began production in 1989 under the operation of Kennecott Minerals Company. Hecla Mining Company “Hecla” has long held an interest in the mine and, in 2008, acquired full interest. Located on Admiralty Island southwest of Juneau, Greens Creek is the largest silver mine in the United States and one of the largest in the world.²⁸ Greens Creek was the third largest zinc producer, eighth largest lead producer, and twentieth largest gold producer in the U.S. in 2015^{29,30,31}

Figure 12. Map of Greens Creek Mine Operations



Source: Hecla Mining Company

²⁸ <https://minerals.usgs.gov/minerals/pubs/commodity/silver/myb1-2014-silve.pdf>. p. 68.7

²⁹ <https://minerals.usgs.gov/minerals/pubs/commodity/zinc/myb1-2015-zinc.pdf>. p. 85.9

³⁰ <https://minerals.usgs.gov/minerals/pubs/commodity/lead/myb1-2015-lead.pdf>. pg. 42.7

³¹ <https://minerals.usgs.gov/minerals/pubs/commodity/gold/myb1-2015-gold.pdf>. p. 31.9

Greens Creek is an underground silver, gold, zinc, and lead mine, which operates on 23 square miles of land, including land leased from the U.S. Forest Service. The mine runs 24 hours per day, 365 days per year. Mine facilities include the underground mine, a dry stacked tailings facility, a ship-loading facility, camp facilities, and a ferry dock.³² The current proven and probable silver reserves of the mine are 89 million ounces, and the estimated remaining life of the mine is 10 years.³³ Interruptible power sales from AEL&P to Greens Creek help keep electricity rates low for all Juneau customers.

In 2016, Greens Creek produced 9 million ounces of silver, the highest year of silver production since Hecla became the sole owner of the mine.² The mine also produced 53,900 ounces of gold, 57,700 tons of zinc, and 20,500 tons of lead.

Greens Creek directly employed 414 people in 2016 with total annual wages of \$50.9 million. Two out of three (66 percent) were Alaska residents (of which 193 workers were Juneau residents). The mine is Juneau's largest private sector employer in terms of annual average, full-time employment and total annual wages.³⁴ Goods and services spending totaled \$75 million statewide and \$58 million with businesses located in Juneau. Including direct, indirect, and induced employment and wages, Greens Creek's operations accounted for 975 jobs and \$76 million in total wages in the statewide economy, including all multiplier effects.

Mine property and sales tax generated \$2.4 million in payments to the City and Borough of Juneau. Additionally, Greens Creek paid \$1.1 million to the State of Alaska, predominantly for the Mining License Tax. Greens Creek contributed \$137,000 to 90 Alaska charities in 2016, including \$48,000 contributed to 51 Juneau non-profits.³⁵

Fort Knox

In production since 1996, Fort Knox Mine is a wholly-owned subsidiary of Canadian-based Kinross Gold Corporation. The mine is a conventional open pit mine located approximately 26 miles northeast of Fairbanks via road (21 miles paved and five miles unpaved). The mine occupies land owned by the State of Alaska and the Alaska Mental Health Trust. It is located in the Fairbanks mining district, a belt of lode and placer gold deposits considered one of the largest gold-producing areas in Alaska and the fifth largest gold producer in the U.S. in 2015.³⁶



The mine operates 24 hours per day, seven days a week, year-round. Higher-grade ore is processed at a mill facility with a capacity of up to 45,000 metric tons per day. In 2007, permits were acquired from the State of Alaska for a mine heap-leaching project in the Walter Creek drainage area, and in 2008 the facility was

³² <http://www.hecla-mining.com/greens-creek/>. Accessed May 22, 2017.

³³ Hecla Mining Company, *2016 Annual Report*, February 2017.

³⁴ City and Borough of Juneau, *Comprehensive Annual Financial Report- Fiscal Year Ended June 30, 2016*. 2016.

³⁵ McDowell Group, "Socioeconomic Impacts of the Greens Creek Mine," prepared for Hecla Greens Creek Mining Company, June 2017.

³⁶ <https://minerals.usgs.gov/minerals/pubs/commodity/gold/myb1-2015-gold.pdf>. p. 31.9

constructed to process lower-grade ore, thus extending the mine's life. In 2016, Fort Knox Mine produced 409,845 ounces of gold and poured its 7 millionth ounce.

The Fort Knox monthly electrical power requirement ranges between 32 and 35 megawatts and is supplied by a powerline extending from the Golden Valley Electric Association (GVEA) substation at Gold Hill to Fort Knox site (approximately 29 miles). Buildings on site include the mill complex, administration and security building, maintenance facility and warehouse, and primary crusher and control office.³⁷

Kinross gained mineral rights to 709 acres of adjacent land (known as Gilmore Dome) from the National Oceanic and Atmospheric Administration in December 2017. This expansion added 2.1 million ounces to Fort Knox's estimated measured and indicated resources, and 300,000 ounces in estimated inferred resources. Kinross expects to initiate the permitting process for mining at Gilmore Dome by the end of 2018.³⁸ Currently, the mine is expected to operate until 2021.

Fort Knox had an annual average employment of 668 employees in 2016, of which 98 percent live in Alaska. Total payroll (excluding benefits) was \$71.8 million. An additional 169 full-time or temporary contractors worked on-site in 2016. Fort Knox spent approximately \$182.5 million (or 69 percent of total goods and services spending) with 469 Alaska vendors.

In a recent 2015 McDowell Group study, it was estimated that Fort Knox-related direct, indirect, and induced employment statewide totaled 1,300 jobs with total wages of \$120 million (2014).³⁹ At the time of that same study, Fort Knox Mine was GVEA's single largest commercial customer, purchasing approximately 30 percent of the total kilowatt-hours sold each year at a value of \$44.9 million in 2014. Based on GVEA's analysis, the size of Fort Knox Mine's power usage translates into significant rate savings (approximately 1.3¢ per kilowatt hour) for all its residential, commercial, and industrial customers.⁴⁰

Kensington

Coeur Alaska, a subsidiary of Coeur d'Alene Mines Corporation, operates the Kensington Gold Mine, located about 45 miles north of Juneau in Southeast Alaska. Juneau is the principal service and supply center for the underground mine and home to most of the operation's labor force. The company started developing the mine in 2005 and, after permitting-related delays, started production in July 2010. In 2016, 124,331 ounces of gold were produced at Kensington. The mine has 497,000 ounces of gold in proven and probable reserves, 871,000 ounces in measured and indicated resources, and 436,000 ounces in inferred resources.⁴¹ Kensington was the fifteenth largest gold producer in the U.S. in 2015.⁴²

³⁷ http://s2.q4cdn.com/496390694/files/doc_downloads/technical_reports/2015TR-FortKnox.pdf

³⁸ <http://www.kinross.com/news-and-investors/news-releases/press-release-details/2017/Kinross-acquires-mining-rights-to-land-adjacent-Fort-Knox-mine-adds-more-than-2-million-ounces-to-mineral-resource-estimates/default.aspx>

³⁹ McDowell Group, "Socioeconomic Benefits of Fort Knox Mine," prepared for Kinross Fort Knox, October 2015.

⁴⁰ Communication with Tom Hartnell, Vice President of Member Services, Golden Valley Electric Association, October 15, 2015.

⁴¹ <http://www.coeur.com/mines-projects/mines/kensington-alaska#.Wl06pzeUuUk>

⁴² <https://minerals.usgs.gov/minerals/pubs/commodity/gold/myb1-2015-gold.pdf>. p. 31.9

In 2016, the mine employed an annual average of 324 workers (not including contractors), of which 67 percent were Alaska residents. Payroll (excluding benefits) totaled \$36.4 million in 2016. In addition, an annual average of 90 contractors worked on-site.⁴³ These contractors provided transportation and warehouse services, construction, engineering, maintenance, electrical, safety, geology, food and camp services, supply chain, and technical services. In 2017, employment grew to about 360 employees. Coeur Alaska spent approximately \$88.5 million on goods and services in 2016, including \$54 million with Alaska vendors.

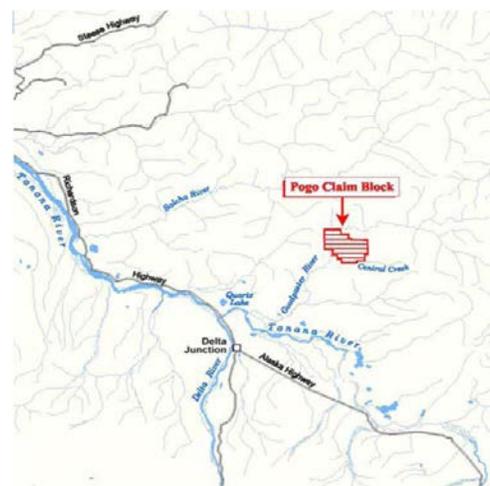


Total sustaining and development capital expenditures were \$36.8 million in 2016. Development of the Jualin decline continued on schedule with 64 percent completed by year-end 2016.⁴⁴ Kensington's 2017 surface and underground exploration was focused at Kensington Main and Jualin, Raven, and other veins. Production from Jualin is expected in 2018.

Pogo

Pogo operations are located about 85 miles southeast of Fairbanks and 38 miles northeast of Delta Junction in the Goodpaster River Valley. The underground high-grade gold mine is accessed by a 49-mile all-season road from the Richardson Highway. Evaluation of mineral potential began in 1981, with claims first staked in 1991. The mine was originally permitted in 2003. In 2005, underground mine development began and by January 2006, the deposit had been fully developed with a large permanent camp, ore processing facilities, water treatment plant, power transmission lines, provisions for tailings disposal, and underground workings. The first gold pour was in February 2006. In 2009, the Pogo project was a joint venture of the Canadian-based Teck Resources Limited (40 percent), the Japanese-based Sumitomo Metal Mining Co., Ltd. (51 percent) and Sumitomo Corporation (9 percent), with Teck as the operator. In July 2009, Teck sold its interest in the mine, which is now a joint venture of Sumitomo Metal Mining Co., Ltd. (85 percent) and Sumitomo Corporation (15 percent). Pogo is permitted to operate through late 2021 or early 2022, though exploration efforts are underway to extend operations beyond that time.

Figure 13.
Map of Pogo Mine Operations



Source: Sumitomo Metal Mining Pogo LLC.

⁴³ Based on email correspondence with Jan Trigg, Coeur Alaska, December 17, 2017.

⁴⁴ <http://dgggs.alaska.gov/webpubs/dgggs/sr/text/sr072.pdf>. p. 48

Because of its remoteness, Pogo is a camp-supported operation, including housing, food, water treatment, emergency medical care, and a full-service fire department at the mine site. Power is supplied from the regional grid via a 50-mile power line paralleling the access road.

Total resources and reserves are 13.6 million short tons of ore with an average gold grade of 0.366 ounces per short ton and with total gold content of 4.97 million ounces. The mine and mill are open year-round and operate 24-hours per day, seven days per week. The mill processes up to 3,500 tons of ore daily. Since 2007, annual production has averaged about 322,900 ounces of gold. In 2015, Pogo was the eighth largest gold producer in the U.S.⁴⁵ In 2016, Pogo produced 269,341 ounces of gold.

In 2016, Pogo Mine directly employed an average of 319 workers. Two-thirds of Pogo's employees live in Alaska. About 48 percent of all Alaska resident employees live in the Fairbanks North Star Borough. Pogo generated \$43.9 million in payroll (excluding benefits) in 2016. On average, Pogo employees have wages more than twice the average of private sector workers in Alaska, Fairbanks North Star Borough, and Southeast Fairbanks Census Area.

In 2016, \$132 million was spent on goods and services purchased from approximately 240 Alaska businesses, or 77 percent of total vendor spending. Of total 2016 in-state vendor spending, \$72.7 million (or 55 percent of total Alaska spending) was spent with vendors with operations in the Fairbanks North Star Borough.

In SFY2016, Pogo paid approximately \$2.6 million in taxes and royalties to the State of Alaska, including \$1.9 million for the Alaska Mining License Tax (representing about 17 percent of the State's total Mining License Tax revenues) and \$701,775 for the Alaska Production Royalty, of which 50 percent is deposited in the Alaska Permanent Fund.

In a 2017 McDowell Group study, it was estimated that Pogo-related direct, indirect, and induced employment statewide totaled 824 jobs with total wages of \$92 million.⁴⁶

Red Dog

Red Dog Operations is an open-pit zinc, lead, and silver mine located 90 miles north of Kotzebue and 55 miles inland from the Chukchi Sea. Red Dog Operations is owned and operated by Teck Alaska and located on property owned by NANA Regional Corporation. It was both the largest lead producer and zinc producer in the U.S. in 2015, and the second largest silver producer in the U.S. in 2014.^{47,48,49}

Production in 2016 included 134,800 U.S. tons of lead in concentrate and 645,000 U.S. tons of zinc concentrate.

Figure 14. Map of Red Dog Operations



⁴⁵ <https://minerals.usgs.gov/minerals/pubs/commodity/gold/myb1-2015-gold.pdf>. p. 31.9

⁴⁶ McDowell Group, "The Economic Impact Legacy of Pogo Mine, 2006-2016," prepared for Sumitomo Metal Mining Pogo, LLC, September 2017.

⁴⁷ <https://minerals.usgs.gov/minerals/pubs/commodity/lead/myb1-2015-lead.pdf>. p. 42.7

⁴⁸ <https://minerals.usgs.gov/minerals/pubs/commodity/zinc/myb1-2015-zinc.pdf>. p. 85.9

⁴⁹ <https://minerals.usgs.gov/minerals/pubs/commodity/silver/myb1-2014-silver.pdf>. p. 68.7

Construction of Red Dog began in 1986 with production commencing December 1989. The mine required construction of a 60-mile access road from a port site on the Chukchi Sea. While ore is mined year-round, the concentrate produced is stored for shipment at the port and shipped during the summer months when waters are ice-free and navigable. A total of 26 ships moved concentrate in 2015.

Red Dog is the most capital-intensive mining project in Alaska with original construction costs and subsequent investments totaling more than \$550 million, plus an additional \$265 million invested by Alaska Industrial Development and Export Authority (AIDEA) in DeLong Mountain Transportation System's road and port. Red Dog has repaid AIDEA's investment in the form of user fees. In 2016, Teck Alaska's user fees were \$24.3 million; in 2017, the fees were \$24.8 million. Cumulatively, Teck Alaska has paid \$456 million to AIDEA for use of the system.

In 2010, Red Dog began mining the Aqqaluk deposit which is adjacent to and adjoins the main deposit, extending the mine's proven and probable reserves and the mine life to 2031. In 2016, Teck Alaska spent approximately \$46 million in sustaining capital, much of which was spent on development of its Qanaiyaq deposit, a near-surface deposit located immediately south of the mined Red Dog Main pit.

Red Dog directly employs an average of 447 year-round workers (not including contractors), with approximately \$65 million in total annual wages. An annual average of 102 contractors also worked on site (for NANA Management Services and NANA Lynden). Combined there was an annual average of 549 workers at Red Dog in 2016, with approximately 55 percent NANA shareholders.

For several years, Teck's regional exploration has focused on a significant high-grade zinc deposit, known as Aktigiruiq. Aktigiruiq is located adjacent to the Anarraaq deposit about seven miles northwest of Red Dog mine. Drill data suggests the Aktigiruiq deposit may contain between 80 million and 150 million metric ton of mineralization at a grade of between 16 percent and 18 percent combined zinc and lead. If realized, this would make the Aktigiruiq zinc deposit one of the top undeveloped zinc deposits in the world.⁵⁰ The Aktigiruiq drilling program includes 18,000 meters in 16 to 20 planned holes (with a budget of about \$16.0 million) in 2017.

LARGE NON-METAL MINES

Usibelli Coal

Usibelli Coal Mine (UCM), located in Healy, Alaska, has been producing coal for more than 70 years and is Alaska's only operating coal mine. In 2016, UCM's year-round mining activity produced 930,987 tons of coal for use in seven Interior power plants. UCM staff are in Healy, Fairbanks and Palmer.

Approximately 75,000 tons of production was exported to Japan through its subsidiary, Aurora Energy Services (AES), which operates the Seward Coal Loading Facility owned by the Alaska Railroad Corporation.

⁵⁰ <https://www.teck.com/news/news-releases/2017/teck-increases-red-dog-production-guidance-and-updates-exploration-results-in-the-red-dog-district>



In 2016, about 80 percent of UCM's coal production came from its Jumbo Dome mine, with lesser amounts from its Two Bull Ridge mine.

UCM directly employs an average of 109 year-round workers (not including contractors), with approximately \$12.0 million in total payroll (not including benefits). All of UCM's employees live in Alaska. In a recent 2015 study conducted by McDowell Group, the total impact of UCM's operations in Alaska was measured at 418 jobs

paying \$31 million in wages.⁵¹

PLACER MINING

"Placer mining" removes valuable minerals such as gold, platinum, and precious stones from unconsolidated detrital material. Placer deposits are formed when the host rock is eroded over millions of years, and minerals are transported and concentrated by rivers and streams.

Archeological records have shown that Alaska Native people were the earliest miners in Alaska, extracting copper, marble and other materials. Placer mining is also the oldest form of mining by Western inhabitants in Alaska. The first placer coal was mined on the Kenai Peninsula during the later 1840s and 1850s by the Russians. The earliest gold prospectors were also the Russians who discovered gold at Hope and on the Russian River in 1849.



The first significant discovery of placer gold was near Juneau with later discoveries along the Yukon River near Rampart, Fortymile River, and Circle. At the turn of the 20th century, placer deposits were discovered in Nome and Fairbanks. With the introduction of large-scale cold-water thawing, hydraulic stripping, and mechanized excavation, Alaska became a leading gold producing state with a yield of nearly 750,000 ounces of gold in 1940, most of which came from placer mines.

⁵¹ McDowell Group, "Statewide Socioeconomic Impacts of Usibelli Coal Mine, Inc.," prepared for UCM, January 2015.



Gold mining was shut down during World War II by Presidential Order. After the war, the industry failed to recover from rising operating costs and fixed gold prices. Most placer mining was discontinued by the 1960s. With the lifting of gold ownership restrictions and abandoning of a fixed price in the 1970s, gold production rose dramatically. By 1982, there were more than 500 placer mines statewide (including recreational mines) producing 174,900 ounces of gold worth \$70 million.

There is a strong link between the number of operating placer mines, placer production, and gold prices. Gold prices saw a marked improvement in the late 1970s, peaking at over \$800 per ounce in 1980, followed by a gradual but fluctuating decline to \$256 per ounce in 2001. With the fall in prices, the number of operating family-run placer mines dropped to 42. From a 2005 price of \$450 per ounce, prices rose steadily to an all-time high of nearly \$1,900 in August 2011. Following the same trend, the number of producing placer mines climbed from 71 in 2005 to a recent peak of 321, with production at a nine-year high of 100,041 ounces in 2012. For the past several years, the price of gold has steadily improved (\$1,340 per ounce, as of January 12, 2018). In 2016, there were an estimated 236 placer gold mines in Alaska producing a total of 51,812 ounces of gold. These operations employed an estimated 222 full-time-equivalent employees.⁵² Just over half of the state's active placer mines are in the Eastern Interior region.

A 2014 McDowell Group study estimated approximately 1,200 direct, mostly seasonal jobs in Alaska's placer mine industry. On average, each placer mine had four workers. For miners receiving compensation, 56 percent were paid a wage, while the remaining 44 percent were compensated with a share of gold. Including multiplier impacts, placer mining-related employment statewide totaled 1,700 jobs with a total statewide labor income of \$65 million.⁵³

ROCK, SAND, AND GRAVEL

Rock, sand and gravel deposits are mined in most Alaska communities, supporting road, airstrip, and other commercial, industrial, and residential construction projects throughout Alaska. Some of the operations are quite small, ranging from small gravel pits serving village communities to large quarries and gravel pits found closer to the larger population centers in Anchorage, Palmer, Wasilla, and Fairbanks along the Alaska Railbelt. Rock quarries produce shot rock, crushed stone, D-1, riprap, and modest quantities of ornamental stone.

Annual rock, sand and gravel production is often a reflection of construction market trends. For example, production dipped in the mid-1980s and mid-1990s, and peaked in the late 1990s, reflecting booms and declines in Alaska's housing, industrial and commercial construction markets.

⁵² <http://dggs.alaska.gov/webpubs/dggs/sr/text/sr072.pdf>. p. 40.

⁵³ McDowell Group, "The Economic Impacts of Placer Mining in Alaska," prepared for Alaska Miners Association, October 2014.

The State reported 23 companies producing sand and gravel in 2014, including six each in the Southcentral and Southeast Alaska, five in the Eastern Interior, and four in the Northern region, with an estimated 30 employees statewide.⁵⁴

The 2016 value of Alaska's rock, sand, and gravel minerals on State lands was at least \$17.3 million. That same year, the estimated volume of State-owned industrial materials sold was 5.4 million tons, of which approximately 81 percent were sources in the Northern mining region. One estimate produced by the Mine Safety and Health Administration is that there were 253 full-time-equivalent jobs in associated with this State land production in 2016.⁵⁵

RECREATIONAL MINING

"Recreational mining" is defined as amateur, casual, short-term mining for placer gold using non-mechanized equipment, such as a gold pan or a small, backpackable sluice box, metal detector or rocker-box. In specific areas, small suction dredges and/or metal detectors may be used. It is typically conducted on private and public properties designated for such purposes and may involve a fee. Recreational mining opportunities are expanding rapidly and are documented throughout most of Alaska. Generally, after paying the state mining license tax, the visiting miners can keep the gold they find or participate in a venture where recovered gold is split equally amongst the participants.

Recreational mining operations range from gold-panning activities attracting several thousand tourists spending \$15 and a few hours to find some gold flakes (such as Crow Creek Mine in Girdwood) to operations where a few hundred people spend as much as \$2,200 per week (including equipment, room and board) for as long as two months looking for more significant rewards for their efforts (such as Gold Fever Prospecting in Chicken).

Based on previous research with recreational mine operators, at least 800 people traveled to Alaska to primarily participate in recreational mining, amounting to at least 1,000 miner-weeks of annual recreational mining at the remote pay-to-mine camps.⁵⁶ Several thousand miner-weeks are also estimated to occur at highway accessible sites near Anchorage and Fairbanks. No attempt has been made to estimate the number of recreational miners visiting Federal and State designated gold panning areas, but it is likely to exceed the number visiting commercial sites.⁵⁷



Though no specific data is available, the total economic impact of recreational mining in Alaska likely exceeds several million dollars, including payments to private owners and spending on transportation, accommodations, food, services and supplies.

⁵⁴ <http://dggg.alaska.gov/webpubs/dggg/sr/text/sr070.pdf>, p. 36.

⁵⁵ Ibid. p. 41.

⁵⁶ McDowell Group, "The Economic Impacts of Alaska's Mining Industry," prepared for Alaska Miners Association, January 2013, p. 25.

⁵⁷ There are several free sites located on State and Federal lands withdrawn from claim staking and available for recreational use, while there are others which are commercial and located on private property or permitted mining claims that charge for the right to mine.

Mine Closure and Reclamation

Mine reclamation is the process of returning an area to a physically and chemically stable condition and converting mined or otherwise industrially developed land to some other useful function. Reclamation occurs at all phases of a mine's life, including the exploration, development, operational (often referred to as contemporaneous reclamation), and closure phases. In remote areas, the goal is most often to create productive ecosystems. In more urbanized areas, the goal might be to convert land to other industrial, commercial or recreational uses. The process of mine reclamation can include grading and stabilizing the landscape, placing topsoil, and generating re-vegetation. Mine reclamation can also involve long-term commitments by mining companies to monitor environmental conditions in the reclaimed areas. Occupations commonly employed during reclamation include: engineers, arborists, horticulturalists, biologists, landscape architects, heavy equipment operators, and various construction trades.

The State of Alaska requires a reclamation bond for disturbances over 5 acres in size. A portion of the reclamation bond may be refunded upon approved reclamation.⁵⁸ The five metal mines in operation have secured a combination of more than \$757 million in personal bonds as their obligation to meet the terms of their reclamation and closure plans, waste management, dam certificates, and road and power line rights-of-way permits.⁵⁹

⁵⁸ <http://dnr.alaska.gov/mlw/mining/placer.cfm>

⁵⁹ State of Alaska Department of Natural Resources Division of Mining, Land, and Water, Mining Reclamation Bonds; Fort Knox (signed 2014), Pogo (2012), Red Dog (2017), Kensington (2013), and Greens Creek (2014) (<http://dnr.alaska.gov/mlw/mining/largemine/>)

Employment and Payroll in Alaska's Mining Industry

This section provides analysis of Alaska's mining industry employment and payroll effects, based on three categories:

- **Direct** employment and payroll includes employees of mining and exploration companies who work in Alaska.
- **Indirect** employment and payroll includes employees of Alaska businesses that provide goods and services to mining and exploration companies.
- **Induced** employment and payroll includes jobs and income created when mine workers spend their payroll dollars in the local economy.

The mining industry directly or indirectly creates thousands of jobs and millions of dollars in payroll throughout the Alaska economy. These jobs and payroll are related to exploration, development and production, along with other mining related activities such as recreational mining. This analysis of employment and payroll in Alaska's mining industry begins with an overview of available employment data for the industry then presents an analysis of the indirect impacts of the mining industry.

Direct Employment and Payroll

Published Sources of Employment and Payroll Data

The Alaska Department of Labor and Workforce Development (DOLWD) and the state Division of Geological and Geophysical Surveys (DGGs) provide measures of mining employment in Alaska, described below.

ALASKA DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT

DOLWD compiles wage and salary employment data from Quarterly Contribution Reports, which all Alaska employers are required to submit for purposes of calculating employment security taxes. These reports provide a count of all workers employed each month, as well as their total quarterly wages. In the DOLWD data, there is no distinction between full-time and part-time employment.

DOLWD categorizes employment according to the North American Industry Classification System (NAICS). Industry sectors that encompass the mining industry include:

- Coal
- Metal Ore
- Metal ores mining
 - Gold ore and silver ore mining
 - Lead ore and zinc ore mining
 - All other metal ore mining

- Non-metallic Mineral, Quarrying
 - Crushed and broken limestone mining and quarrying
 - Other crushed and broken stone mining and quarrying
 - Construction sand and gravel mining
 - All other non-metallic mineral mining
- Mining Support Activities
 - Metal mine drilling
 - Non-metallic mine drilling

Mining-related activity falls into several other NAICS categories as well, though it is combined with non-mining employment. This includes the professional services sector, where several mineral exploration firms are classified. These firms typically work under contract to mining companies, therefore their employment could be considered indirect.

Some of the types of businesses and professionals engaged in exploration projects include:

- Geological exploration services
- Drilling services
- Camp support services
- Helicopter support services
- Construction services
- Scientific and other professional research services

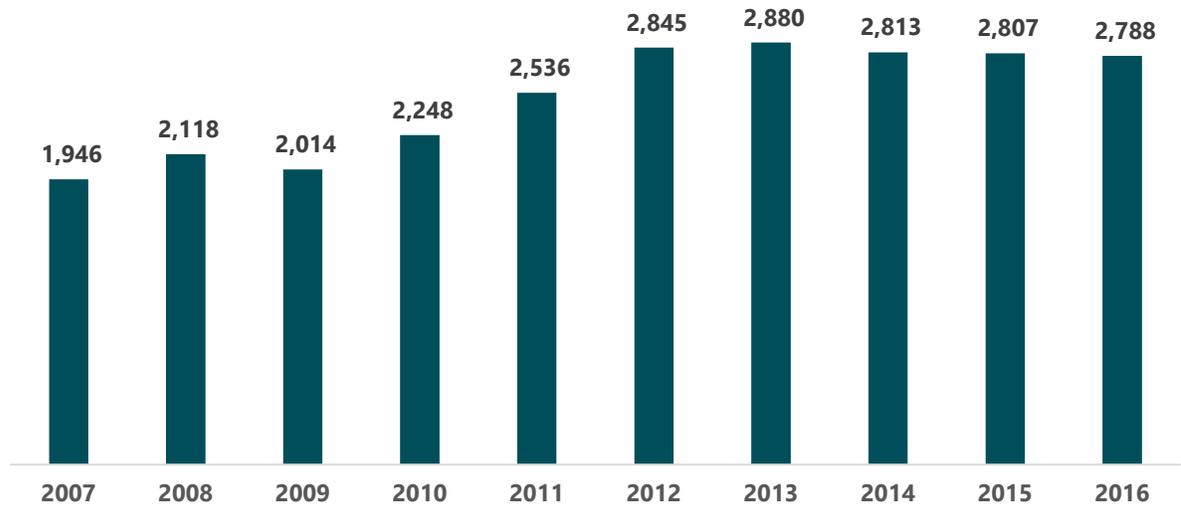
Of these services, DOLWD provides mining specific data only for drilling services, but this is only a partial measure as some drilling jobs are included in the construction sector.

There is other direct mining industry employment that is not captured at all in DOLWD data. Notably, DOLWD data does not include self-employed “proprietors.” In the mining industry this could include small-scale placer mining operations. It could also include individuals working under contract, such as exploration geologists.

According to DOLWD data, metal mining employed an average of 2,531 wage and salary workers in 2016. Alaska’s metal mining industry generates some of the highest paying jobs in Alaska, with an average annual wage of \$115,516 in 2016, more than double the state average of \$53,160 for all sectors of the economy. Only the oil industry generates higher annual wages than the mining industry in Alaska. Including coal mining and non-metallic mineral mining or quarrying activity, mining employment in 2016 averaged 2,788 employees with an average annual wage of \$108,624.

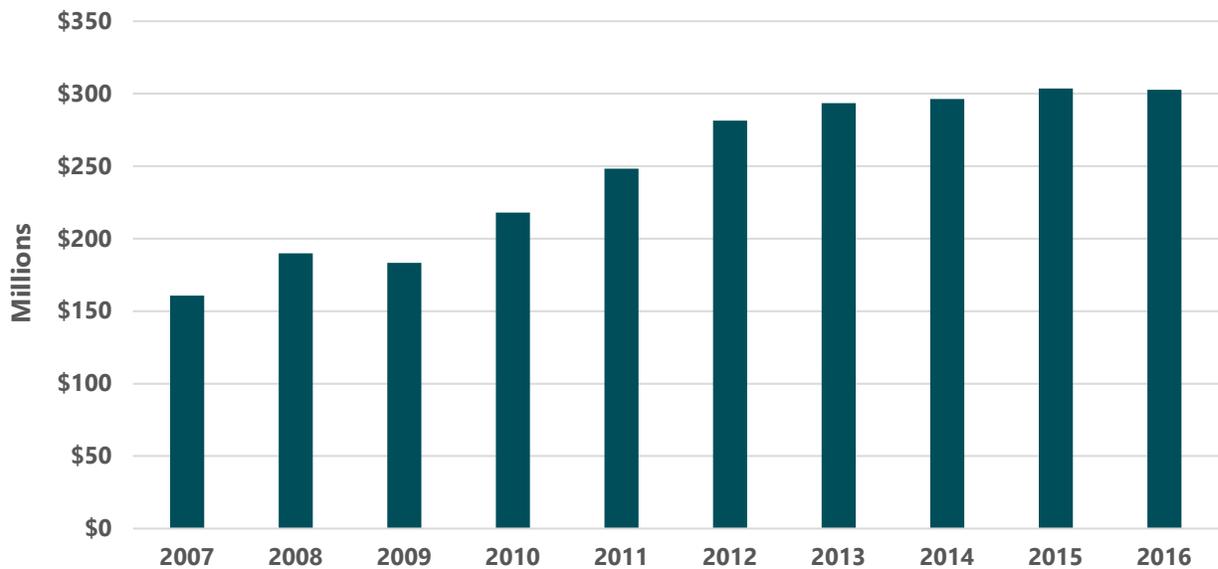
The last ten years of DOLWD-reported mining employment and wages are found in the figure below.

Figure 15. Alaska Mining Industry Employment, 2007-2016



Note: Includes metal ore, coal, and nonmetallic mining.
Source: Alaska Department of Labor and Workforce Development

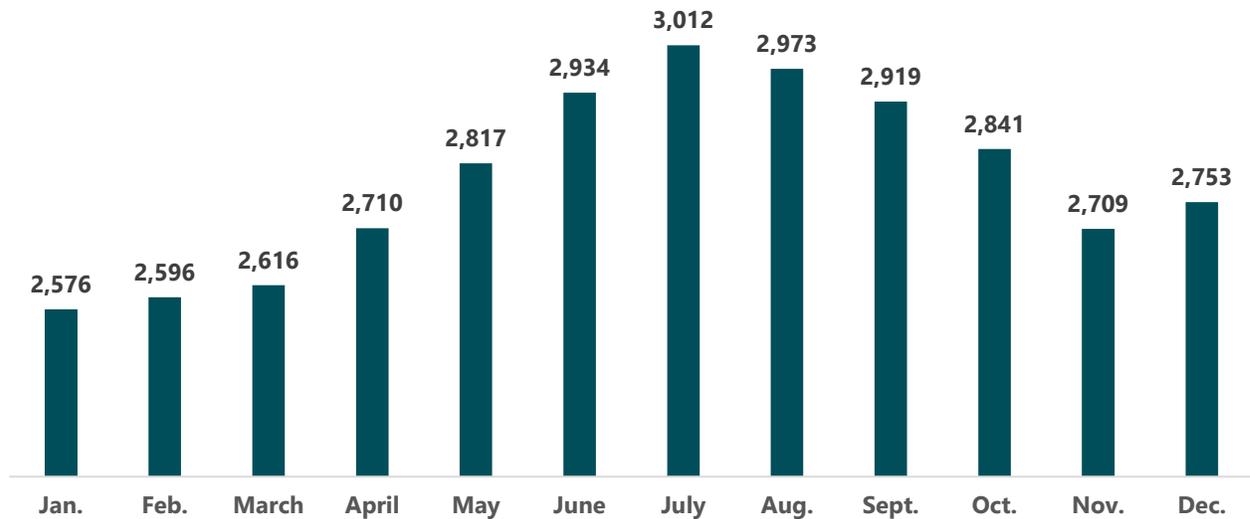
Figure 16. Alaska Mining Industry Wages, 2007-2016



Note: Includes metal ore, coal, and nonmetallic mining.
Source: Alaska Department of Labor and Workforce Development

The graph below shows the seasonality of Alaska’s monthly mining employment, which is largely associated with summer exploration projects.

Figure 17. Monthly Employment in Alaska’s Mining Industry, 2016



Note: Includes metal ore, coal, and nonmetallic mining.
Source: Alaska Department of Labor and Workforce Development

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

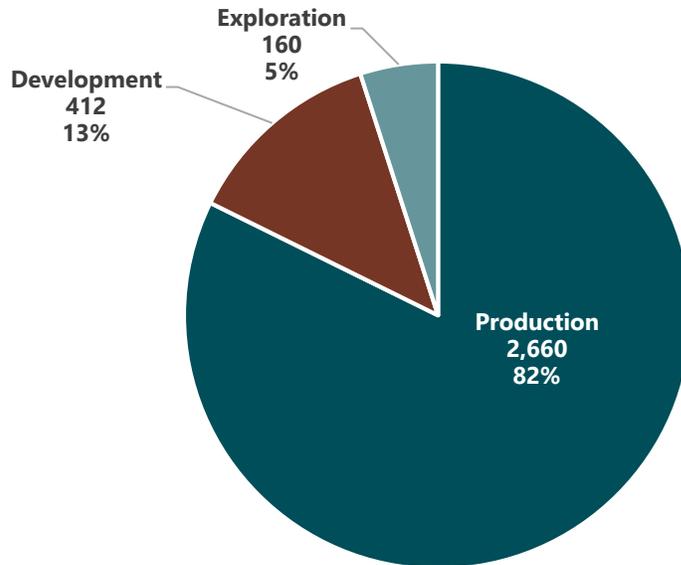
DGGS provides a broader measure of mining industry employment in Alaska. Its report, *Alaska’s Mineral Industry 2016*, estimated mining industry employment at 3,232 full-time equivalent jobs. This includes both direct and some employment that conventionally would be defined as indirect. The data is from a survey of businesses, agencies, and individuals in Alaska that are engaged in some aspect of mining in the state.

The DGGS estimate includes production employment such as that reported by DOLWD as well as a broad range of contract employment in drilling, camp support, and other professional and trade services. The DGGS estimate also includes construction materials handling employment that is likely captured by DOLWD in the construction sector rather than in the mining sector and might be considered indirect. Finally, it includes the smaller operations, many of which are placer operations, that do not report employment to DOLWD.

The best comprehensive estimate available for exploration program employment in Alaska is provided by DGGS. In 2016, DGGS estimated 160 annual average, full-time equivalent jobs in exploration. Though data is not available, employment during the peak summer season is much higher.

The figure below shows DGGS’s breakout of employment by exploration, development, and production categories.

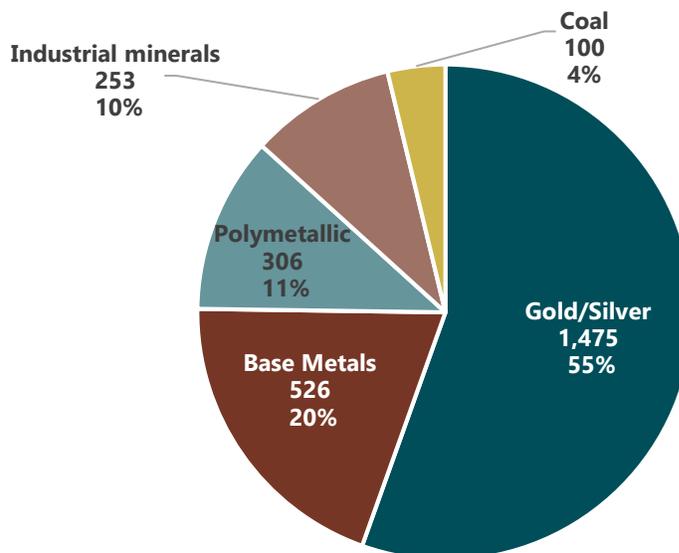
Figure 18. Mining Employment, by Activity, Full-time Equivalent Jobs, 2016



Source: DGGs, Alaska Department of Natural Resources

DGGs also breaks up the total 2,660 production employment estimate for 2016 by mining type. Gold and silver producing mines represent the largest type of production employment (1,475 workers or 55 percent of all production workers), followed by base metals and polymetallic mining.

Figure 19. Mining Production Employment, by Mining Type, 2016



Source: DGGs, Alaska Department of Natural Resources

Other Mining-Related Employment

A wide variety of other jobs are indirectly linked to Alaska’s mining industry: for example, regulatory and research jobs in state and federal government that directly serve the mining industry. These include jobs with the US Bureau of Land Management, the US Geological Survey, and the USDA Forest Service. In State government, there are personnel within the Department of Natural Resources tasked with conducting mining industry-related research. The University of Alaska’s Mineral Industry Research Laboratory conducts basic and

applied research to facilitate the development of Alaska's mineral and energy resources. The UAF College of Engineering and Mines through the Department of Mining and Geological Engineering also supports Alaska's mining industry. Mining industry-related employment in Alaska also includes jobs at mine training centers such as the Mining and Petroleum Training Services in Juneau and Fairbanks. In this study, these jobs are assumed to be included in the mining industry's indirect employment, which is discussed below.

McDowell Group Estimate

Recognizing that the routinely published measures of mining industry does not provide a full accounting of industry employment in Alaska, McDowell Group uses survey research and other research and analysis to develop a more comprehensive measure of annual average employment and total annual wages. McDowell Group's estimates for 2016 and 2017 are presented in the following table.

Table 3. Mining Industry Employment and Wages in Alaska, 2016 and 2017

Year	Annual Average Employment	Total Wages (\$millions)
2016	4,350	\$390
2017	4,500	\$404

Source: McDowell Group estimates.

Indirect Benefits of Mining for Alaska's Business Sector

This section describes how Alaska businesses, other than mining companies, benefit from mining activity in the state. In-state spending with Alaska firms by mining companies in support of their mining and mine development projects benefits hundreds of Alaska businesses. Partnerships and other relationships with Alaska corporations that own mineral property rights are other important avenues that convey the economic benefits of mining to Alaska businesses and therefore to individual Alaskans.

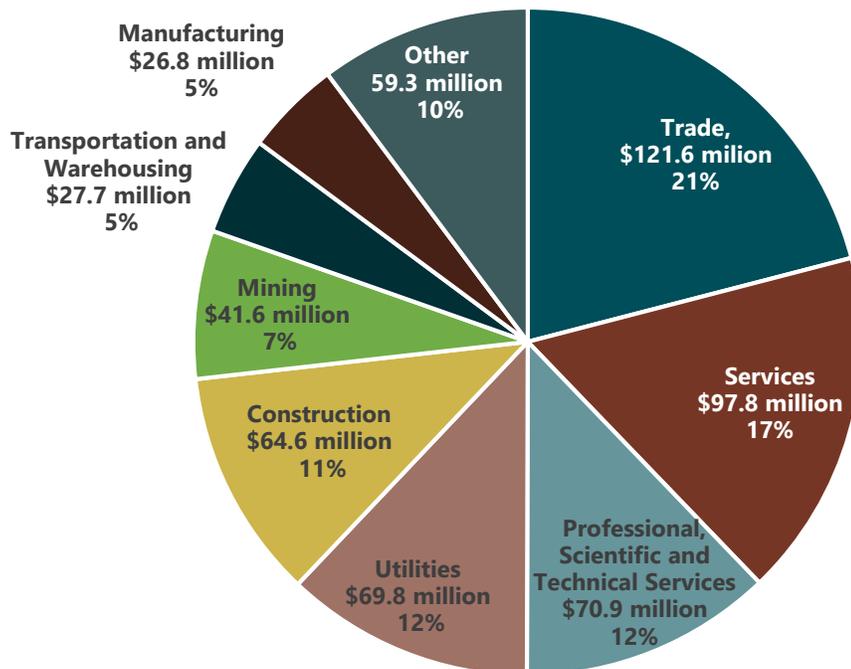
Purchases of Goods and Services in Support of Mining

Alaska's six largest mines (Usibelli Coal, Greens Creek, Red Dog, Fort Knox, Pogo, and Kensington) and advanced exploration projects spent an estimated \$880 million in 2016 with businesses inside and outside Alaska. This amount varies year-to-year, depending on the level of capital investment (including construction activity) at each mine. Two-thirds (\$580 million) of these goods and services purchases were made with approximately 600 Alaska vendors.

Spending patterns differ whether a project is in the exploration, advanced exploration, development, or production stage. For example, exploration spending is primarily with businesses providing professional services (such as engineering, environmental services, consulting, etc.), services (such as camp support services), transportation (helicopter support, marine and air transportation) and drilling and mine support. Producing mines spend mostly with wholesale and retail trade businesses, companies providing professional, scientific, and technical services, utilities (mostly electricity), and construction services.

The figure below shows how mining company spending was distributed among different types of Alaska vendors in 2016.

Figure 20. Alaska Mining Industries Goods and Services Spending, by Type of Vendor, 2016



Indirect and Induced Employment and Payroll

Multiplier Effects

The direct employment figures described previously in this report do not include all the support sector jobs in Alaska that are linked to mining. The non-payroll spending by mining companies and spending by employees creates additional economic activity in Alaska, sometimes described as the “multiplier effect.” Mining-related spending flows through the Alaska economy in a variety of ways, creating additional spending, employment and payroll. For example:

- **As described above, mining companies collectively purchase several hundred million dollars’ worth of goods and services** from hundreds of Alaska businesses located throughout the state. Regional centers such as Anchorage, Fairbanks and Juneau provide many of the goods and services that can be provided in-state, but businesses in smaller communities also benefit from local purchases, especially in support of remote exploration programs.

Though the Alaska mining industry has a high multiplier effect relative to other industries (second only to the oil industry), it does not create as large a multiplier effect as mining in some other regions of the U.S. simply because fewer of the materials the industry needs are manufactured in Alaska. The multiplier effect is greater when the spending is on supplies and materials locally (or regionally) produced. Mining materials consumed in large quantities—such as explosives, chemical reagents used in ore processing, drilling supplies, and equipment—are shipped into Alaska. A mine spending the same amount in

Nevada and Alaska will have larger multiplier effects in Nevada because more of the goods purchased there are also produced within that state. As Alaska's mining industry grows, there may be opportunities to start manufacturing some of the supplies needed by the mining industry in Alaska, thus increasing the industry's multiplier effect.

- **Mining creates jobs for Alaska residents in other industries.** Because of the industry's above-average wages, spending by mining employees creates more induced activity than most other sectors in Alaska (only the oil and gas industry pays a higher average wage).
- **Royalties paid to regional Alaska Native Corporations (ANCs)** show how mining can benefit every area of the state. In 2016, \$108.7 million in royalties were paid to NANA Corporation for its ownership interest in Red Dog Operations. Of that, \$65.8 million was redistributed to all other Alaska Native regional corporations, Kikiktagruk Inupiat Corporation, and at-large shareholders through the provisions of the Alaska Native Claims Settlement Act. Under that law, half of distributions go to the regional corporation under Section 7(i) and half to the village corporations in each region under 7(j). In 2017, NANA received \$247 million in royalty payments, of which \$156.4 million was redistributed.⁶⁰
- **Tax revenue paid to the State of Alaska** supports state government activity throughout the state, including payroll for state workers and program support (such as education funding). The mining industry paid approximately \$42 million in mining license tax to the State of Alaska in 2017 (state revenues from the mining industry are described in detail later in this report). The Mining License Tax is a mining-specific tax not paid by other industries.
- **Taxes paid to local governments** are an important source of revenues for several jurisdictions in Alaska. In 2017, approximately \$34.0 million in local government revenue was generated through property tax payments and payments in lieu of taxes made by Alaska's mining industry. Fort Knox paid \$8.3 million in property taxes to the Fairbanks North Star Borough, making it the Borough's largest single property tax payer (in 2017, Fort Knox paid \$8.7 million). Greens Creek Mine, which paid \$1.7 million in real and business property taxes to the City & Borough of Juneau in both 2016 and 2017, is the largest property tax payer in the Borough. Red Dog Operations' payment in lieu of taxes (PILT) to the Northwest Arctic Borough totaled \$21.8 million (including \$2.0 million paid directly to the Northwest Arctic Borough School District and approximately \$11.0 million retroactive payments to the Village Improvement Fund) in 2016. In 2017, these payments were approximately \$22 million, by far the single largest source of revenue for the Borough. These payments support local government jobs, payroll and public services in the communities closest to the mining operations.

Input-output models can aid in assessing the effects of industry spending in the form of "multipliers." IMPLAN™, a widely-used input-output model for analyzing the economic impact of industrial and commercial development projects, provides statewide multipliers for several mining and mining-related sectors. IMPLAN™ multipliers are one guide for economic impact analysis, but they do not capture all the economic effects of mining in Alaska, for example, they do not include the ANC 7(i) and 7(j) distributions described above.

⁶⁰ Email correspondence with Amy Hastings, NANA, January 23, 2018.

All these factors together mean that the mining industry has significant multiplier effects throughout the Alaska economy.

Total Employment and Payroll Effects

Based on detailed analysis of industry spending patterns, McDowell Group estimates that modeling an employment multiplier of approximately 2.0 accurately captures the total direct and indirect employment impact of the mining industry employment in Alaska, including the full breadth of the industry, from coal and metal mining, exploration and development spending, and construction materials mining. With that multiplier, total direct, indirect and induced employment in 2016 was approximately 8,600 jobs, and 9,000 jobs in 2017. Total direct, indirect and induced wages are estimated at \$675 million in 2016 and \$700 million in 2017.

Economic Output

Economic output – a measure of total spending – is another indicator of the total economic impact of mining in Alaska. The total value of mineral production in Alaska was \$3.0 billion in 2016. However, this estimate of value overstates economic impact in Alaska because it is based on refined commodity prices, not the value of the concentrates that are produced and exported. In terms of economic impacts, a more relevant measure of the value of Alaska mineral production would be the sum of the value of concentrates that are produced by Alaska mines; the value of dore gold bars produced in Alaska and exported for further refining; and the value of construction materials (sand, gravel and rock) produced and used in Alaska. Though this kind of measure is not available from any published sources, a proxy value is the estimated export value of concentrates and gold are exported from Alaska.

In 2016, Alaska's mining sector spent approximately \$880 million on goods and services to support their operations, \$5 million in charitable giving and membership organization support, \$330 million in labor costs (payroll plus the costs of benefits and other loading factors), and \$396 million in royalties, PILT, taxes, and fees. The total value of Alaska mineral production therefore was \$1.6 billion in 2016. Applying an Alaska output multiplier of 1.6 to this total indicates in-state economic activity of approximately \$2.6 billion.

Alaska Resident Employment

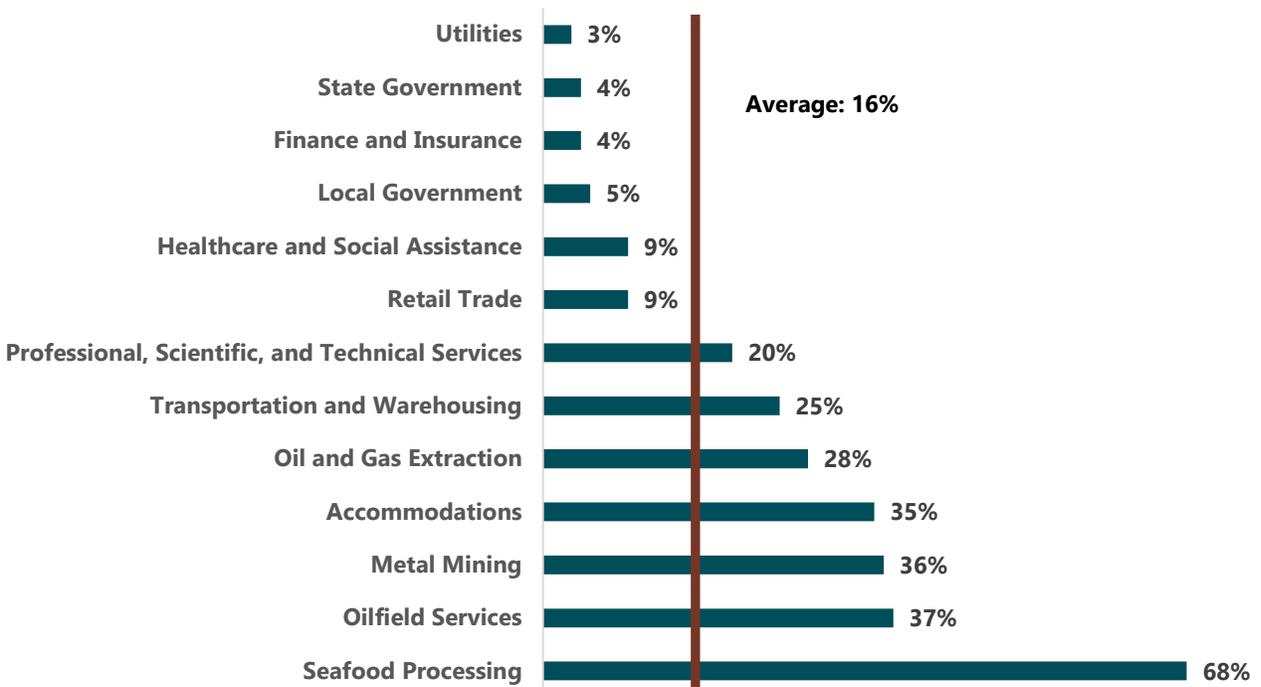
Resident Hire in the Mining Industry

Alaska Department of Labor and Workforce Development (DOLWD)'s methodology for calculating workforce residence is based on Permanent Fund Dividend (PFD) applications and results in a conservative estimate of "resident" employment. A new resident to Alaska must reside in the state for a full calendar year before they are eligible to apply for a PFD. A new Alaska resident who arrived in the state in February of 2017, for example, would not be eligible to apply for a PFD until the 2019 application period. As a result, this person would reside in Alaska for nearly two years before being recorded as an Alaska resident.

Nonresidents are often employed in seasonal industries, at remote site locations (where workers work on a rotation schedule, allowing for workers to not live close to their job), or when specific job skills are not readily available in Alaska.

For comparison purposes, in 2016, on average 16 percent of Alaska's jobs were held by nonresidents. Some sectors, including the oil and gas sector, are above that average. Other sectors relying on nonresidents include: seafood processing (68 percent); metal mining (36 percent); accommodations (35 percent); transportations and warehousing (25 percent); and professional, scientific, and technical services (20 percent). The metal mining nonresident rate has trended down in recent years, dropping from a high of 39 percent in 2012.

Figure 21. Percent of Positions Held by Nonresidents, by Sector, 2016



Note: Data exclude self-employed, fishermen, and private household workers.
Source: Alaska Department of Labor and Workforce Development.

The nonresident rate also differs significantly depending on the occupation of the worker employed at a metal mine. The table below provides information on the 10 largest occupations in Alaska’s metal mining industry where nonresidency rates range from 9.9 percent to 84.7 percent.

Table 4. Top 10 Occupations in Alaska’s Metal Mining Industry, 2016

Occupation	Total Workers	Percent Nonresident
1. Underground mining machine operators, all other	733	29.6
2. Extraction workers, all other	306	54.6
3. Mobile heavy equipment mechanics, except engines	162	58.0
4. Miners, except drillers and machine operators	136	32.4
5. Plant and system operators, all other	111	9.9
6. Millwrights	106	39.6
7. First line supervisors of mechanics, installers, and repairers	81	35.8
8. Mining and geological engineers, including mining safety engineers	78	44.9
9. Earth drillers, except oil and gas	72	84.7
10. Electricians	67	65.7

Note: Occupations totals include only workers in the industry. Additional workers in these occupations may be found in other industries. Source: Alaska Department of Labor and Workforce Development.

Using another data set – W2 data provided by the producing mines – Alaska’s largest mining employers have high percentages of residents in their work forces, particularly the long-established mines. For example, in 2016, 100 percent of Usibelli Coal’s and 98.4 percent of Fort Knox’s workers were Alaska residents. Based on compilation of W2 data from all six producing mines, approximately 79 percent of employees are Alaska residents.

Important Source of Jobs for Rural Alaskans

Alaska’s mining industry supports mostly year-round jobs for residents from more than 50 communities throughout Alaska, over half of which are found in rural Alaska (off the road system) where few other jobs are available. Including employment at sand and gravel operations, and rock quarries (that are found throughout Alaska) mining supports workers living in all areas of the state. Because of rotation schedules and camp setups, many mine workers reside in areas different from where they work. Below are some summaries of residents working at Alaska’s producing mines in 2016 and 2017:

- **Fort Knox:** While most employees live in Fairbanks and North Pole, other rural residents include Delta Junction, Palmer, Salcha, Seward, and Two Rivers.⁶¹
- **Green Creek:** While most of Greens Creek Mine Alaska employees reside in Juneau or Douglas, other Alaska employees live in smaller communities, including Angoon, Barrow, Big Lake, Chickaloon, Coffman Cove, Craig, Delta Junction, Gustavus, Haines, Hoonah, Nenana, Ninilchik, North Pole, Petersburg, Salcha, Seward, Wasilla, and Wrangell.⁶²

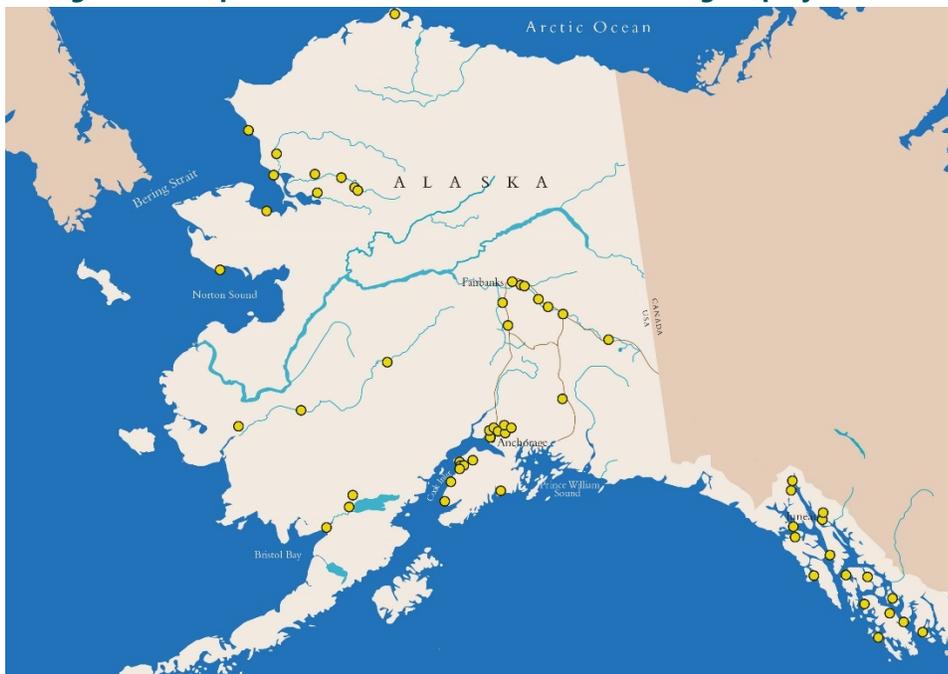
⁶¹ Data provided by Kinross Fort Knox.

⁶² Data provided by Hecla Greens Creek Mine to McDowell Group.

- **Kensington:** Most of Kensington’s Alaska resident employees live in Juneau. Others live in Anchorage, Angoon, Chugiak, Craig, Delta Junction, Eagle River, Fairbanks, Haines, Hoonah, Kake, Kenai, Ketchikan, Ninilchik, Palmer, Sitka, Skagway, Soldotna, Wasilla, Willow, and Wrangell.⁶³
- **Pogo Mine:** Employees live in dozens of different Alaska communities, from as near to the mine as Delta Junction to as far as Southeast Alaska.⁶⁴
- **Red Dog Operations:** 347 out of 447 Teck Alaska workers (78 percent) live in Alaska. Along with Anchorage, Red Dog employees live in Northwest Arctic Borough communities, including Ambler, Buckland, Deering, Kiana, Kivalina, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak, as well as in other communities throughout Alaska.⁶⁵
- **Usibelli Coal:** 100 percent of UCM’s workers live in Alaska. Most live in Healy or elsewhere in the Denali Borough, as well as the Fairbanks North Star Borough, Matanuska-Susitna Borough, and Anchorage.⁶⁶

Exploration and development projects also include employees from rural communities, such as residents of Aniak and Bethel working at Donlin Gold, and residents of Nondalton, Iliamna, and Naknek working for Pebble Partnership. A map of Alaska follows that denotes communities where mining sector employees live.

Figure 22. Map of Alaska Communities Where Mining Employees Live



Note: Does not include communities with employees involved in placer mining, and rock, sand, and gravel production.

⁶³ Data provided by Kensington Mine to McDowell Group.

⁶⁴ Data provided by Sumitomo Pogo to McDowell Group.

⁶⁵ Data provided by Red Dog to McDowell Group.

⁶⁶ Data provided by UCM to McDowell Group.

Payments to Local and State Government

The mining industry creates a broad range of economic impacts in addition to jobs and income. The industry generates revenue for state and local governments and for public and private landowners and business interests. It offers training and skill development for Alaskans seeking careers within the industry and in other sectors of the economy that may have lifetime benefits. Finally, mining helps build infrastructure that can help support communities and other industries.

The extent to which mining generates revenues for particular state and local governments depends largely on the location of the mine and the tax structure in local jurisdictions. The table below outlines the land ownership and local jurisdiction for Alaska's largest producing and potential mining projects.

Table 5. Largest Producing Mines and Active Projects in Development and Advanced Exploration Projects State and Local Government Current and Expected Tax Obligations

	Land Status	State Mining License Tax	State Royalty Payments	Local Government Tax Payments	Local Taxing Authority
Producing Mines					
Fort Knox	State/Mental Health Trust	✓	✓	✓	Fairbanks North Star Borough
Greens Creek	Private	✓		✓	City & Borough of Juneau
Kensington	Private/Federal/State	✓	✓	✓	City & Borough of Juneau
Pogo	State	✓	✓		
Red Dog	Private	✓		✓	Northwest Arctic Borough
Usibelli Coal	State	✓	✓	✓	Denali Borough
Project in Development					
Donlin Gold	Private	✓			
Pebble Project	State	✓	✓	✓	Lake & Peninsula Borough
Advanced Exploration Projects					
Graphite	State/Federal	✓	✓		
Livengood	State/Mental Health Trust/Federal	✓	✓		
Palmer Project	Federal/State/Mental Health Trust	✓	✓	✓	Haines Borough
Upper Kobuk	State/Federal/Private	✓	✓		

Source: Compiled by McDowell Group.

Most mining projects pay either property tax or a payment in lieu of taxes (PILT) to a local government. Mines on private or federal land, most of those listed above, are not subject to state royalty payments. In addition to state royalties and property tax payments, several other fees and taxes are imposed on the mining industry: mining license fees, annual mining claim rentals, severance taxes on coal produced from state land, severance taxes on gravel production, and other miscellaneous fees. Like other businesses, mining firms also pay corporate income taxes to the State of Alaska.

State of Alaska Payments

In 2016, the State of Alaska received \$80.6 million in revenues from the mining industry through mechanisms such as license fees, rents, royalties, material sales, and other fees. In 2017, revenues increased to \$109.3 million. These revenues are described below.

Table 6. State of Alaska Payments

Type	Description	CY2016	CY2017
Mining License Tax	This is a tax on the net income of, and royalties received in connection with, all mining property in the state irrespective of land ownership status. It applies only to mining. For mining income under \$40,000, no tax is charged; for income over \$100,000, the tax is capped at \$4,000 plus 7 percent of net income and royalties, less exploration and other credits (minerals exploration incentive and qualifying education tax credits). Except for quarry rock, sand and gravel, and marketable earth mining operations, new mining operations are exempt from the mining license tax for a period of 3.5 years after production begins. The Alaska Department of Revenue forecasts mining license taxes to reach \$45.8 million in FY2018.	\$11,137,900	\$41,525,192
Annual Claim Rental	The Annual Rental law (AS 38.05.211) requires locators and holders of State mining locations to pay an annual rental. The requirement applies to mining claims, leasehold mining leases, offshore mining leases and prospecting sites on state land. For all traditional mining claims (40 acres), the annual rental amount is \$35 per year for the first five years, \$70 per year for the second five years, and \$170 per year thereafter. For quarter section mining claim (160 acres), the annual rental amount is \$140 per year for the first five years, \$280 per year for the second five years, and \$680 per year thereafter. For all leases, the annual rent is \$.88 per acre per year for the first five years, \$1.75 per acre for the second five years, and \$4.25 per acre per year thereafter. It is noted that an acre is approximately 208 by 208 feet. For prospecting sites, there is a one-time upfront fee of \$255, which covers the two-year term of the site.	\$7,327,630	\$7,658,003
Production Royalty	The Production Royalty Law (AS 38.05.212) requires holders of state mining locations to pay a production royalty on all revenues received from minerals obtained from state land. The production royalty is 3 percent of net income as determined under the Mining License Tax Law (AS 43.65), and regulations (15 AAC 65). A production royalty return must be filed and all required royalty payments must be made by anyone: who <ul style="list-style-type: none"> • Owns, leases, and operates a mining property • Owns a mining property and receives lease fees, royalty payments based on production, or a combination of lease fees and royalty payments from the property • Leases a mining property from another person and operates the property • Possesses a mineral interest, whether an economic or production interest, in a producing property, including royalty, lease fees, working or operating interests, net profits, overriding royalties, carried interests, and production payments. 	\$2,816,884	\$3,125,925

Type	Description	CY2016	CY2017
Annual Labor	The payment in lieu of annual labor is based on the premise that when prospecting or discovering a locatable mineral, and staking a mineral location, annual labor must be performed each year in the further development of the locatable minerals so they can be mined. Every year, a minimum of \$100 or \$400 worth of labor or improvements must be performed on or for the benefit or development of each mining claim on leasehold location on state land. Every year \$100 worth of labor or improvements must be performed on each partial or whole 40 acres of each mining lease. The holder of a mining claim, leasehold location, or mining lease may make a cash payment to the state equal to the value of labor required (\$100 or \$400 per claim).	\$331,986	\$374,244
Coal Rents and Royalties	The standard rate for coal royalties on state lands for new leases is 5 percent of gross value. For coal leases in existence on June 18, 1982, the royalty rate at the next time of adjustment will be five percent of the adjusted gross value. Certain costs may be deducted.	\$2,585,101	\$2,501,260
Material Sales	There are three types of materials sales from which the state receives payments: <ol style="list-style-type: none"> 1. Limited Material Permit, where there is no filing or application fee 2. "Limited" and small "negotiated" sales where the price is set by the Alaska Department of Natural Resources based generally on the fair market value of material in the area 3. "Negotiated" and "competitive" sales where the amount charged for larger material sales (>25,000 cubic feet) is based on a site-specific appraisal or an abbreviated appraisal. A "competitive" sale price is initially set by an appraisal but may be increased during an auction if more than one person or company competes for the material. 	\$6,559,395	\$4,950,720
State Fuel Tax	Alaska levies a tax on motor fuel sold, transferred or used within the state.	\$2,066,313	Not currently available
Corporate Net Income Tax	All corporations doing business in Alaska must file a tax return. The corporate net income tax payment is based on profitability and is calculated from the federal taxable income with certain Alaska adjustments. Multi-state corporations apportion income on a "water's edge" basis using the standard apportionment formula of property, payroll, and sales. Tax rates are graduated from 1 to 9.4 percent in increments of \$10,000 of taxable income. The maximum rate (9.4 percent) applies to taxable income of \$90,000 and higher.	\$1,636,850	(\$729,670)
Large Mine Permit Coordination Program	The Large Mine Permit Team (LMPT) establishes a Memorandum of Understanding (MOU) with each applicant and Reimbursable Service Agreements with each participating state agency to reimburse the State's costs for the LMPT process. These agreements are renewed annually and "not-to-exceed" limitations are applied.	\$1,364,952	\$968,827
Other State Mining Fees	These fees include filing, penalty, surface mining application, and Annual Placer Mining Application fees.	\$348,059	\$255,089
TOTAL		\$36,175,070	\$60,629,590

Source: Alaska Department of Revenue and Alaska Department of Natural Resources.

Bond Pool Payment

In accordance with AS 27.19, bonding is required for all operations mining an area over five acres on State Land. The required bond is \$750 per acre, unless the miner can demonstrate that a third-party contractor can do the needed reclamation for less than that amount. A Statewide bonding pool has been established and all mining operators can participate. No reclamation plan approval goes into effect until the bonding pool deposit and an annual nonrefundable fee are paid. Federal land managers may have additional bonding requirements.⁶⁷ A portion of the reclamation bond may be refunded upon approval of the reclamation. In 2016, \$57,825 was contributed to the Bond Pool and \$96,350 in 2017.⁶⁸

Permanent Fund

The Alaska Constitution was amended in 1977 to establish a permanent investment fund into which, “at least 25 percent of all mineral lease rentals, royalties, royalty sale proceeds, federal mineral revenue sharing payments and bonuses received by the state” are to be deposited annually.⁶⁹ This 25 percent applied to state mining leases issued on or before December 1, 1979. Mines operating with state leases issued after December 1, 1979 pay 50 percent.

In 2016, \$4.9 million of the state rents and royalty payments by Alaska’s mining industry was earned for the Alaska Permanent Fund. In 2017, \$5.2 million was earned for the Fund.⁷⁰

Other State Agency Fees

The mining industry is also an important source of revenue to quasi-government organizations such as the Alaska Railroad and the Alaska Industrial Development and Export Authority (AIDEA).

ALASKA RAILROAD

The Alaska Railroad Corporation (ARRC) is owned by the State of Alaska. Coal from Usibelli Coal Mine in Healy moves to Fairbanks (for power generation) and to Seward for export to Pacific Rim markets. Coal export infrastructure in Seward includes a railcar dumper facility, stockpile areas, an extensive conveyor system that was recently upgraded to address environmental concerns, a stacker-reclaimer used to move coal on and off the conveyor system, and other infrastructure.⁷¹ The Seward Loading Facility, owned by ARRC, is capable of loading roughly 2 million tons per year.



A short spur line provides access to gravel resources near Palmer. During the building season (April through October) aggregate products move from the Matanuska-Susitna Valley to Anchorage.

⁶⁷ http://dnr.alaska.gov/mlw/forms/18apma/2018APMA_Fillable.pdf

⁶⁸ Email correspondence from Jennifer Athey, Department of Natural Resources, January 29, 2017.

⁶⁹ AS 37.13.010.

⁷⁰ Email correspondence from Jennifer Athey, Department of Natural Resources, January 29, 2017.

⁷¹ https://www.alaskarailroad.com/sites/default/files/akrr_pdfs/2015_08_05_Seward_Coal_Loading_Facility_FS_PROJ.pdf

Table 7. Freight Shipped ('000s of tons), by Type, and Freight Revenue, Alaska Railroad, 2008-2017

Freight Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gravel	2,776	2,306	2,614	2,252	2,003	2,025	2,345	2,288	1,945	3,196
Coal (for export)	471	801	1,051	1,195	961	634	513	137	72	0
Coal (in-state)	761	762	791	836	838	793	766	796	698	696

Source: Alaska Railroad Corporation

In 2016, the railroad received \$17.5 million to move coal, sand, and gravel. In 2016, the Alaska Railroad moved coal from Healy to Seward to load one ship for export to Japan. Gravel movements in 2017 grew by 64 percent over 2016 volumes (largely to support large road construction projects in Anchorage).

In 2017, the mining industry paid approximately \$21.2 million to the Alaska Railroad Corporation for moving coal, sand, and gravel, representing 31 percent of the Corporation's revenue from freight movement.⁷²

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY

Teck Alaska, as the operator of Red Dog Mine, pays a toll for use of the state-owned DeLong Mountain Transportation System (DMTS), the 52-mile road and port that serve the Red Dog Operations. AIDEA owns the DMTS and Teck Alaska payments go to AIDEA to repay the cost of construction of the transportation system and provide a return on AIDEA's investment in the port and road. In the 2017 shipping season, the DMTS moved approximately 1.3 million wet metric tons of zinc and lead concentrate.⁷³

The initial construction of the DMTS cost \$180 million with a subsequent upgrade of \$85 million for a total cost of \$265 million. By the end of 2017, the state had received more than \$456 million from Red Dog Operations for use of the system.

In 1990, AIDEA purchased the Skagway Ore Terminal. The facility includes a warehouse and shipping operation for base metal concentrates exported from the Yukon Territory to international markets. While the terminal was not in use for several years, in 2008, Minto Explorations Ltd., a subsidiary of Capstone Mining Corporation, started shipments of copper concentrate. In 2017, Capstone shipped 10,921 dry metric tons of copper concentrate through the terminal. According to AIDEA, the Skagway Ore Terminal creates up to 23 jobs at the terminal (including three full-time, two part-time, and 18 temporary jobs during ship loading six times a year for a 24-year period).⁷⁴ In FY2017, AIDEA received \$780,000 from Capstone for use of Skagway Ore Terminal. Since 1990, AIDEA has received \$21 million for use of the terminal.⁷⁵



⁷² Email correspondence from Barbara Amy, Alaska Railroad Corporation, January 23, 2018.

⁷³ http://www.aidea.org/Portals/0/PDF%20Files/PFS_DMTS.pdf

⁷⁴ http://www.aidea.org/Portals/0/PDF%20Files/PFS_Skagway.pdf

⁷⁵ Email correspondence from Elizabeth Greer, AIDEA, February 2, 2018.

In FY2016, the mining industry paid \$24.3 million to AIDEA for use of the DMTS and the Skagway Ore Terminal. In FY2017, AIDEA received \$24.8 million for use of these state-owned facilities.^{76,77}

Table 8. Other Payments to State of Alaska Agencies, 2016

	FY2016	FY2017
User fees to AIDEA (DTMS and Skagway Ore Terminal)	\$24.3 million	\$24.8 million
Payments to Alaska Railroad Corporation for Movement of Coal and RSG	\$17.5 million	\$21.2 million

Source: Alaska Industrial Development and Export Authority, and Alaska Railroad Corporation.

Combining payments to AIDEA and Alaska Railroad Corporation with the tax, royalty, and fee obligations, the mining industry paid approximately \$41.8 million to the State of Alaska in 2016 and \$46.0 million in 2017.

Payments to Local Governments

The mining industry paid an estimated \$14 million to local governments in 2016. There are several ways the mining industry provides direct payment to local governments, including property taxes, sales tax, severance taxes, payments in lieu of taxes (PILTs), and rents or production revenue from rock, sand, and gravel production on local government lands.

Property Tax

Mining companies represent some of the largest property taxpayers in the City & Borough of Juneau, Fairbanks North Star Borough, and the City of Nome. In 2016:

- Fort Knox Gold Mine paid the Fairbanks North Star Borough \$8.3 million in real property and business property taxes, making the mine the largest single property taxpayer in the Borough. In 2017, they paid \$8.7 million to the Fairbanks North Star Borough.
- Greens Creek paid \$1.7 million in real and business property taxes associated with real and business personal property assessments. The mine has long had the highest taxable assessed property value in Juneau, with an assessment of \$217 million.⁷⁸ Included in this total is the \$120.8 million assessed value of mine property on Admiralty Island, including both land and structure value.⁷⁹ The remaining assessed value is attributed to business personal property such as mining equipment. Coeur Alaska, operator of the Kensington Mine, has the second highest property valuation in Juneau. In 2017, Greens Creek paid \$1.7 million in real and property tax.
- Kensington Mine paid \$1.4 million in property taxes to the City & Borough of Juneau in both 2016 and 2017.
- Greens Creek and Kensington mines are the two largest private property tax payers in the City & Borough of Juneau.

⁷⁶ Email correspondence from James Hemsath, AIDEA, February 2, 2018.

⁷⁷ These figures are based on gross receipts and do not reflect payments on debt service, purchase price, or any operating fees.

⁷⁸ City and Borough of Juneau, *Comprehensive Annual Financial Report- Fiscal Year Ended June 30, 2016*. 2016.

⁷⁹ <http://www.juneau.org/assessordata/sqlassessor.php>. Accessed May 18, 2016.

- Bering Straits Native Corporation, Arctic Gold Mining, and Nome Gold Alaska Corporation and Alaska Gold Company paid \$96,968 for property taxes to the City of Nome in 2017.⁸⁰
- Additional property taxes were paid by UCM for its Wishbone Hill property in the Matanuska-Susitna Borough and for offices in Fairbanks North Star Borough.

These direct payments by mines to local governments do not include property tax payments made by mine employees. For example, a 2016 study conducted by McDowell Group for Hecla Greens Creek Mining Company found that Greens Creek employees paid approximately \$521,000 in property taxes in that year.⁸¹ A 2015 study conducted by McDowell Group for Fairbanks Gold Mining Corporation estimated Fort Knox Gold Mine employees who owned homes in the Fairbanks North Star Borough paid approximately \$1.3 million in property taxes in 2014.⁸²

Payment in Lieu of Taxes (PILT)

Local government payments can also include PILT for those jurisdictions that do not have property tax taxing authority.

In FY2016, Teck Alaska's PILT payment to the Northwest Arctic Borough totaled \$8.8 million, plus \$2.0 million paid to the Northwest Arctic Borough School District. In 2017, the new PILT agreement was signed between Teck Alaska (operator of the Red Dog Mine) and the Northwest Arctic Borough, retroactive to 2016 and lasting 10 years with an option to revenue. The new PILT is based upon a percentage of Red Dog Operations' annual fixed asset value, with estimated average value in the range of approximately \$14 million to \$18 million per year, starting at 3.75 percent in 2016 and increasing to 4.0 percent by 2021.⁸³

In FY2017, the Borough received approximately \$14 million in PILT from Teck Alaska; no payment was made to the school district. Instead, as part of the PILT agreement, a new Village Improvement Fund was created to support critical infrastructure, services, and programs in the 11 villages of the Northwest Arctic Borough. On June 1st every year Teck will deposit money in the Fund. The annual amount depends on the profitability of Red Dog Operations but will have a guaranteed minimum payment of \$4 million and a maximum of \$8 million. The Fund was also retroactive to 2016; Teck paid \$11 million into the Fund in the first year. In June 2017, Teck Alaska's second payment was \$8 million (for a Fund total of \$19 million).

Since 1989 when mining began at Red Dog Operations, the mine has contributed more than \$199.4 million in PILT to the Northwest Arctic Borough, direct payments to the Northwest Arctic Borough School District, and the Village Improvement Fund. Red Dog Operations is the Borough's single most important source of revenue. The Borough receives no sales tax or property tax revenues.

⁸⁰ Telephone conversation with Christine Piscoya, City of Nome, February 12, 2018.

⁸¹ McDowell Group, "Socioeconomic Impacts of the Greens Creek Mine," prepared for Hecla Greens Creek Mining Company, June 2017.

⁸² McDowell Group, "Socioeconomic Benefits of Fort Knox Mine," prepared for Kinross Fort Knox, October 2015.

⁸³ Email correspondence with Wayne Hall, Teck Alaska, February 2, 2018.

Severance Tax

In the Denali Borough, UCM pays a severance tax of \$0.05 per ton of coal. The Borough also receives other severance tax payments for limestone and gravel operations. In FY2016, mining companies paid \$70,565 in severance taxes to the Denali Borough.⁸⁴ In FY2017, severance tax paid to the Denali Borough totaled \$51,162.⁸⁵

Sales Tax

In certain jurisdictions, mining companies pay sales taxes on their local purchases of goods and services. For example, based on goods and services purchased in 2016, Greens Creek paid an estimated \$616,000 in sales taxes and Constantine (Palmer Project) paid approximately \$28,000 in sales tax to the City and Borough of Haines.

Rock, Sand, and Gravel Production

Most local governments also receive payments for the production of locally-owned or leased rock quarries, and sand and gravel pits. It is assumed these payments to local governments are relatively small, yet for some small communities, these payments may be important sources of revenue supporting local construction projects.

Payments to Alaska Mental Health Trust Authority

In 1956, the US Congress passed the Alaska Mental Health Enabling Act, transferring the responsibility of providing mental health services from the federal government to the Territory of Alaska. To establish the Alaska Mental Health Trust, the state selected a million acres of land to provide funds for the development of the mental health services. In 1994, a legal settlement reconstructed the Trust with 500,000 acres of original Trust lands and 500,000 acres of replacement land. The Trust contracts with the Alaska Department of Natural Resources to manage the Trust's land. These lands are managed separately from other State of Alaska lands.

Most Trust mineral lands are in Interior and Southeast Alaska, with active exploration and mining taking place in Interior Alaska. For example, Fort Knox mine, is located on Trust land north of Fairbanks. The Trust continues to solicit interest in the Salcha land block, containing 180,000 acres of Trust land in the Salcha area, about 30 miles northwest of Pogo mine.⁸⁶ Other Interior Alaska lands available for competitive bid include the Liberty Bell land block approximately 20 miles northeast of Healy (copper-gold porphyry), the Ophir Block approximately 36 miles west northwest of McGrath (gold). In Southwest Alaska, the Trust has approximately 4,700 acres available near Thorne Bay (iron, copper, and gold), as well as other lands including coal deposits in the Healy, Tyonek, and Sutton areas.

In 2016, the mining industry paid \$2.6 million to the Alaska Mental Health Trust for rents and royalty payments, and construction material sales. In 2017, the Trust received \$2.7 million.⁸⁷

⁸⁴ http://www.denaliborough.org/vertical/sites/%7B63112C6F-13FC-4147-831D-8F3F0E33EC53%7D/uploads/Financial_Report_June_2016.pdf

⁸⁵ http://www.denaliborough.org/vertical/sites/%7B63112C6F-13FC-4147-831D-8F3F0E33EC53%7D/uploads/Financial_Report_May_2017.pdf

⁸⁶ <https://mhtrustland.org/index.php/minerals-materials/>

⁸⁷ Email correspondence with Mike Franger, Senior Resource Manager, Trust Land Office (January 25, 2018).

Benefits to Alaska Native Corporations

All Alaska Native Corporations (ANCs) benefit from mining industry activity via jobs for shareholders, 7(i) and 7(j) royalty sharing payments, or business partnerships.

Alaska Native Corporation Business Development Opportunities

Forming relations with the mining industry has provided business development opportunities for ANCs. Below are a few examples.

NANA

Two NANA subsidiary operations play major roles in Red Dog Operations. NMS provides meals and lodging services for mine employees, and NANA Lynden Logistics provides transportation and logistics support for the mine, including transporting materials and supplies to and from the mine and trucking zinc concentrate from the mine to the port. NANA subsidiaries also provide drilling through NANA/Major Drilling, soils testing by DOWL HKM, oil products through NANA Oilfield Services, security through NMS Security, engineering by DOWL HKM, NANA WorleyParsons, and NANA/Pacific, training by NMS Training Systems, and temporary workers through NMS Staffing.

Calista Corporation

At Donlin Gold, Chiulista Services, Inc. provides remote camp facility leasing and management, as well as camp services, including cooking, housekeeping, and janitorial services. It also provides exploration and remote camp temporary personnel such as heavy equipment operators and mechanics, construction trades, geotechs, diamond core drillers and helpers, survey personnel and others. Chiulista Services was incorporated in 1996 when Calista Corporation had the opportunity to provide camp structures, equipment and personnel in support of the Donlin Gold exploration program. Since then, Chiulista Services has steadily expanded its client base and business volume.

Iliamna Development Corporation

Pebble Partnership works directly with several village corporations, including Iliamna Development Corporation (IDC), a wholly owned for-profit subsidiary of Iliamna Natives Limited. IDC provides Pebble Partnership with site support services, including food services, housekeeping, transportation, and waste disposal (incinerator) services. IDC also provides automotive, helicopter and heating fuels to support Pebble's operation and uses its barge transportation business for some freight and fuel transport. Additionally, Pebble Partnership leases some of IDC's buildings and property for their site operations.⁸⁸

⁸⁸ Alaska Peninsula Corporation, Kijik Corporation, Igiugig Native Corporation, and Tenalian Incorporated also have business relationships with Pebble Partnership.

Alaska Native and Shareholder Hire

ANC shareholders benefit from opportunities for mining-related employment, especially in remote areas of the state where other job prospects are limited. Red Dog and the Donlin Gold are both situated on Alaska Native lands.

At Red Dog, approximately 55 percent of the year-round jobs are filled by NANA shareholders, including Teck Alaska, NANA Lynden and NMS jobs. At Trilogy's Upper Kobuk Minerals Project, 59 percent of the employees and contractor hires were NANA shareholders in 2017.

The successful Calista Corporation and Donlin Gold exploration shareholder hire agreement (signed in 1995 by Calista Corporation and then owner, Placer Dome) is a case study in the benefits of resident hire during the exploration phase. While no specific goals were laid out, Calista shareholders and their descendants were given a hiring preference for Donlin Gold. This policy has been successful. In 2016, 37 percent of the jobs at Donlin Gold were filled by Alaska Natives.

Royalty Payments

Alaska Native Claims Settlement Act (ANCSA) corporations are major private holders of land and sub-surface mineral interests in Alaska. Much of these lands have significant mineral potential, including a number of historic mining districts, such as the Ambler district, numerous placer gold areas, and rock, sand, and gravel deposits. ANCSA corporations can lease their land to mining companies. As part of some lease arrangements, the mining industry makes direct payments (royalties) to Native corporations.

Additionally, under a clause referred to as Section 7(i) in the 1971 Alaska Native Claims Settlement Act, ANCSA corporations are mandated to annually redistribute 70 percent of their net revenue earned on subsurface developments of lands given to them by the settlement among the 12 regional corporations (the 13th Region is not included) based on shareholder enrollment. Net revenue from rock, sand and gravel extractions is exempted from 7(i) payments. The purpose of this clause was to create an opportunity to share the wealth between those regions rich in natural resources and those not.

Red Dog Operations

NANA Corporation is an example of the very significant economic potential of relationships between the mining industry and ANCSA corporations. Red Dog Operations is operated by Teck Alaska under an agreement with the property owner, NANA Regional Corporation. As owner of the Red Dog property, NANA Regional Corporation earned royalties equal to 4.5 percent advance net smelter return until full recovery of certain capital expenditures by year-end 2007. NANA's royalty structure then shifted to 25 percent of net proceeds of production (NPP) from the mine. The NPP increases by 5 percent every fifth year to a maximum of 50 percent. The high grades of the ore body made this unique agreement possible.

In FY2017, NANA received \$247.0 million in royalties from Red Dog Operations. NANA distributed approximately \$156.4 million, net of allowable costs, directly to ANCs and indirectly to village corporations as part of its Sections 7(i) and 7(j) payment requirements.⁸⁹ Since 1990, NANA has distributed \$1.1 billion (not including NANA's distributive share) through Section 7(i) payments to ANCs.

Other Mining Projects and Prospects

Several ANCs are exploring mining potential on their own lands. NANA has entered into a formal exploration agreement with Trilogy Metals, Inc. in the Ambler Mining District. Within the district, the Arctic Project is the most advanced (*see "Exploration in Alaska" section of this report*).

ASRC has been engaged in evaluating its coal resources in the Western Arctic since the late 1980s. Four trillion tons of high quality bituminous and subbituminous coal – one-ninth of the world's known coal resources, and one-third of the U.S. resource – are estimated to lie within ASRC's region. Approximately 2 billion tons of high rank bituminous coal has been identified and located six miles from tidewater on the Chukchi Sea. ASRC estimates that through additional drilling, it can identify an additional 50 to 100 million tons in this one deposit. In 2006, ASRC signed an exploration agreement with BHP Billiton with option to lease lands for a 5-year coal exploration program at Deadfall Syncline (about 40 miles south of Point Lay). In 2009, Billiton suspended its drilling program and terminated its agreement with ASRC. ASRC is continuing its search for a development company to explore and develop these coals deposits.

In 1995, Doyon Limited signed a 25-year lease with Mystery Creek Resources (previous assess of Fire River Gold Corporation), a subsidiary of Titan Resources, to explore and develop the Nixon Fork underground gold mine located approximately 35 miles northeast of McGrath and 8 miles north of Medfra. The 11,000-acre property includes the underground mine, surface mill, tailings storage facility, administrative and camp facilities, and a 4,200-foot long airstrip. Previous owners included Nevada Goldfields Inc. (1993-1999) and St. Andrew Goldfields Ltd. (2003-2008). Between 2004 and 2008, St. Andrew Goldfields Ltd. spent more than \$50 million on upgrades to the processing facilities. In 2009, Fire River Gold Corporation purchased the mine for \$3 million and planned on producing 50,000 ounces of gold per year. After a restart of production in July 2011 (mining and development activities included 90 on-site employees), the mine went into temporary closure status in 2013 after Fire River Gold Corporation ran into project logistical support issues, tailing bond overflows, regulatory non-compliance, and financial difficulties. In August 2016, Mystery Creek Resources submitted notification to the Alaska Department of Natural Resources it plans to restart the project in the future.

In 1995, Calista Corporation entered into a lease for mineral exploration and development of the Donlin Gold. Calista Corporation holds the sub-surface rights, and The Kuskokwim Corporation holds the surface rights. After the permitting phase (to be completed in 2018), construction is expected to take four years, including construction of a natural gas pipeline from Cook Inlet to the mine. Donlin Gold has the potential to become one of the world's largest gold-producing mines (*see "Mine Development and Construction" section of this report*). Calista continues to promote other properties such as its Goodnews Bay platinum operation and the

⁸⁹ Email correspondence with NANA, January 23, 2018.

Stuyahok property. In 2016, approximately \$2 million in royalties were paid by mining companies to Calista Corporation for all its mineral interests.⁹⁰

Bering Straits Native Corporation owns its subsidiary, Alaska Gold Company, and three projects located near Nome: Rock Creek, Big Hurrah and Nome Gold. Alaska Gold Company has exploration and mining lease arrangements with Bering Straits Native Corporation, Sitnasuak Native Corporation and Solomon Native Corporation for mining and surface use. Currently, Alaska Gold Company is soliciting offers for cost-effective resource redevelopment of the Rock Creek deposits.

Other mineral prospects on regional ANC land include The Aleut Corporation's sub-service lease option agreements for the Pyramid Copper Project with CopperBank Resources Corporation and for the Unga Gold Project with Red Star Gold. Redstar Gold Corporation has identified wide zones of rich, high-grade gold vein mineralization, as well as near surface-gold-silver mineralization in the Unga Project that consists of the Shumagin Property and the Unga-Popof Property.

Several regional ANCs have also entered into placer and hard-rock exploration agreements. For example, Calista Corporation leased land to Tonogold Resources for hard rock mineral exploration at Nyac, located 63 miles east of Bethel, and other placer leases on Crooked Creek and the Tuluksak River. Doyon Limited leased property in 2007 to Freegold Ventures for its Vinasale gold project, located south of McGrath. Doyon has issued other mineral exploration and development lease option agreements for exploration projects throughout the Doyon region.

⁹⁰ Email correspondence from Jeff Foley, Calista Corporation, December 2016.

Additional Mining Industry Benefits

Mining offers additional advantages to the Alaska economy, including the development of workforce skills to support mining (and other support sectors) and public and private infrastructure, that have broader benefit beyond the primary use of a mining venture.

Workforce Development

The mining industry can offer long-term, year-round employment. Many of the jobs are rural-based and yield transferable skills in a rapidly growing industry. Direct job training is available in management, engineering and science (geologists, metallurgists, environmental scientists, etc.); technical specialties (surveyors, drafters, computer technicians, instrumentation technologists, lab technicians, environmental, etc.); mine and mill work (millwrights, electricians, diesel mechanics, plumbers, maintenance planners, metallurgical samplers, machinists, welders, industrial mechanics, operators, drillers, laborers, etc.); and administrative and support staff (accountants, purchasing agents, in-house trainers, employee relations personnel, payroll clerks, secretaries, health workers, cooks, security guards, warehouse workers, etc.).

The training and experience Alaskans (particularly rural Alaskans) gain from working in the mining industry makes them more employable in other projects around the state; for example, in the oil and construction industries, in environmental monitoring activities, and in a broad range of other sectors of the economy. Skills gained on-the-job or through mine training make residents better able to fill positions that may come available in their communities (jobs that might otherwise be filled by non-residents) or in other remote jobs that might allow them to maintain rural residence while working rotational shift schedules (i.e., week-on, week-off). In many cases, these skills are in demand throughout the world and having these skills can greatly increase personal opportunities.

Several institutions and organizations in Alaska currently provide training support for and with the mining industry. Notable is the University of Alaska's Mining and Petroleum Training Service (MAPTS) program and the University of Alaska Southeast (UAS) Center for Mine Training.

University of Alaska's Mining and Petroleum Training Service (MAPTS)

University of Alaska's Mining and Petroleum Training Service (MAPTS) has trained over 12,000 mining students since the program began in 1979. MAPTS provides training and workforce development ranging from employer-driven soft-skills (such as job-readiness, work ethic, and career planning) to hands-on industrial training. In 2015, MAPTS acquired the Delta Mine Training Center. The Center features simulators and heavy-duty mine equipment, a surface and underground classroom, several shops and a warehouse, a 36-bed camp and kitchen/dining hall, and about 6,000 feet of mine drift complete with two underground classrooms and a three-story underground office complex. MAPTS provides standardized training that meets the requirements for the State of Alaska and the Mine Safety and Health Administration (MSHA). MAPTS custom designs programs for individual mine employers.⁹¹

⁹¹ <http://www.alaska.net/~mapts/pdf/MAPTS%20Mine%20Training%20Program%20Brochure.pdf>

With its administrative office located in Soldotna, the program also offers classes through UAS in Juneau and through UAA in Anchorage. MAPTS' Juneau courses include a 6-week new miner training program in underground hard rock mining and includes an equipment simulator. The Anchorage program offers MSHA certification for both metal and sand and gravel training. The Soldotna campus offers students a wide range of courses including OSHA, EPA and DEC training.

UAS Center for Mine Training

The UAS Center for Mine Training is a partnership between UAS and MAPTS. Administered by UAS Career Education, the program encourages students to pursue workforce training leading to an Occupational Endorsement for Mine Mechanics and an Associate of Applied Science in Power Technology/Diesel. The Center also was the first school in the U.S. to house an underground mine simulator named Cybermine. Mining companies have provided financial support for the Center.

Charitable Giving and Membership Organization Support

In 2016, approximately \$4.6 million was given by Alaska's mining community, supporting at least 385 nonprofit organizations throughout the state in health, arts, civic, education, recreation, youth, and social services. Of these contributions, approximately \$1.2 million went to the University of Anchorage and its various programs. Some companies, such as Donlin, Pogo, and Usibelli Coal also match employee giving.

Mining companies also provided over \$300,000 in support to many civic, business, and industry organizations in Alaska through sponsorships and membership fees. These organizations include local Chambers of Commerce, Alaska Chamber of Commerce, Alaska Miners Association, Alaska Support Industry Alliance, Council of Alaska Producers, local economic development organizations (such as Fairbanks Economic Development Corporation and Southeast Conference), Resource Development Council of Alaska, among others.

Educational Support

The mining industry is also active in promoting student performance and interest in areas of study where the mining sector has employment needs, for instance, engineering, geology, environmental sciences, and the building and construction trades. Examples of mining support include:

- Teck Alaska (Red Dog Operations) provided annual employee scholarships (\$15,000), university and vocational scholarships (\$27,500) and support of the Aqqaluk Trust Scholarship (\$100,000) in 2015.
- Greens Creek donated \$300,000 to the University of Alaska Foundation to create the Career Pathways in Mining Program at the University of Alaska Southeast (UAS) Center for Mine Training in 2011. By providing scholarships, mining courses, tools, and equipment, the program is designed to build a local mining workforce in Southeast Alaska. The program includes high school student engagement, a two-week mining academy resulting in students earning a Mine Safety and Health Administration (MSHA) certificate, and job shadowing opportunities. Continued support of the program included another \$300,000 donation from Greens Creek in 2014. Greens Creek also supports the University of Alaska with yearly contributions. In 2013, Greens Creek launched another annual scholarship to provide funding to

students in the Environmental Science program at UAS. In 2016, Greens Creek donated \$17,500 to the UA Foundation and offered scholarships for students enrolled at the University of Alaska Anchorage (UAA) and the University of Alaska Fairbanks (UAF), in addition to scholarships and programs at UAS.⁹²

- UCM contributed \$290,000 to the University of Alaska Foundation in 2016.
- Fort Knox contributed \$330,000 to the University of Alaska Fairbanks Mining Endowment in 2016, \$13,000 to the University of Alaska Foundation, and \$7,500 to University of Alaska Athletics, as well as other sponsorships of events.
- Pogo contributed \$2.5 million to University of Alaska (UA) in 2016, including the Institute for Social and Economic Research, Mining and Petroleum Training Services (MAPTS), College of Engineering and Mines, School of Management, and Mining Engineering Department. In 2011, Pogo Mine made a \$1 million three-year pledge to the Mining Engineering Research Endowment at University of Alaska Fairbanks (UAF). The Endowment is used to support graduate student research projects in the UAF Master of Engineering or Doctorate programs. In 2013, Pogo extended their pledge with an additional \$1 million gift to the Endowment (three-year pledge from 2014-2016), offering research funding for as many as four graduate students per year.⁹³

Infrastructure Development

Alaska's mining industry has also played a historical role in the development of important infrastructure, including the development of the Alaska Railroad, Richardson Highway, Steese Highway, Hatcher Pass, the road into Denali National Park, and even the settlement of Anchorage. Though initially developed for mining-related purposes, this infrastructure now has obvious value to non-mining interests. Other examples include:

- The marine terminal at Cascade Point built by Goldbelt Corporation to transport miners across Berners Bay area north of Juneau, supporting operations of the Kensington mine.
- The transmission line extension to the Green Creek Mine, making it possible to transmit power to the community of Hoonah on Chichagof Island, which relied on costly diesel power generation. Without the economies of scale offered by Greens Creek, it is unlikely that the extension to Hoonah would be economically feasible.
- Trilogy pays for continued maintenance on the Kobuk to Dahl Creek road for local and business use.

⁹² McDowell Group, "Socioeconomic Impacts of the Greens Creek Mine," prepared for Hecla Greens Creek Mining Company, June 2017.

⁹³ McDowell Group, "The Economic Impact Legacy of Pogo Mine, 2006 to 2016," prepared for Sumitomo Metal Mining Pogo, LLC, September 2017.

Utility Impacts

Alaska Electric Light and Power

Greens Creek is Alaska Electric Light and Power's (AEL&P) largest interruptible power customer, accounting for 87 percent of interruptible power sales in 2016.⁹⁴ In exchange for lower rates, interruptible customers agree to have service interrupted in an emergency or when the utility does not have capacity to serve all customers. Interruptible customers allow AEL&P to fully utilize available water for hydroelectric generation and largely avoid running their costly diesel generators except during emergency situations.

In the long run, sales to Greens Creek mine also help the utility cost-effectively build new hydro capacity to serve Juneau's growing load. From 1996 to 2006, AEL&P pursued permitting and licensing for the Lake Dorothy hydroelectric project and negotiated an interruptible agreement with Greens Creek, then under Kennecott ownership.⁹⁵ In the initial phase, Greens Creek agreed to purchase surplus energy from Lake Dorothy. As demand from other Juneau customers grew, the mine would become an interruptible customer. AEL&P has noted that "feasibility of Lake Dorothy was dependent on having a market for the surplus energy available in the early years, resulting in a lower cost to firm customers."⁹⁶

Revenue generated from the sale of power to Greens Creek also directly benefits AEL&P customers through a cost of power adjustment (COPA). When AEL&P receives monthly revenue from Greens Creek in excess of \$554,480, the amount above this threshold becomes a credit to the COPA account, which then reduces each customer's monthly bill. In October 2016, the Regulatory Commission of Alaska approved an interim rate increase request which increased the monthly revenue limit to \$797,473 per month.⁹⁷ Greens Creek's status as an interruptible power customer contributes to AEL&P having the lowest residential utility costs in Alaska.⁹⁸

Golden Valley Electric Association

Fort Knox Mine is Golden Valley Electric Association's (GVEA) single largest commercial customer. The mine pays for its own transmission line. In addition, the mine purchased approximately 25 percent of the total kilowatt-hours sold by GVEA at a value of \$41.7 million in 2016. Fort Knox Mine is one of GVEA's nine industrial customers (only using transmission voltage) and accounted for 18 percent of GVEA's total operating revenues of \$227.3 million in 2016. Given the size and stable load Fort Knox represents, GVEA has been able to further develop its power generation facilities.⁹⁹

⁹⁴ Alaska Electric Light and Power Company, *FERC Financial Report*, April 2017.

⁹⁵ Alaska Electric Light and Power Company, *Letter to the City and Borough of Juneau*, February 8, 2006. https://www.juneau.org/assembly/agendas/2006/2006-02-13/Res2346-AELP_re_Lake_Dorothy_Hydro.pdf. Accessed May 20, 2017.

⁹⁶ Timothy D. McLeod, *Pre-filed Direct Testimony of Timothy D. McLeod*, September 2016.

⁹⁷ Regulatory Commission of Alaska, *Order Suspending Tariff Filing*, October 2016.

⁹⁸ Alaska Electric Light and Power Company, *Revenue Requirement Study*, September 2016.

⁹⁹ Communication with Ron Woolf Vice President of Finance & CFO, Golden Valley Electric Association, January 24, 2018.

Alaska's Mineral Development Potential

While Alaska has a rich mining heritage spanning over 100 years and the industry currently plays an important role in local and regional economies, the future of mining in Alaska holds the promise of a significant mineral endowment. Over 190 million acres of Federal, State, and Native-owned lands are open for mineral-related activities and mining.

Over the past 125 years, Alaska's mining industry has produced about 47.6 million ounces of gold, 377.5 million ounces of silver, 15.3 million tons of zinc, 3.2 million tons of lead, and significant quantities of copper, tin, and platinum. The industry has also produced 80.0 million short tons of coal, and over 1.3 billion tons of sand and gravel.¹⁰⁰ Fifty different mining districts have historically each produced more than 10,000 ounces of gold. Six districts have produced more than one million ounces of gold, ranging from the Nome district in western Alaska to the Juneau district in Southeast. However, most of the 58 mining districts have only had placer gold production; lode sources of the placer mines have not yet been found.

Despite its historical mineral production, according to the United States Geological Survey, "Alaska is still a frontier region with respect to basic geologic, geochemical, and geophysical data. From the mid 1970's until the early 1990's, the USGS funded a large effort to gather and publish such data in Alaska and to use it to assess undiscovered mineral resource potential. Even at the reconnaissance scale of 1:250,000, less than half of the state has been covered to date."¹⁰¹

There are at least 7,200 known mineral occurrences recorded in the Alaska Resource Data Files, not including coal or industrial/construction materials deposits.¹⁰² With this resource potential, and with exploration expenditures in Alaska totaling \$1.4 billion between 2010 and 2017, the mining industry sees a bright future in the state. Further, with rising base and precious metal prices, international market conditions are right for further growth in Alaska's mining industry bringing greater economic benefit for Alaskans.

With 44 million acres of privately-held land, much of which was selected for its mineral potential, ANCs and their shareholders will play a key role in future development of the mining industry in Alaska. Of course, the future of mining in Alaska depends on the state remaining an attractive investment environment, one with stable regulatory and tax regimes and a supportive political environment.

¹⁰⁰ <http://dgggs.alaska.gov/webpubs/dgggs/sr/text/sr072.pdf>. Appendix B and C, pgs.57-59.

¹⁰¹ <http://minerals.usgs.gov/alaska/economic/index.html>.

¹⁰² https://ardf.wr.usgs.gov/ardf_data/1225.pdf



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