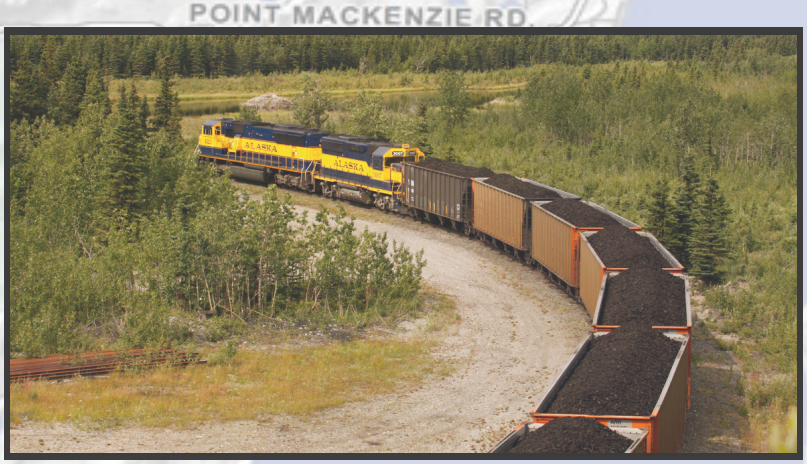
Port MacKenzie
Rail Freight Market Analysis

Prepared for:

Mat-Su Borough Public Affairs



Alaska Railroad Corporation

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Acronyms

ABI	Alaska Basic Industries
ADOT&PF	Alaska Department of Transportation & Public Facilities
AIDEA	Alaska Industrial Development and Export Authority
AMDIAP	Ambler Mining District Industrial Access Project
ARRC	Alaska Railroad Corporation
BCF	Billion cubic feet
BDMT	Bone dry metric ton
BLM	Bureau of Land Management
COFC	Container on flat car
DMTS	Delong Mountain Transportation System
EIS	Environmental Impact Statement
FEED	Front end engineering and design
FEU	Forty-foot equivalent units
FNG	Fairbanks Natural Gas
FOB	Free on board
IEP	Interior Energy Project
ISO	International Organization for Standardization
MLLW	Mean lower low water
MMT	Million metric tons
MSB	Matanuska-Susitna Borough
NM	Nautical mile
PEA	Preliminary economic assessment
POA	Port of Anchorage
RORO	Roll on roll off
TEU	Twenty-foot equivalent unit
TOFC	Trailer on flat car
UCM	Usibelli Coal Mine
WBG	World Bank Group
WMT	Wet metric ton

Executive Summary

As Alaska works to diversify its economy, Interior Alaska's vast natural resources present an important long-term development opportunity. Key to developing those resources is a transportation system that supports efficient movement of large volumes of materials, including outbound commodities and the supplies needed to extract resources and products destined for overseas markets. The Alaska Railroad already plays a critical role in that regard, moving millions of tons of freight each year. However, further development of that network may be required to fully tap the Interior's development potential.

Matanuska-Susitna Borough (MSB), with support from the State of Alaska, has been positioning itself as the gateway to Interior Alaska's natural resources, through development of Port MacKenzie and a connection to the Alaska rail network. Approximately $184 million has been invested in the 35-mile rail extension, with another $125 million required to complete the job.

Port MacKenzie Advantages

Development of Port MacKenzie reflects the need for industrial port facilities designed to accommodate export of bulk commodities. Port of Anchorage efficiently handles inbound consumer and commercial goods. Existing industry needs (oil and gas, mining, construction) for inbound freight are currently being met by ports in Anchorage, Whittier, Seward, and Valdez. However, if Alaska is to extract full value from its natural resources, much of which are hundreds of miles from tidewater, leveraging every potential opportunity to reduce transportation costs will be required. In that regard, Port MacKenzie offers:

Port MacKenzie. Photo copyright Alaska Aerial Technologies.

- Large acreage of uplands available for bulk cargo handling and storage.
- 142-mile advantage over the region's only other bulk export terminal (in Seward).
- Unconstrained access to the Interior, without logistical or safety concerns related to moving freight through busy urban areas.
- With a rail connection, the ability to take full advantage of railroad capacity to move large volumes of material over long distances much more efficiently than is possible by truck.

It is within this context that this study considers the foreseeable rail market opportunities associated with extension of rail to Port MacKenzie.

Recognizing that investment in rail infrastructure can result in benefits many decades into the future, the purpose of this study is to assess near-term market and revenue potential associated with completing the rail extension to Port MacKenzie. The analysis considers mineral development-related opportunities, forest products, rail shipment potential associated with various oil and gas industry projects, construction materials, general cargo, and other potential sources of freight that might be moved through Port MacKenzie with intermodal rail connections. The results of this study are summarized below.

Mining Industry Rail-Related Opportunities

Development of Interior Alaska's extensive mineral resources, particularly base metal resources (copper, zinc, and lead) will be dependent on efficient movement of bulk materials. Mine operations similar to Red Dog produce large tonnages of concentrates that must be shipped to overseas smelters for final processing. Base metal projects with potential to benefit from rail transport to tidewater include the Arctic and Bornite deposits in the Ambler District, Shorty Creek, Caribou Dome, and Red Mountain.

Ambler District Mineral Development

- The Arctic and nearby Bornite projects are the most advanced exploration efforts among the base metal projects considered in this analysis. Located roughly 700 miles from Port MacKenzie, concentrates would be trucked to Fairbanks then loaded onto rail cars for shipment to the port. Outbound shipment of concentrates and inbound shipment of supplies associated with the Arctic Project have the potential to generate $10 million in annual railroad revenues over the life of the mine and beyond as other Ambler District resources are developed. Preliminary mine planning includes trucking concentrates the full distance to Port MacKenzie. Rail would provide a lower-cost option.

- The critical path toward mine development in the Ambler District includes several factors, the most important of which is completion of the Ambler Mining District Industrial Access Project, an AIDEA-led effort to build a 215-mile road connecting the district to the Dalton Highway. An Environmental Impact Study (EIS) is expected to be launched in 2017.

- Including the time to complete an EIS, construct the road, conduct a separate EIS for the proposed mine, and construct mine facilities, the first concentrate production from the Ambler District is likely a decade or more away. Rail transport of materials and equipment could be used in advance of that in support of mine development.

Other Interior Alaska Base Metal Prospects

- Shorty Creek, Caribou Dome, and Red Mountain are all base metal prospects within relatively easy reach of the railroad. These early-stage prospect evaluation projects have long-term development potential but have not yet been subject to preliminary economic analysis. All are the subject of ongoing

geological evaluation. If one or more prove to have commercial potential, earliest operations would most likely be in the 15 to 20-year timeframe. It is premature to predict rail revenue from any one of the projects, though even at a relatively small scale of development, annual rail revenues could total $5 million (assuming 200,000 tons of annual concentrate shipments).

Base Metal Markets

- Conditions in global base metal markets are a critical aspect of mine development in the Interior. Since the mining industry's use of the rail extension and Port MacKenzie was last analyzed, there was a virtual collapse in base metal prices. While prices have stabilized and zinc has recovered somewhat, sustained improvement will be required to stimulate mine development in Alaska (and elsewhere).

- Weak base metal and precious metal prices have also constrained access to the capital needed to evaluate and develop mineral resources. Exploration spending in Alaska in 2015 and 2016 remains far below the levels seen a few years ago.

- China is by far the world's largest consumer of copper, zinc, and lead. Depressed base metal demand in China is one reason for the downturn in prices. Going forward, industrial activity and economic growth in China will be key drivers of mine development in Alaska.

Inbound Mining Supplies

- All of Alaska's mines, base metal and precious metal, require substantial and continuous inbound supplies of fuel and other consumables used in mining, mineral processing, and tailings disposal. Non-fuel supplies totaling 40,000 to 60,000 tons a year is typical for Alaska's hard-rock mines. Efficient movement of these supplies is an important part of mine feasibility, with rail playing an important role in Interior Alaska.

Interior Gold Mines

- Fort Knox and Pogo have proven that profitable large-scale gold mining is possible in Interior Alaska. These mines operate with a multimodal inbound supply chain (neither produces a concentrate for outbound shipment). Fort Knox is supplied via conventional barge, rail barge, and container ship to Southcentral ports (Anchorage and Whittier), then by rail or truck to Fairbanks, and finally by truck from Fairbanks to the mine site.

- Gold miners welcome additional investment in Alaska's transportation infrastructure, as it offers an additional avenue to move materials as quickly and efficiently as possible. The Port MacKenzie rail extension would change how existing gold mines are supplied to the extent that new freight transportation service providers using the port and rail extension are able to meet mine supply needs at lower cost than is now possible, taking advantage of the shorter distance from a deepwater port to the Interior mines.

- Similarly, prospective gold mine developers, including owners of the Livengood and Golden Summit projects and mining companies exploring in eastern Interior Alaska, would be likely to work with the

current services and infrastructure available through the ports of Anchorage, Whitter, and Valdez, until such time that freight carriers offer lower cost or more timely service through Port McKenzie.

Coal

- Shipment of coal has been an important source of revenue for the Alaska Railroad for many years and with 500 million tons of proven reserves, Usibelli Coal Mine (UCM) will continue generating rail revenue for many years to come. Interior Alaska has been a reliable market for UCM coal, an essential source of low-cost energy for the region.

Coal train. Photo courtesy Alaska Railroad Corporation.

- Export markets, where UCM's ultra-low sulfur coal is used as a blend with high-sulfur coals, have been much less reliable. Alaska is always challenged to remain competitive in Pacific Rim markets that include large-scale, low-cost suppliers such as Indonesia, where labor costs are far lower and regulation more limited.

- In 2016, overseas demand for Healy coal was at historically low levels. Though coal prices have rebounded recently the Seward coal loading facility is currently in "cold storage" status, pending improvement in export markets (mainly Korea and Japan). The 75,000 tons of coal exported in 2016 is the lowest level of export in at least 15 years. As recently as 2012, UCM was exporting a million tons annually.

- Pacific Rim market conditions are expected to continue constraining Alaska's export opportunities. However, as those constraints ease, UCM will look for opportunities to reenter the export market in the most cost effective way possible. Though Port MacKenzie would offer a 142-mile advantage, UCM would first use Seward's fully permitted, established facility. Assuming market conditions improve and UCM resumes exports, it is likely the company would choose to use the Seward facility to its full capacity (about 2 million tons) before investing in another coal loading facility. At tonnages greater than 2 million tons annually, UCM would rely on a Port MacKenzie rail-supported bulk commodities terminal.

Oil and Gas Industry Related Rail Opportunities

- Liquefied natural gas (LNG) shipping presents a near-term opportunity for use of the Port MacKenzie rail extension. In Fall 2016, test shipments of ISO containerized LNG were successfully trucked 70 miles from AIDEA's Titan LNG plant near Port MacKenzie to the Anchorage rail yard before being loaded on a northbound train to Fairbanks.

- Though the specific path toward expanded LNG production capacity in the Port MacKenzie area is unclear at the time of this study, development of additional capacity does appear likely, as part of an effort to provide lower-cost energy in Fairbanks. As production capacity is increased at the Titan plant or a new facility, LNG could be moved by rail to Fairbanks, with a rail extension to the plant.

- ARRC has federal government approval to operate up to three trains per week with 12 ISO containers per train until the end of 2017 when the allowed capacity increases to a maximum of 60 ISO containers every four days. Each ISO container can carry 7,000 gallons (27,000 pounds) of LNG. ARRC's is the first approval issued by the Federal Railroad Administration in the nation.

- Resource Energy Inc. (REI) has proposed development of an LNG export facility at (or very near) Port MacKenzie. The 100,000 gallons per day facility would liquefy Cook Inlet natural gas for export to Japan. REI may begin engineering and design work by the end of 2016/early 2017. The facility could have the capacity to fill containers of LNG to be transported by truck or rail to Interior consumers, if demand warranted.

- It is difficult to predict the scale of rail shipment of LNG over the next few years. Uncertainty around Cook Inlet gas supply, the timeframe for expansion of production capacity at the Titan facility (or elsewhere near Port MacKenzie), the pace of build-out of Fairbanks natural gas distribution infrastructure, the price of competing fuels, uncertainty around North Slope gas pipeline construction, and a myriad of other factors are at play.

- However, as LNG supply and demand dynamics evolve, at high volumes a rail spur to an LNG production and storage facility would be highly advantageous, relative to trucking to a rail transshipment terminal.

- Regarding refined petroleum products, Central Alaska Energy has plans to develop a tank farm at Port MacKenzie with capacity to store approximately 7 million gallons of ultra-low sulfur diesel (ULSD) and gasoline. Product from the tank farm would be used to supply Railbelt markets. Located near the rail extension, transport of refined products to Interior customers could be by rail. The timing of facility construction is uncertain and contingent on market conditions.

- Current LNG pipeline plans were developed without assuming a rail link to Port MacKenzie. A fully developed Port MacKenzie would provide advantages over Seward and has the potential to be the main port of entry for pipeline sections. Pipe shipments are estimated at 420,000 tons under the Alaska Stand Alone Pipeline proposal. Alaska LNG project documents estimate 14,975 rail cars loads will be required to move an estimated 58,000 40-foot pipe sections and related materials (mainline block values, pipe bends, etc.). However, a Fall 2016 analysis indicates that competitiveness of the Alaska LNG pipeline ranks poorly compared to other projects competing to supply markets in North Asia. The future of these proposals is uncertain.

Concrete-coated pipe transshipment at Port MacKenzie.
Photo provided by MSB Public Affairs.

- Alberta to Alaska (A2A) Rail Development Corp. has recently designated Port MacKenzie as the Alaska marine terminal for its 1 million barrels per day Alberta bitumen rail transport project. That $30 billion rail development project would fundamentally alter the economics of the Port MacKenzie rail extension,

with five 196-car trains daily, eventually increasing to nine trains daily. Each train would carry 122,500 barrels of bitumen.

General Cargo

- Approximately 2.3 million tons of cargo are shipped northbound into Southcentral ports each year. Approximately 1.5 million tons arrive in a Matson container ship or a Totem Ocean Trailer Express (TOTE) roll-on, roll-off vessel. Other cargo through the Port of Anchorage includes cement (129,000 tons in 2015), using a newly expanded storage facility. Private barge operators, based near the Port of Anchorage, account for additional inbound freight. Another 300,000 tons arrives in Whittier mainly aboard rail barges. Arrivals in Seward and Valdez account for much of the balance.

- Southbound freight moving through Southcentral ports is mainly fish and empty containers, as well as a relatively small volume of containerized household items.

- Extension of rail to Port MacKenzie would not be expected to fundamentally change inbound or outbound marine shipping patterns in the near term. Port of Anchorage will remain the region's container ship terminal over the long-term (it now operates at about 40 percent capacity). Unable to accommodate rail barges, Port MacKenzie will not capture the market now served by Whittier. The private barge operators working out of Anchorage using their own facilities (with no wharfage or dockage fees) would not in the near term have cost incentive to relocate their facilities or services.

- As with other segments of the freight market, Port MacKenzie's opportunities in general cargo movement depend on marine and overland transportation providers seeing cost advantages associated with better access to the Interior.

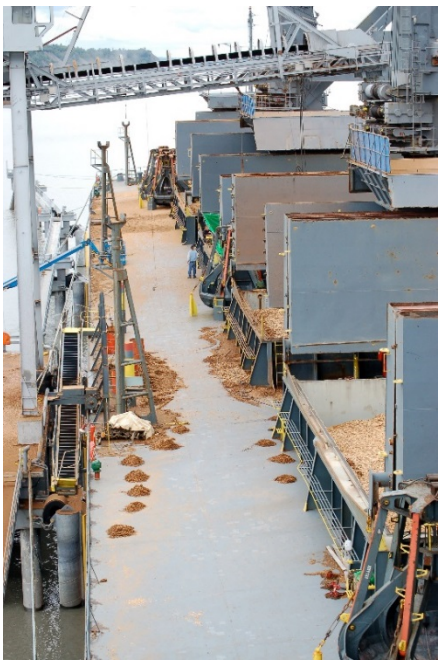
Forest Products

- Interior Alaska holds vast forest resources. A recent inventory indicates that the Tanana Valley alone could sustainably produce nearly 500,000 tons of forest products annually.

- An export industry would likely depend on wood chips destined for paper and fuel markets in Japan and China. White spruce saw logs also offer export potential.

- Chinese demand for hardwood chips has experienced very strong growth over the last ten years. Markets in Japan and China (roughly 84 percent of the global export market) are forecasted to remain strong over the foreseeable future.

- An Interior Alaska forest resources export industry would be very sensitive to transportation costs. A rail connection to Port MacKenzie would likely provide the cheapest option for moving high volumes of materials.



Loading wood chips destined for Asia, Port MacKenzie.
Photo provided by MSB Public Affairs.

- Industry representatives indicate that shipping to Asia is cheaper from Port MacKenzie than comparable ports in the Pacific Northwest and British Columbia. Port MacKenzie is 3,742 nautical miles (nm) from Shanghai (for example), significantly closer than Prince Rupert (4,652 nm), Vancouver (4,873 nm), and Seattle (4,960 nm).

- Past shipments and current proposals – based on trucking from MSB-area logging operations – give the port familiarity with this market and help justify the infrastructure investments needed to attract additional business.

- A fully developed Port MacKenzie is likely to see use by wood chip exporters. Between 100,000 and 300,000 tons of wood chips could conceivably be exported annually during periods of market strength such as are currently projected.

- Astoria Forest Products - an active forest products exporter based in Astoria, Oregon – is in the process of setting up an operation in the MSB. Together with local partners, the company plans to harvest timber in the Mat-Su region and export wood chips and other forest products to Asian markets. Other products, such as birch saw timber, may also be shipped to domestic mills.

Aggregates

- The Port MacKenzie area has considerable sand and gravel resources.
- Operations in the Palmer area currently ship 2 million+ tons of gravel to Anchorage by rail each year (the only major aggregate shipments over the Alaska Railroad system). These operations are expected to continue to supply Anchorage's demand.
- While there are no current plans to export Port MacKenzie's aggregate resources, shipments directly through the port have been a significant source of revenue and could help generate the economies of scale needed to maintain port infrastructure such as the bulk commodity conveyor system.

Gravel barge, Port MacKenzie.
Photo provided by MSB Public Affairs.

Limestone

- The Globe Creek limestone deposit, located about 38 miles from Fairbanks, is the largest known resource in the Railbelt region, containing 1.6 billion tons of high-purity limestone. This resource may, at some point in the future, have potential for large-scale development. Lime and Portland cement are the two primary products derived from limestone.

- Alaska's mines are among the state's largest consumers of lime, nearly all of which is currently imported. Similarly, all of Alaska's cement needs are met with imports.

- Access to low-cost energy and low cost product transportation are prerequisites for development of the Globe Creek limestone resource. To the extent market conditions and production costs support limestone resource development in Interior Alaska (a long-term possibility), rail to Port MacKenzie could play a role in product transportation.

Agriculture

- Alaska's agriculture sector is small in scale and focused on in-state markets. The largest rail need is for inbound shipments of fertilizer, which are now served by rail barge to Whittier.

Summary Overview

A connection to the regional rail network is an essential component of developing Port MacKenzie as Interior Alaska's bulk commodities marine terminal. The Interior holds important known mineral and other natural resources, along with high potential for undiscovered mineral resources. For Interior Alaska to be competitive in global commodities markets, development of very efficient transportation infrastructure and services will be essential to move large tonnages over long distances to a deep-water terminal.

To the extent that the rail connection supports development of one or more base metal mines, revenues could be substantial. A mine operating at the scale of Southeast Alaska's Greens Creek mine could generate $3 million in annual railroad revenue. A Red Dog-scale mine would generate close to $20 million annually, assuming concentrates were transported 325 miles by train. Port revenues could total $200,000 to $1.5 million per year, based on current bulk commodity wharfage rates. Back haul freight would account for additional port and railroad revenue. With Port MacKenzie already identified as the Arctic Project's deepwater port of choice, close engagement with Trilogy and AIDEA on transportation infrastructure planning would be in MSB's best interest.

Potential mining related benefits associated with the rail extension are long-term rather than immediate. Current base metal exploration and development efforts are in early phases. Further, challenging Pacific Rim and global market conditions make it difficult to predict with any degree of certainty the timing and magnitude of railroad or port revenue that might be associated with Port MacKenzie rail extension.

Other opportunities are more immediate but similarly difficult to pin down. Shipment of significant volumes of LNG by rail could occur within a few years, but again the timeframe around a substantial scale-up of gas shipments to the Interior is unclear, as is the point when shifting from trucking to rail will make the most economic sense. The rapidly changing landscape around Interior LNG supply warrants close observation and engagement, as a potential market for Port MacKenzie rail services.

Forest products were among the first resources shipped out from Port MacKenzie and they are most likely to emerge as the best near-term market opportunity. However, as is the case for all commodities and other materials, high volumes are essential for utilization of cost-competitive and efficient rail service.

The Matanuska-Susitna Borough (MSB) commissioned this study to estimate the type and volume of freight that could be moved over the foreseeable future through a fully developed Port MacKenzie rail extension. The scope of this market analysis covers the full spectrum of freight, including mineral concentrates; mining-related supplies and equipment; LNG and other refined petroleum products; forest products; agricultural products; general cargo; construction materials such as rock, gravel, and cement; and other categories of freight.

Initial sections of this report provide background information on Port MacKenzie, the Alaska Railroad Corporation (ARRC), and current freight dynamics in Southcentral and Interior Alaska. Subsequent sections describe commodities and freight types with the potential to be shipped through Port MacKenzie via the rail extension. Current freight movements, if any, are described, as well as significant development opportunities and resources in Interior Alaska. Completion of the rail extension could contribute to development of these resources through reduced transportation costs. The competitive position of Port MacKenzie, and outlook for use of the rail extension, is discussed for each type of commodity.

Methodology

The information presented in this report is based on a review of secondary resources, analysis of available transportation and other data, and executive interviews to verify and update findings.

Document Review and Secondary Data Collection

The following is a short sample of key resources reviewed for this report:

- Alaska LNG. (2016). *Draft Resource Report 5: Socioeconomics.*
- ISER, University of Alaska Anchorage. (2008). *Benefit-Cost Assessment of the Port MacKenzie Rail Extension.* Prepared for the Matanuska-Susitna Borough.
- Matanuska-Sustina Borough. (2016). *Port MacKenzie Master Plan.*
- McDowell Group. (2016). *Southcentral Alaska Ports Freight and Fuel Analysis.* Prepared for Port of Anchorage.
- Metz, P. (2007). *Economic Analysis of Rail Link: Port MacKenzie to Willow, Alaska: Phase II - Possible Rail Extension Users Analysis.* Submitted to the Matanuska-Susitna Borough.
- Tetra Tech. (September 2013). *Preliminary Economic Assessment Report on the Arctic Project, Ambler Mining District, Northwest Alaska.* Prepared for NovaCopper Inc.
- World Bank Group. (July 2016). *Commodity Markets Outlook.*

A full list of references cited is included at the end of this document.

INTERVIEWS

Existing reports and secondary data provide a useful but incomplete picture of conditions in markets most relevant to Port MacKenzie rail services. To formulate an up-to-date assessment of current and expected market conditions in key potential markets, a series of more than 36 executive interviews were conducted with key informants in the mining, oil and gas, forestry, construction, energy, and transportation sectors. These interviews provide useful guidance on the timing and magnitude of resource development, how Port MacKenzie could alter the transportation playing-field in Southcentral Alaska, and other important information.

Port MacKenzie rail embankment construction. Photo copyright Alaska Aerial Technologies.

Port MacKenzie

Strategically located in Upper Cook Inlet across from Anchorage and southwest of Wasilla, Port MacKenzie began operation in 2002. Owned and operated by the Matanuska-Susitna Borough, the port is designed for the efficient export of Alaska's natural resources, but is capable of handling a wide variety of goods. Lying 38 miles by paved road from Wasilla, the Port has direct access to the State's highway system.

Key features of the port include:

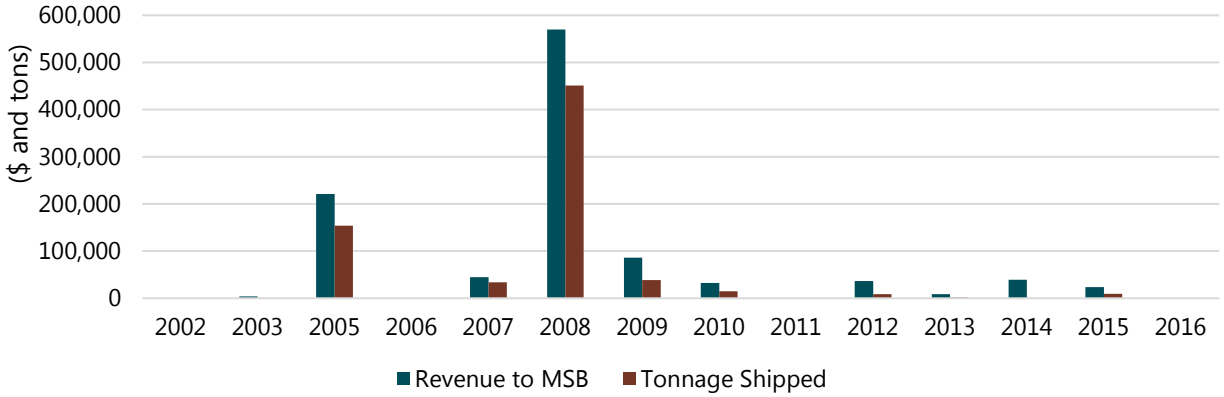
- 1,200-foot deep draft dock (-60 feet at mean lower low water, the deepest in Alaska) that can accommodate panama and cape class vessels.
- Barge dock with a 14.7-acre gravel surface at -20 feet mean lower low water with a 500-foot sheet pile face for docking.
- 7,000 square foot terminal building, with full utilities and office space for lease.
- 9,033 acres of uplands available for commercial/industrial development.
- 3,000-foot long, 5-foot wide conveyor system for loading bulk commodities at speeds up to 2,000 tons per hour.
- Two cranes with capacities of 230 and 100 tons.
- Tariff, dockage, and wharfage rates significantly below those charged at comparable ports in Southcentral Alaska.[1]
- Rail connection currently under development, including a rail loop for efficient offloading.

Historically, the port has not received consistent and regular freight shipments. Rather, shipments come on a contract and as-needed basis.

Through Fall 2016, activity at Port MacKenzie has generated roughly $1.33 million in revenue for the MSB, with over 700,000 tons moved across the port (see Figure 1). By volume, the largest categories of freight shipped have been gravel to Anchorage (451,000 tons), logs and wood chips exported to Asia (188,000 tons), cement imports (50,700 tons), and various other goods (22,800 tons, including coal, heavy equipment, modular housing, concrete-coated pipe, scrap metal, and other cargo).

[1] (McDowell Group, 2015)

Figure 1. Port MacKenzie Total Revenue to MSB and Total Tonnage Shipped, 2002-2016



Source: MSB.

Master Plan

A 2016 Port MacKenzie Master Plan lays out the MSB's vision for the port's future.[2] The following major needs are prioritized:

- Road upgrades from the port to Parks Highway, including expansion to four-lane arterials and construction of a Big Lake bypass.
- Completion of the rail connection to the ARRC system.
- Construction of a 9-mile pipeline to extend natural gas from Goose Creek Correctional Center to service domestic and industrial uses in the port district.
- Dock improvements, including expansion of the deep draft dock to accommodate two vessels and construction of a second trestle connecting the port's barge dock to the deep-draft dock. Improvements will increase the efficiency of loading and unloading vessels.

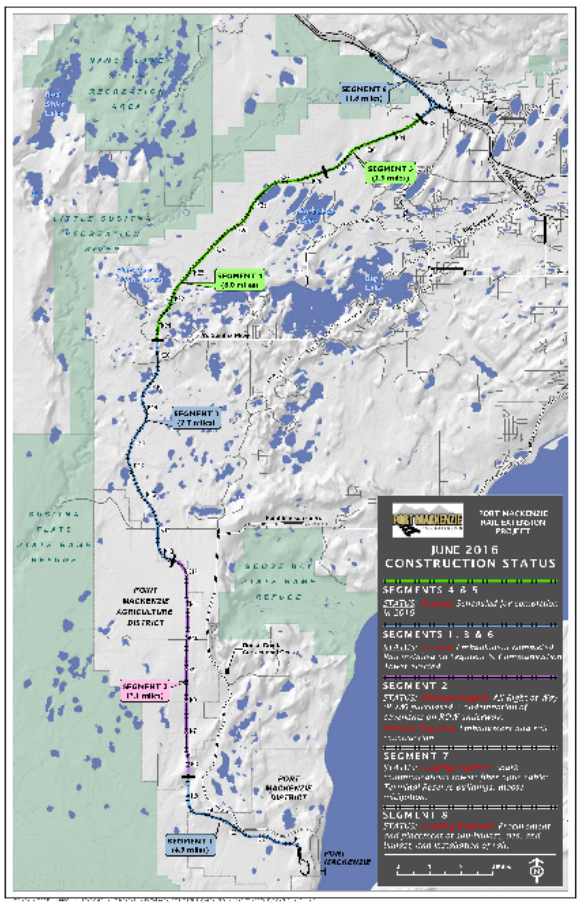
Other port upgrades envisioned include the addition of a second bulk commodity conveyor; pipelines to facilitate loading and unloading of bulk fuel shipments, cement, LNG, and other products; and improvements to utility systems, local roads, and other port developments.

Port MacKenzie Rail Extension

Currently under construction, the Port MacKenzie rail extension is a 35-mile line connecting Port MacKenzie to the existing ARRC system. MSB and ARRC co-manage the rail extension project. An Environmental Impact Statement was completed in 2011 by the federal Surface Transportation Board, including selection of a preferred route. The total project budget is $309 million, of which $184 million has been funded via state grants and $125 million is needed to complete the project.

[2] (Matanuska-Sustina Borough, 2016)

After completion, the extension will operate as part of the ARRC system. The extension will provide the shortest rail route from Interior Alaska to tidewater, cutting 142 miles off bulk commodity shipments to Seward as well as avoiding the parts of the ARRC system that experience the most congestion and steepest grades.



Construction Status

The Port MacKenzie rail extension is being built in six main segments (see map at right) through mostly undeveloped lands in the Sustina River Valley.

As of Fall 2016, embankments and bridges have been completed on five of the six segments, totaling 26 miles and involving an estimated 7.23 million cubic yards of earth movement. Eight bridges spanning a combined total of roughly 900 feet have been built. Remaining efforts include embankment construction on segment 2, as well as installation of ballast and rail on five of the segments. A rail loop on the bluff above Port MacKenzie has been cleared but not installed.

Segment 6 near Houston, consisting mostly of siding along the ARRC main north-south line, has been completed and is currently operational.

Bulk Commodity and Freight Terminal Concept

The Port of Prince Rupert, western Canada's principal marine gateway to Pacific Rim markets, provides an example of the long-range vision Mat-Su Borough has for development of Port MacKenzie as Alaska's bulk commodity terminal. In 2015, the rail-connected Port of Prince Rupert handled 3.6 million metric tons of coal, 734,000 tons of wood pellets, and 435,000 tons of logs. The port is a key agricultural product export terminal, including 3.7 million tons of wheat and 2.2 million tons of canola in 2015. The port also handled 600,000 TEU in inbound and outbound containerized cargo.[3] Port of Prince Rupert notes as a key competitive advantage being 1 to 2 days closer to Asian markets than other West Coast ports.[4]

Port of Prince Rupert.

[3] (Port of Prince Rupert, 2015)
[4] More information is available at http://www.rupertport.com/.

The Alaska Railroad Corporation (ARRC) – a largely self-sustaining corporation owned by the State of Alaska – operates freight and passenger rail service on 521 miles of track in Interior and Southcentral Alaska. The rail system connects ports in Seward, Whittier, and Anchorage with Interior Alaska, including Denali National Park, Fairbanks, North Pole, Eielson Air Force Base, and Fort Wainwright. The ARRC has nearly a billion dollars in capital assets.

In 2015, the ARRC generated $164 million in operating revenue from freight (44 percent) and passenger services (17 percent), grants (27 percent), real estate income (11 percent), and other sources. Operating expenses were roughly equal to revenue generated in 2015.[5]

The State of Alaska recently developed a State Rail Plan, which describes the state's current passenger and freight rail system in detail and lays out improvements and additions needed to meet forecasted future demand.[6] The plan, currently available as a public review draft, was prepared to comply with requirements of the Passenger Rail Investment and Improvement Act of 2008. It is meant to inform the State of Alaska's role in future rail transportation in Alaska, not to serve as a long-term plan for the ARRC.

Freight Overview

As described in the State Rail Plan, the Alaska Railroad's major lines of freight business include the following:

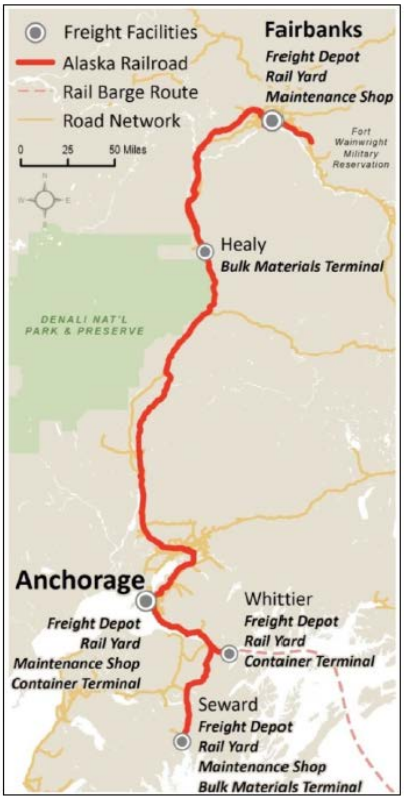
Barge/Interline Services

Two entities (ARRC's Alaska Rail Marine and Canadian National Railway's AquaTrain) move railcar shipments to/from Alaska via Seattle and Prince Rupert, interchanging with Lower 48 and Canadian railroads, respectively. Containers arriving by rail barge move from Whittier to Anchorage, Fairbanks, or other destinations by rail.

According to one source, 85-90 percent of the freight hauled via Alaska Rail Marine is oil and gas related.[7]

Coal

Coal from Usibelli Coal Mine in Healy moves to Fairbanks (for power generation) and to Seward for export to Pacific Rim markets. Coal



Source: (HDR, Inc., 2015)

[5] (Alaska Railroad Corporation, 2015)
[6] (HDR, Inc., 2015)
[7] (Alaska LNG, 2016)

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.[8] The Seward Loading Facility, owned by ARRC, is capable of loading roughly 2 million tons per year.

Stone, Sand, and Gravel

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.

Trailers/Containers on Flat Cars (TOFC/COFC)

TOFC/COFC move north and south between Seward, Whittier, Anchorage, and Fairbanks. A significant portion of this traffic is interline shipments that arrive via rail barge in Whittier.

A five-times-weekly train – the ARRC's only scheduled freight service – carries containers from Anchorage to Fairbanks.

Miscellaneous/In-State Local

Important categories of ARRC freight business that do not fit into those described above include in-state shipments of cement, scrap metal, military equipment, and pipe.

Data on ARRC's most common freight routes – including distance, travel time, and freight moved in 2014 – are presented in Table 1 below.

Table 1. Distance, Travel Time, and Freight Moved in 2014, for Selected ARRC Routes

Route	Distance (miles)	Travel Time (hours)	Freight Moved, 2014 (Tons)	Freight Moved, 2014 (Tons) reverse direction
Anchorage to Fairbanks	356	11	1,559,378	1,108,066
Anchorage to Seward	114	4	523,926*	31,744
Anchorage to Whittier	62	2	416,405	783,439
Healy to Fairbanks	114	4	-	-
Healy to Seward	358	11 (including time to re-crew in Anchorage)	512,000	-
Palmer to Anchorage	43	-	2,344,600	-

Source: (HDR, Inc., 2015) and (Alaska LNG, 2016)
Notes: Anchorage to Seward freight tonnage includes cargo hauled from Healy to Seward. Data was not available, or was negligible for some routes or route directions.

[8] (Alaska Railroad Corporation, August 2015)

Rail Freight Trends and Projections

In 2015, 53 percent of total freight shipped by ARRC consisted of gravel and other aggregates, followed by coal for in-state markets (19 percent), petroleum products (11 percent), interline shipments via rail barge (11 percent), other types of freight (6 percent), and coal for export (3 percent).

Over the last eight years, ARRC's freight business has declined by more than a quarter (-27 percent) when measured by revenue and more than a third (-35 percent) when measured by tonnage. As shown in Table 2, the major categories experiencing a decline include petroleum products (-80 percent, the result of closure of the Flint Hills refinery in North Pole), coal for export (-71 percent, the result of weakening export markets), and gravel (-18 percent). Comparatively steady sources of ARRC freight business over this period include coal for in-state markets and interline shipments. The category of "Other" freight, and shipments for oil field activities specifically, have been a bright spot, growing 29 percent over the last eight years. In 2014, ARRC hauled nearly 40,000 tons of pipe for the oil and gas industry.[9]

Figure 2. Alaska Railroad Freight Revenue and Tons Shipped, 2004-2015

Source: Alaska Railroad Annual Reports.

Table 2. Freight Shipped (000s of tons), by Type, and Freight Revenue, Alaska Railroad, 2008-2015

Freight Type	2008	2009	2010	2011	2012	2013	2014	2015	2008-2015
Petroleum Products	1,911	1,657	1,253	1,292	1,057	947	580	381	-80%
Gravel	2,776	2,306	2,614	2,252	2,003	2,025	2,345	2,288	-18%
Coal (for export)	471	801	1,051	1,195	961	634	513	137	-71%
Coal (in-state)	761	762	791	836	838	793	766	796	5%
Interline	491	466	412	432	459	464	497	470	-4%
Other	190	171	210	187	243	244	216	246	29%
Total Freight	**6,599**	**6,163**	**6,332**	**6,194**	**5,561**	**5,107**	**4,917**	**4,285**	**-35%**
Freight Revenue (000s, $2015)	**$111,457**	**$97,043**	**$96,969**	**$106,286**	**$105,820**	**$99,441**	**$95,273**	**$81,525**	**-27%**

[9] (Alaska Railroad Corporation, 2014)

State Rail Plan Forecast

The State Rail Plan includes a forecast for Alaska's rail freight volumes in 2025 and 2035. The forecast presented is a modified version of a forecast by the Freight Analysis Framework – a partnership between the Bureau of Transportation Statistics and the Federal Highway Administration. The forecast was modified to include more accurate data from ARRC and address other factors unique to Alaska. As stated in the plan, "These forecasts [rely] on well-recognized and widely-used sources, but they are incapable of foreseeing unpredictable factors that may have either a positive or negative influence on the projected freight flows."

The State Rail Plan forecasts a slight increase in total rail freight movements between 2013 and 2025, based on national trends and other expectations built into the FAF forecast. Specific freight types that are projected to increase in volume include coal and chemicals. Petroleum products, iron/steel products, and other freight are projected to decline, while gravel and intermodal shipments are projected to stay roughly at current levels.

Table 3. State Rail Plan Rail Freight Forecast, by Type, 2013, 2025, and 2035

Freight Type	2013	2025	2035
Stone, Sand, Gravel	2,025	2,124	2,187
Petroleum Product	947	606	418
Coal	1,427	1,687	1,939
Chemicals	155	207	264
Iron/Steel Products	70	63	58
Intermodal	104	104	107
Other	382	356	336
Total	**5,110**	**5,147**	**5,310**

Source: (HDR, Inc., 2015) based on Freight Analysis Framework and ARRC data, with custom data analysis by HDR.

Proposed Improvements and Extensions to Alaska Rail System

The State Rail Plan includes an overview of proposed improvements, upgrades, and extensions to Alaska's rail system, ranked by priority level. Though subject to revision following ongoing public input, the priorities described on the following pages below were identified for the ARRC freight system.

Freight Rail – Proposed Short Term Investments

- Seward marine terminal improvements, including enlarging existing freight dock, improvements to jetty, dredging, and various upland improvements. Work to be completed in four phases for an estimated total of $183 million.
- Port MacKenzie rail extension. See page 12 for full description.
- Fairbanks area rail line relocation to enhance safety, reduce travel times, and accommodate enhanced passenger service. $75-95 million estimated cost.
- Construction of a Cantwell intermodal facility to support development of a hard aggregate facility in the area. $4.1 million estimated cost.
- South Wasilla rail line relocation to reduce track curvature and improve safety and travel times. $40 million estimated cost.
- Nenana rail line relocation to enhance freight and passenger service. Estimated $30 million cost.

- Increasing clearance at Portage and Divide Tunnels (accessing Whittier and Seward, respectively) to accommodate double stack container railcars. Total estimated cost of $5.8 million.

Freight Rail – Proposed Long Term Investments

- Anchorage to Seward track rehabilitation. Estimated $100 million cost.
- Whittier wharf replacement to serve freight and other larger ships. $60 million.
- Whittier yard improvements to improve efficient movement of intermodal traffic.
- Northern rail extension, adding approximately 80 miles of new rail from North Pole/Eielson Air Force Base to Delta Junction and Fort Greely. The extension would provide commercial freight service to the corridor, support military needs (including providing year-round access to the military's Joint Pacific Area Range Complex), and provide an alternate route to the Richardson Highway for passengers and tourists. Estimated cost of $1.1 billion, of which $188 million has already been expended to build a new bimodal rail-vehicle bridge over the Tanana River at Salcha.
- Healy Canyon stabilization and rail realignment. $3 million.
- Port of Anchorage track improvements to extend to the port's new north end barge facility and increase offloading efficiency. $8 million estimated cost.
- Fairbanks freight intermodal terminal rail/truck staging area improvements. Estimated $18 million cost.
- Separation of at-grade crossings throughout the ARRC system. $222.5+ million cost.
- Susitna Watana rail spur to support hydroelectric project construction. $25-100 million cost.
- Support rail extensions to access resources.
- Standardize Alaska's track to 286,000-pound capacity.
- Develop a Fairbanks Area Rail Plan.

Other Proposed Investments for Further Study

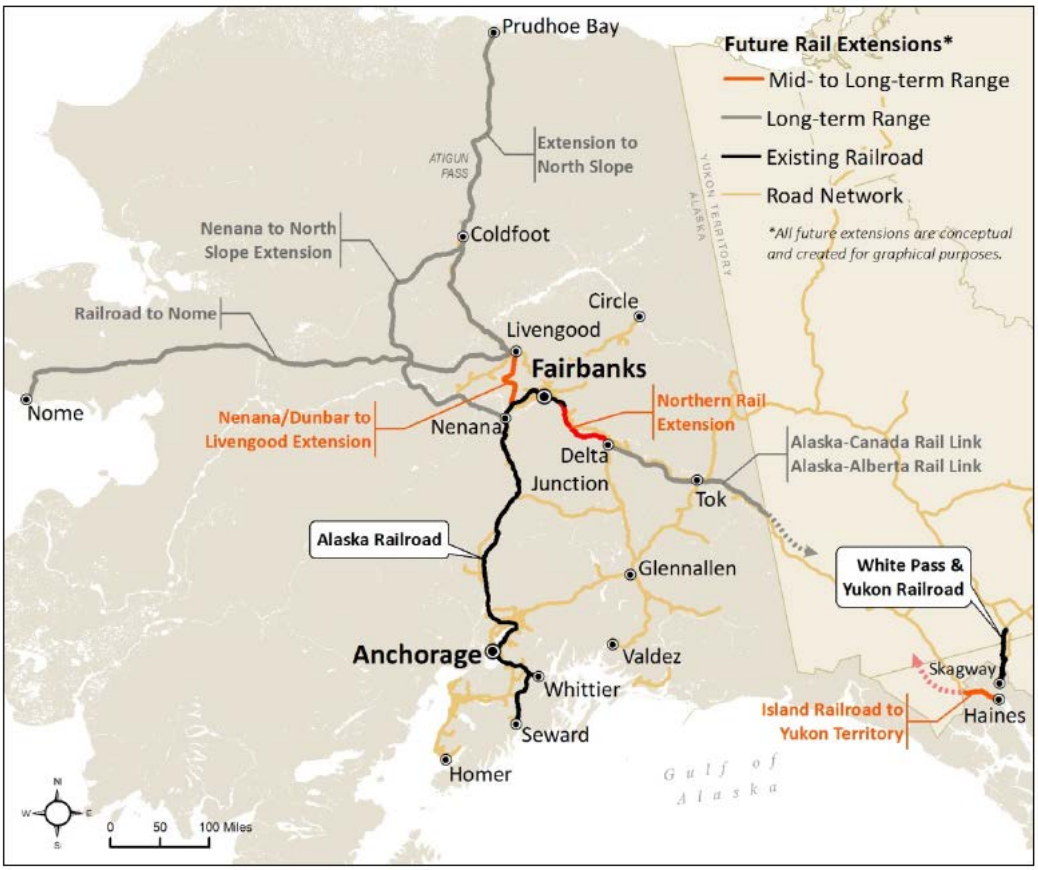
- Nenana/Dunbar to Livengood rail extension – This roughly 45-mile extension would support limestone and other mining in the project corridor, and has an estimated $300 million capital cost.
- Rail extension to North Slope – A rail link to the North Slope would help address especially high capital and operating costs that decrease the competitiveness of Alaska oil and gas. Reducing transportation costs via a rail link has the potential to stimulate a wide variety of oil/gas and mining opportunities on the North Slope.[10] Potential benefits of the 450-mile rail extension include the possibility of supporting non-conventional oil and gas production, such as large-scale horizontal drilling and hydraulic fracking. Hydraulic fracking requires huge volumes of sand, drilling muds, and other materials. The project has an estimate cost of $7 billion.
- Rail connection to Canada. Two recent studies – Alaska-Canada Rail and Alaska-Alberta Rail – consider linking Canada's rail system to Alaska's for the purposes of connecting resources to tidewater ports in Alaska, notably Port MacKenzie. Alaska-Canada Rail project studies were initiated in 2005 with joint funding by the State of Alaska and the Yukon Territory, and produced an estimated construction cost

[10] (HDR, Inc., 2015) Appendix D

of $11 billion.[11] While the Alaska-Canada Rail project was focused on mineral resources, the proposed Alberta to Alaska ("A2A") railway would connect Alberta's petroleum resources to tidewater ports in Alaska. Under the project's revised business model Port MacKenzie would be the primary transshipment port, receiving five 196-car trains daily starting in late 2020. Mineral resources along the rail corridor are also anticipated to be developed and add to freight traffic to Port MacKenzie. A $1.8 million pre-feasibility study was published in 2015 with funding from Alberta Energy and generated a capital cost estimate of between $28 and $34 billion ($2013 Canadian).[12] Addition information about the Alberta to Alaska railway project is provided in the final chapter of this report.

- Rail extension to Nome. Development of a transportation corridor from Interior Alaska to Nome has long been a goal. The most recent study concluded that a road was more cost effective than rail.[13]
- ARRC Knik Arm Crossing and new central railyard.
- Rail extension west of the Susitna River to access promising timber, coal, and other resources.

Figure 3. Proposed Rail Extensions Described in the Alaska State Rail Plan



Source: (HDR, Inc., 2015)

[11] (ALCAN RaiLink Inc., 2007)
[12] (The Van Horne Institute, 2015), (HDR, Inc., 2015),
[13] (Dowl HKM, 2010)

Freight enters and leaves Southcentral Alaska through ports in Anchorage, Whittier, Seward, Valdez, Homer, and Port MacKenzie. The ports have different infrastructure, so that while POA receives the highest volume of inbound freight, other ports play their own unique role.

Major inbound shipments include fuel, consumer goods, household goods, and materials for construction and natural resource development. Upon entry into a Southcentral port, shipments transfer to truck, rail, barge, or plane for transportation to secondary or final destinations. Major outbound shipments include coal, fish, scrap material, and empty containers.

This section describes key port infrastructure in Southcentral Alaska and the amounts of various types of freight that move across these ports. The implications of a completed rail extension to Port MacKenzie are explored to determine any associated changes to the dynamics of freight movement in Southcentral and Interior Alaska.

Key Southcentral Port Infrastructure

Port of Anchorage

The Port of Anchorage (POA) serves as the main point of entry for a variety of cargo entering Alaska.[14] Well-developed infrastructure facilitates efficient unloading, allowing cargo to move quickly onto rail, truck, or air for distribution to communities throughout Alaska.

POA has a draft depth of -35 feet mean lower low water (MLLW), a cargo wharf extending 2,100 feet, and two wharfs for petroleum tankers each with a length of 600 feet.[15] It lies on 220 acres of land with 90 acres leased to long-term users. The cargo dock has one 40-ton and two 30-ton electric cranes mounted on rails and, for container ships, supports either roll-on/roll-off or lift-on/lift-off vessels. Because of its relationship with nearby military installations, the POA is designated by the Department of Defense as a Nationally Strategic Seaport.

FREIGHT

Deep-water container vessels, operated by Matson (formerly Horizon) and TOTE, bring in most of the POA freight. Both operators run twice weekly deliveries from the Port of Tacoma. Of all Southcentral ports, POA is the only one that allows full use of TOTE's roll-on/roll-off system. Other facilities either cannot work with roll-on/roll-off or cannot handle all two ramps that TOTE uses to load and offload.

[14] (McDowell Group, 2016)
[15] Dredging is required to maintain that draft depth.

Beyond containerized shipments, POA receives 7-8 shipments of cement throughout the year. POA is the only Alaska port capable of handling bulk cement, which is offloaded through a 2,400-foot cement pipeline to storage silos. Alaska Basic Industries (ABI) recently tripled cement storage capacity at POA to 60,000 tons.

Significant volumes of petroleum products travel through POA. These volumes have increased in recent years with the closure of Flint Hill's North Pole refinery and the subsequently heightened reliance on petroleum imports. Existing infrastructure enables POA to efficiently transfer and store large quantities of petroleum products. Companies with storage capacity for refined petroleum products at POA include Tesoro, Flint Hills, Crowley, and Aircraft Services International Group. New construction by Crowley and Delta Western will push POA's total storage capacity to 3.4 million barrels. A 69-mile, 48,000 barrel per day pipeline connects POA with the refinery in Nikiski and the Ted Stevens Anchorage International Airport (ANC). Another pipeline distributes JP-8 jet fuel to Joint Base Elmendorf and Richardson (JBER). Fuel products stored at POA are also distributed by truck throughout Southcentral Alaska's road system and by barge throughout the state.

Other Anchorage Ports

Adjacent to POA lie two separate private port facilities with access to highway and rail transportation modes. Shipments through these facilities support construction and industry activity throughout the state, especially on the North Slope and in Western Alaska.

AML

The AML/Northland Services facility receives barges with containerized or break-bulk cargo. During the ice-free season, AML ships a barge once a week to its Anchorage terminal, or more frequently as demand warrants.

AML facilities lie on 20 acres leased from the Alaska Railroad Corporation (ARRC) and are a combined rail transfer and port facility. They have a draft depth of +8' MLLW. This means they are "go dry" berths, which brings both advantages and disadvantages. An advantage includes reduced impact of tides on ramp-forklift operations. Structural and dredging issues result in a disadvantage.

North Star

The other Anchorage facility, owned and operated by North Star Terminal & Stevedore Co., brings in barges of containerized or break-bulk cargo. Lumber comes in multiples times throughout the year. In the summer months, construction equipment destined for rural areas of the state leaves through North Star facilities. One-time contract barges also come to these docks to support construction projects, scrap metal exports, and other shipping needs.

North Star infrastructure includes three 300-ton cranes and a large fleet of smaller cranes, forklifts, loaders, dozers, and scrap handlers. The property includes a 376-foot wharf and 22 acres of land.

Whittier

After POA, the second largest volume of freight enters Southcentral Alaska through Whittier. ARRC's Whittier dock has a depth of -35 feet MLLW and a length totaling 350 feet. Rail tracks run all the way to the dock and allow railcars to transfer directly from barges to rail. The dock can receive barges but not container ships. The

facilities lie on 230 acres of ARRC-owned land. The width of the Whittier tunnel and length of trains that can travel through the town can place some constraints on cargo brought through Whittier.

All freight transported through Whittier comes on rail cars or in containers. Natural resource industries, especially oil and gas, ship the most freight through Whittier. Commodities include machinery, building materials, drilling fluid and mud, and pipe. ARRC facilities also support the local Whittier seafood processing and tourism businesses.

Seward

Up until the past two years, freight activity in Seward has centered around exporting coal produced at Usibelli Coal Mine. Coal exports declined significantly in 2015 and 2016, and in the summer of 2016, the Seward Loading Facility (owned by ARRC) went into "cold storage" until the economics of exports improve. The Seward Loading Facility allows for enhanced handling of bulk commodities from rail cars into bulk cargo vessels. It handles primarily coal but also gravel.

In addition to the Seward Loading Facility, ARRC holdings in Seward include a freight dock with a land area of 5.3 acres, dock face length of 550 feet, draft depth of -35 feet MLLW, and support equipment including a 150-ton crane. The dock can handle roll on/roll off transfer, but is limited in this capacity due to a narrow land area. TOTE has designated Seward as its emergency contingency berth.

A barge from Samson Tug and Barge Inc. delivers to Seward's ARRC facilities once every two weeks. Containerized cargo composes about two-thirds of shipments while break bulk accounts for the other third. Other barges deliver to Seward on an as-needed contract basis.

Valdez

At the terminus of the Trans-Alaska Pipeline, the Valdez Marine Terminal is the most significant port in Alaska by volume. Multiple oil tankers leave from the terminal each week. The terminal does not handle significant quantities of other cargo.

Freight activity at the city-owned Port of Valdez supports both local and statewide interests.[16] Holdings of the Port of Valdez include the Valdez Container Terminal, an unused Valdez Grain Terminal (capacity for 522,000 bushels in nine concrete silos), and the John Thomas Kelsey Municipal Dock.

The Container Terminal handles containerized cargo and allows for loading and unloading both roll on/roll off and lift on/lift off technologies. It has a dock length of 700 feet, two dolphins that allow for a length up to 1,200 feet, a depth of -50 feet MLLW, a 140-ton crane, and multiple diesel forklifts. A 21-acre uplands yard has lighting, electrical plug-ins for reefer containers, and a 60-ton scale.

[16] (McDowell Group, 2015)

Freight shipments through the Valdez Container Terminal bring in containerized and break bulk goods to serve the military and industry. Significant quantities of military munitions travel through Port of Valdez. Materials and supplies for construction projects, North Slope oil and gas production, and mining operations, including Pogo Gold Mine, also travel over the Valdez docks.

Significant quantities of seafood products are shipped south through Port of Valdez by the town's sizable processing sector. Recent record harvests of pink salmon in Prince William Sound have driven up the tonnage of exports. Silver Bay Seafood's recent expansion in Valdez will also expand exports, potentially doubling the number of reefer containers leaving the port.

Southcentral Freight Dynamics

In 2015, waterborne non-fuel freight entering Southcentral totaled approximately 2.3 million tons. About 80 percent came as van/container/platform cargo, followed by rail cargo (10 percent) and break-bulk, bulk, and other non-fuel freight (10 percent). Of all inbound freight, approximately 73 percent entered through POA, with the rest distributed though the other Southcentral ports.

Table 4. Inbound Southcentral Waterborne Freight (Non-Petroleum) by Type of Freight, 2015, POA and All Other Ports

Type of Freight	Tons	Percent of Total
Van/Container/Platform cargo	**1,829,000**	**81%**
Port of Anchorage	1,529,000	68
All Other Southcentral Ports	200,000	13
Rail cargo	**200,000**	**9%**
Whittier	200,000	9
Break-Bulk, Bulk, and Other Non-Fuel freight	**230,000**	**10%**
Port of Anchorage	130,000	6
All Other Southcentral Ports	100,000	4
Total	**2,259,000**	**100%**
Port of Anchorage	1,659,000	73
All Other Southcentral Ports	600,000	27

Source: (McDowell Group, 2016)

Itemized Freight

Most van/container/platform or itemized freight entering Southcentral does so through POA and comes by way of container vessels operated by TOTE and Matson. In 2015, these vessels brought 1.53 million tons of itemized freight to POA – roughly 84 percent of all itemized general cargo inbound to Southcentral Alaska. According to industry representatives, approximately 50-55 percent of the goods brought by these shipments stay in the Anchorage area. Another 10-15 percent are trucked to the Kenai Peninsula. The rest of POA's inbound itemized

freight is trucked to Mat-Su (20 percent) or transported by truck or rail to Fairbanks and the Interior (15 percent).[17]

In 2015, Southcentral ports other than POA brought in approximately 300,000 tons of van/container/platform general cargo, approximately 16 percent of the region's total.

The weight of outbound itemized cargo falls well short of the weight of inbound itemized cargo. Empty containers and fish comprise most of the outbound van/container/platform cargo. Outbound itemized cargo also includes some containerized scrap metal, though most scrap metal leaves the state as bulk freight (see below).

Rail Cargo

Rail cars aboard rail barges operated by CN and AML bring approximately 200,000 tons of freight annually through regular shipments to Whittier. This total does not include the tonnage of containerized freight that AML rail barges stack above rail cars.

Break-Bulk, Bulk, and Other Non-Fuel Freight

Other commodities entering Southcentral include cement, iron/steel, construction supplies, materials for natural resource operations (namely mining and oil and gas), and other miscellaneous break-bulk goods (freight not carried in containers). Cement enters primarily through POA, but has also been shipped through Port MacKenzie. The other commodities come into the region through all Southcentral ports. Shipments of break-bulk, bulk, and other non-fuel freight come both as scheduled service and on an as-needed basis. In 2015, 129,000 tons of break-bulk, bulk, and other non-fuel freight entered through POA, including 100,000 tons of cement. Specific tonnages of inbound non-containerized freight to other Southcentral ports are not available, but are estimated at approximately 100,000 tons.

Outbound break-bulk, bulk, and other non-fuel freight includes scrap metal and construction supplies. Non-itemized scrap metal – which comprises most of the outbound scrap metal – leaves the region through the AML and North Star port facilities in Anchorage. Construction supplies barged out of Southcentral are destined for remote communities in Western Alaska. Inbound quantities of break-bulk, bulk, and other non-fuel freight far exceed outbound quantities.

Fuel

Much of the fuel products consumed in Southcentral and transported through Southcentral to other parts of the state come from the Tesoro refinery in Nikiski and the Petro Star refinery in Valdez. Out-of-state shipments bring in all the region's aviation gas and supplement the supply of jet fuel. POA serves as the primary hub for the reception and distribution of this fuel. In addition to fuel brought by pipeline from the Tesoro refinery, POA

[17] (McDowell Group, 2016)

receives barge shipments from the Tesoro and Petro Star refineries. It also receives all out-of-state shipments of aviation gas and jet fuel. Other Southcentral ports receive smaller quantities of fuel from the local refineries.

Port MacKenzie Outlook For General Cargo

Port MacKenzie has important physical attributes and established assets that position it to serve as a bulk commodity marine terminal. It also has assets that position it to play a role in inbound freight movement. These include:

- For goods bound for Interior Alaska, a 30-mile advantage over the region's principal marine inbound freight terminal (in Anchorage), and a 90-mile advantage over the region's other primary inbound port (Whittier).
- 1,200-foot deep draft dock (-60 feet at mean lower low water, the deepest in the region) capable of serving panama and cape class vessels.
- Substantial uplands (9,033 acres) available for bulk cargo handling and storage, significantly more than any other Southcentral port)
- Unconstrained access to the Interior, without logistical or safety concerns related to moving freight through busy urban areas.
- Rail connection currently under development, including a rail loop for efficient loading and offloading.
- Proximity to the proposed Knik Arm bridge, which if constructed could shift significant commercial and industrial activity to the Port MacKenzie area.

These assets position Port MacKenzie well for playing a role in future Interior resource development. However, in terms of the Port's potential to capture a share of the existing inbound freight market, existing specialized infrastructure in other ports, established efficiencies, and the location of key markets present competitive challenges to Port MacKenzie.

Van/Container/Platform Cargo

An estimated 35 percent of the 1.83 million tons of van/container/platform cargo entering Southcentral annually is destined for the Mat-Su or Interior Alaska. Port MacKenzie would provider a shorter, less-congested route for this freight to reach its destination. However, the economies of scale are such that POA is likely remain the region's principal container terminal for the foreseeable future. Approximately 60-70 percent of goods brought by TOTE and Matson container vessels serve markets in Anchorage and the Kenai Peninsula. The location of these markets and the infrastructure that specially equips POA to handle container vessel shipments will keep POA as the port of call for TOTE and Matson.

Substantial volumes of itemized cargo enter Southcentral through the AML Anchorage docks and on board the AML rail barge that services Whittier. AML gains cost efficiencies as the operator of its Anchorage dock facilities and the barges that serve it. AML Anchorage facilities have access to highway and rail transportation modes. In Whittier, AML's rail barge also carries containers. Neither the rail car traffic or the container traffic on those barges would be expected to relocate.

Most scrap metal leaving Southcentral does so in break-bulk, bulk, and other non-fuel freight, but some is containerized. Containerization allows for shipment on board container vessels leaving POA or the rail barge

leaving Whittier. Scrap metal comes from household goods and appliances, construction, infrastructure demolition, oil and gas production, and many other sources. These sources lie throughout Alaska's road system. Much of the metal recycled beyond the Southcentral region is placed on rail and shipped south to Whittier for export through the rail barge. In the past, some scrap metal exports have traveled to foreign destinations. Today, most ship to Washington. Low prices for scrap metal, combined with the ever-present shipping costs out of Alaska, constrain the current market for scrap metal exports and has resulted in the closing of several scrap metal recyclers.

Rail Barge Cargo

Port MacKenzie does not have ability to serve rail barges. Critical efficiencies are generated in rolling cars off rail barges directly on to tracks. Whittier will remain as the region's port of call for freight brought to Alaska by rail barge.

Break-Bulk, Bulk, and Other Non-Fuel Freight

Cement makes up a large proportion of the break-bulk, bulk, and other non-fuel freight entering Southcentral Alaska. With a pipeline for offloading and 60,000 tons of cement storage capacity POA is the Southcentral port most capable of handling bulk cement. Most cement inbound through POA and stored at ABI's storage units remains in Anchorage for consumption. Smaller amounts travel by rail north to Fairbanks, where it then services local construction needs or travels by truck to the North Slope and area mines. Airports and military installations along the Railbelt also draw upon this supply. With its recent expansion at POA, ABI will remain committed to importing through POA.

Other break-bulk, bulk, and other non-fuel freight entering Southcentral includes construction supplies and materials for natural resource production. Pogo Mine brings in significant quantities of material through Valdez. The North Star Terminal in Anchorage brings in supplies for Spenard Builders Supply (SBS). Given the concentration of SBS stores in Anchorage and the Kenai Peninsula, it is unlikely these shipments will go through Port MacKenzie.

An estimated 17,000 tons of break-bulk, bulk, and other non-fuel freight enters Southcentral annually on an as-needed basis.

Scrap metal leaving Southcentral in break-bulk, bulk, and other non-fuel freight primarily goes through the AML and North Star facilities in Anchorage. Much of the scrap metal exiting through these ports comes from recyclers in the Anchorage region. Port MacKenzie has also handled shipments of scrap metal, including exports directly to Asia.

Fuel

At POA, the infrastructure to support distribution of petroleum products – over-the-dock intake facilities; pipelines connected with Tesoro's Nikiski refinery, ANC, and JBER; 3.4 million barrels of existing or near-built storage capacity; and established transshipment systems – will challenge other Southcentral ports to capture a substantial share of this market. However, as described elsewhere in this report, Port MacKenzie offers room for fuel storage and enhanced access to Interior markets. These assets have generated interest in tank farm development at the port.

MILITARY

The military discloses limited details on the quantity and type of materials and equipment shipped through various Alaska ports. It is difficult to speculate on how a fully developed Port MacKenzie would compete for this market. Advantages of Port MacKenzie include the following:

- Redundancy is especially important for the military given its national security mission.
- Because of procurement rules, the military must often choose the cheapest method to bring supplies to their operations.
- The Northern Rail extension, currently under development, would provide a rail link to the Joint Pacific Alaska Range Complex (JPARC) and Fort Greely. An estimated 10,000 personnel train at JPARC, a national training asset with 65,000 square miles of airspace. The recent completion of the rail/vehicle bridge spanning the Tanana River near Eielson AFB is expected to contribute to increased year-round use of JPARC.
- Expansion of Eielson Air Force Base will add an estimated 3,000 more personnel on base, and require increased shipping of supplies and equipment. The base anticipates increasing the number of exercises in the future from its current average of three or four annually. In addition, new F-35s will require about 25 percent more munitions.
- Increased focus on the Arctic by military and civilian leaders is expected to result in increased military presence, infrastructure, and exercises in Alaska.
- Clear Air Force Station will have substantial freight associated with the planned expansion of the long-range missile defense system at the Interior Alaska station.
-

A number of substantial factors may reinforce the status quo for military shipping:

- The size of the military operation at Joint Base Elmendorf Richardson (JBER), coupled with the special designation of the adjacent POA as having strategic importance to the Department of Defense, results in Anchorage serving as the primary port for many military shipments.
- A shipment commonly has 75 percent or more of its goods destined for JBER, with the balance of freight bound for Fort Wainwright or Eielson AFB.
- Easy access via the Richardson Highway to Interior military bases is a competitive advantage for the Port of Valdez, which is used regularly for munitions shipments.

Overall, it is reasonable to assume that a rail-connected Port MacKenzie will see some use by the military, but whether the use will be regular or significant is not clear.

Future mine development in Interior Alaska represents the best opportunity for generating freight tonnages necessary to support significant additional investment in rail assets. This chapter considers potential mining industry use of the rail extension to Port MacKenzie. The analysis includes the following components:

- **Ambler Mining District Projects and Resources**
  - Arctic Project
  - Bornite Project
  - Other Ambler District Resources
  - Ambler Transportation Corridor Planning
  - Ambler District Development Implications for Port MacKenzie Rail
- **Base Metal Price Trends**
- **Interior Alaska Metallic Mineral Development Projects**
  - Livengood Gold Project
  - Golden Summit
  - Shorty Creek
  - Caribou Dome
  - Red Mountain
  - Elephant Mountain
  - Tetlin
  - Pogo Area Prospects
  - Lucky Shot
- **Shipping Needs of Alaska's Hard Rock Mines**
- **Metal Mining Industry Related Railroad and Port Revenues**
- **State of Alaska Revenues from the Mining Industry**
- **Coal Mining**
  - Usibelli Coal Mine (Healy)
  - Wishbone Hill
  - Other Alaska Coal Resources
  - Coal Mining Implications for the Port MacKenzie Rail Extension
- **Limestone**

Ambler Mining District Projects and Resources

Located approximately 785 miles (by highway and proposed road) from Port McKenzie, the Ambler Mining District lies within a 75-mile-long zone of mineralization that has been the target of mineral exploration activity for many years. The area contains copper deposits with near to longer-term development potential, assuming construction of suitable transportation infrastructure. Promising resources include Trilogy Metals Inc.'s (formerly NovaCopper) Arctic and Bornite deposits, Andover Mining Corporation's Sun property, and Teck's Smucker deposit. These projects are described in more detail below.

The Ambler Mineral Belt has been characterized as one of the largest un-developed copper-zinc mineral belts in the world.[18] In addition to known deposits, the district has significant additional mineral exploration and development potential.

Arctic Project (Trilogy Metals)

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

The Arctic deposit hosts 27 million metric tons of Indicated and Inferred resources containing copper, zinc, lead, gold, and silver. The Arctic deposit is very high grade, with an average copper grade of 3.2 percent and a copper-equivalent grade of 5.9 percent.[19] The Arctic Preliminary Economic Analysis (PEA), completed by Tetra Tech in September 2013, indicates 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) is expected to launch an Environmental Impact Statement (EIS) process for the Ambler Mining District Industrial Access Project (AMDIAP). The AMDIAP is described in more detail in a following section of this chapter.

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 (and the most advanced concentrate-producing mine project in the broader Railbelt region) its likelihood and timing of development is 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 Metals)

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

[18] http://www.andovermining.com/wp-content/uploads/2011/12/Andover-Mining-Corp.-Presentation-20134.pdf
[19] (Tetra Tech, September 2013) The Arctic PEA indicates average head grades of 2.28 percent copper, 0.53 percent lead, 3.13 percent zinc, 0.50 grams/ton gold, and 37 grams/ton silver (page 22-2).

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.[20] 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.[21]

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 in 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.

Other Ambler District Mineral Deposits

Sun Deposit

Located about 34 miles from the Arctic deposit, the Sun prospect is owned by Enirgi Group. The most recent available estimates place Sun's resource at 2.2 million tons of Indicated resource, grading 1.4 percent copper and 4.1 percent zinc, along with lead, silver, and gold values. The Inferred resource is 11.6 million tons, grading 1.1 percent copper and 3.9 percent zinc, plus lead, silver, and gold values.[22]

As reported in the Arctic PEA, 96 drill holes totaling 63,000 feet have been completed on the Sun Property. This includes 47 holes drilled by Andover in 2007, 2011, and 2012 (previous drilling work had been performed by Anaconda, Noranda, Cominco, and Bear Creek).

Smucker Deposit

The Smucker deposit is an inactive poly-metallic (copper-lead-zinc-gold-silver) prospect owned by Teck (operator of the Red Dog mine) and located about 24 miles northwest of the Arctic Project. Early estimates place the size of the Smucker resource at about 7.2 million tons at 0.5 percent copper and 4.9 percent zinc, plus lead, silver, and gold values.

Placer Gold and Coal

In addition to the various poly-metallic hard-rock prospects in the Ambler Mining District, the AMDIAP has the potential to affect other mineral resource development along the corridor. For example, gold placer mining in portions of the Koyukuk mining district could see improved access. Placer gold production in 2012 in portions of the Koyukuk mining district within or close to the corridor totaled 3,400 troy ounces.[23] The region also contains coal resources, including bituminous coal beds on the north side of the Middle Fork of the Koyukuk

[20] (NovaCopper Inc., 2016)
[21] (NovaCopper Inc., 2016, pp. 10-52)
[22] (Mine Development Associates, September 2013)
[23] (Alaska Department of Commerce, Community, and Economic Development, November 2013, p. 15)

River. Improved access could support efforts to assess the development potential of the region's coal resources, which currently are poorly understood.

Ambler Transportation Corridor Development

Construction of the AMDIAP is essential for development of the Arctic and Bornite deposits as well as other mineral resources in the Ambler District. Beginning in 2010, ADOTPF conducted reconnaissance-level investigations of several easterly transportation corridor options to connect the Ambler district to the Dalton Highway. A roughly 215-mile route along the foothills of the Brooks Range from Mile 135 of the Dalton Highway appears to be the best option in terms of engineering feasibility and cost. The "Brooks East" corridor lies primarily on State of Alaska, Doyon, and NANA Corporation land. The route may ultimately be slightly longer or shorter than 215 miles depending on final alignment. Road construction costs have most recently been estimated at between $275 million and $350 million.[24] Multiple road design and construction options have been under consideration, ranging in cost from $190 million to $400 million.[25]

State of Alaska work conducted on the project to date includes reconnaissance-level route investigation, preliminary engineering and cost analysis, geotechnical studies, baseline environmental research, cultural resource analysis, and an extensive public outreach effort that included public meetings in the communities potentially affected by corridor development.

In 2013, project management was transitioned from ADOTPF to AIDEA, to take advantage of AIDEA's greater ability to develop public/private partnerships and other financing tools. AIDEA is working with BLM to initiate an EIS process for the AMDIAP.[26]

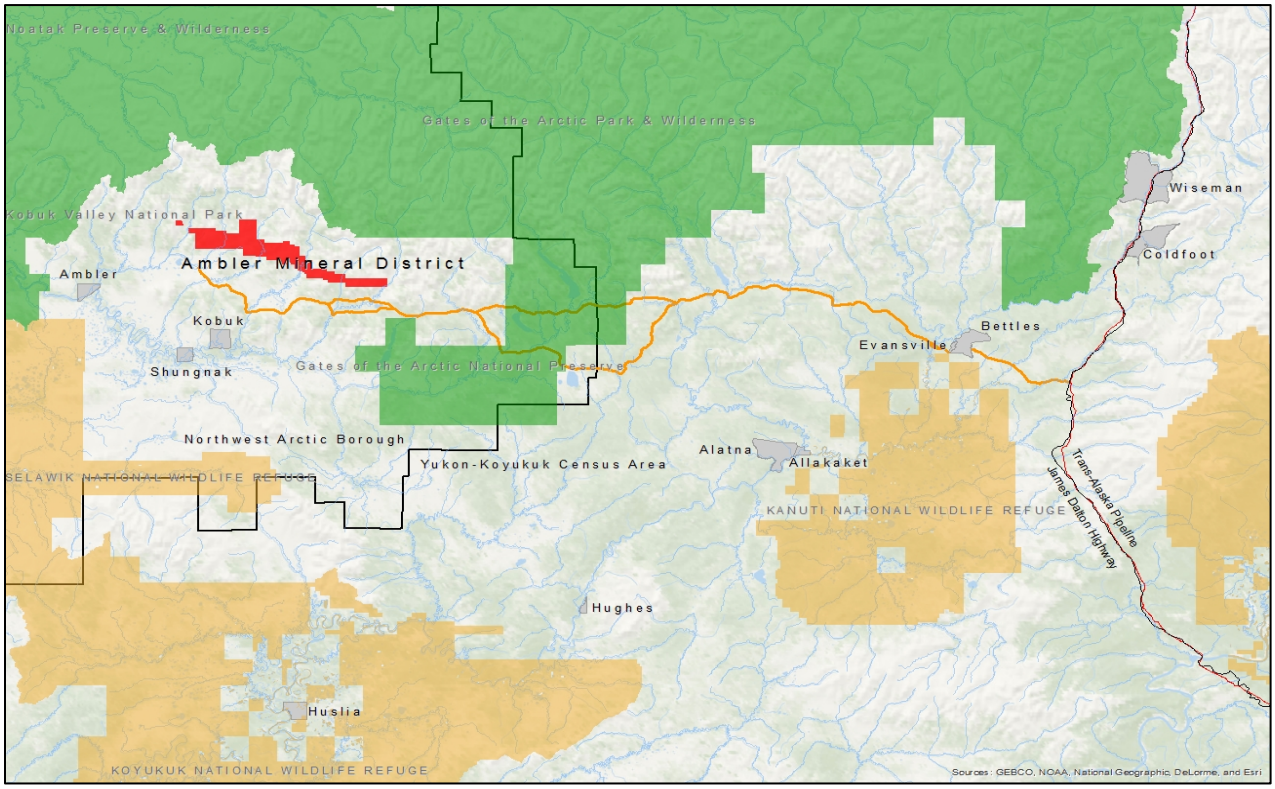
Upon completion of the NEPA process, AIDEA will reevaluate the financial feasibility of the project. If it is determined to be a good investment for the State, AIDEA will seek private sector investors interested in constructing and operating the road and collecting tolls from road users.[27] Before proceeding with the project, AIDEA will need resolutions of support from the Regional Resource Advisory Council for the eastern portion of the proposed route and from the Northwest Arctic Borough.

The finances associated with development and operation of the AMDIAP could be modeled after the Delong Mountain Transportation System, where Teck makes annual payments based on a minimum annual amount plus additional payments based on zinc prices and throughput. AIDEA has invested approximately $267 million in cash and bonding in DMTS road and port facilities. DMTS has generated a total of approximately $500 million in user fees.

[24] DOWL HKM estimates, published in (Cardo, 2015).
[25] (McDowell Group, January 2014)
[26] http://www.ambleraccess.org/projects/ambler/
[27] http://www.ambleraccess.org/projects/ambler/schedule.html

For purposes of the Arctic PEA, it was assumed the Arctic mine operator would pay a toll for using the AMDIAP of $9.7 million annually for the 12-year mine life. That annual payment is contingent on the assumption the Arctic Project would be one of two or more large-scale users of the toll road.

Figure 4. Ambler Mining District Industrial Access Road Map



Source: (McDowell Group, January 2014) Ambler District in red.

Ambler District Development Implications for Port MacKenzie Rail

CONCENTRATE SHIPMENTS

Based on the 2013 PEA, the Arctic mine and processing facility would produce 370,000 tons of copper, lead, and zinc concentrates annually.[28] Three separate concentrates would be produced, including 203,400 metric tons of copper concentrate (29 percent Cu), 144,100 tons of zinc concentrate (56 percent Zn), and 23,300 tons of lead concentrate (50 percent Pb).[29] Production of concentrates would range from about 118,000 tons in the first year of operations to a peak of about 540,000 tons by the fifth year of production. These estimates are subject to change as more detailed mine feasibility studies are conducted. The Ambler District has the potential to generate larger volumes of concentrates than outlined in the Arctic PEA.

[28] https://trilogymetals.com/assets/docs/presentations/presentation-sept2016.pdf
[29] (Tetra Tech, September 2013, p. 17)

Table 5. Arctic Annual Concentrate Production (000s of dry metric tons)

Year	Copper	Lead	Zinc	Total Annual Concentrate
1	73	6	41	120
2	139	12	85	236
3	173	22	131	326
4	207	30	180	417
5	284	38	228	550
6	270	28	165	463
7	268	30	191	489
8	231	28	172	431
9	207	20	131	358
10	262	28	181	471
11	207	26	145	378
12	121	14	76	211
Average	203	24	144	371

Source: (Tetra Tech, September 2013). Compiled by McDowell Group.

The Arctic PEA states that the copper and zinc concentrates would be shipped out in bulk while the lead concentrate would be shipped off site in containers. More recent planning indicates that all concentrates might be containerized.[30] Based on the PEA, these concentrates would be trucked to Port MacKenzie, then transported by ship to overseas smelters. The PEA estimates trucking costs at $65 per wet metric ton (wmt) for the approximately 700-mile drive from Ambler to Port MacKenzie (actual costs would likely be well above $65). The drive includes the Ambler Road to Dalton Highway (215 miles), Dalton Highway to Fairbanks (135 miles), and Fairbanks to Port MacKenzie (354 miles). Potential railroad revenues associated with transporting concentrates from Fairbanks to Port MacKenzie are described elsewhere in this report.

Base Metal Price Trends

Global market conditions for base metals such as copper, lead and zinc will play an important role in timing and extent of mine development in the Ambler district and elsewhere in Alaska.

In the Arctic PEA, the economic analysis considers copper prices ranging from $2.50 to $3.50.[31] The base case scenario assumes long-term metal prices of $2.90/lb for copper, $0.85/lb for zinc, $0.90/lb for lead, $22.70/oz for silver and $1,300/oz for gold. Copper prices at the date of this study are approximately $2.65/lb. Copper

[30] Personal communication, Rick Van Nieuwenhuyse
[31] (Tetra Tech, September 2013, p. 22:4)

prices have been forecasted to increase slowly over the next decade, reaching $2.55/lb by 2025. Zinc prices are currently above the price assumed in the Arctic PEA, at $1.09/lb.

Table 6. Global Copper Price History and Outlook

				2016-2025 Forecast					
	2013	2014	2015	2016	2017	2018	2019	2020	2025
Nominal $									
$/Metric ton	$7,332	$6,863	$5,510	$4,650	$4,866	$5,092	$5,329	$5,577	$7,000
$/Pound	$3.33	$3.11	$2.50	$2.11	$2.21	$2.31	$2.42	$2.53	$3.18
Constant $									
$/Metric ton	$6,913	$6,482	$5,216	$4,320	$4,447	$4,581	$4,718	$4,860	$5,614
$/Pound	$3.14	$2.94	$2.37	$1.96	$2.02	$2.08	$2.14	$2.21	$2.55

Source: (World Bank Group, July 2016). Constant $ are 2010 U.S. dollars.

The World Bank's outlook for copper is consistent with other forecasts. For example, Canada's Scotia Bank closely tracks commodity markets. It notes:

> *"Copper, now in its sixth consecutive year of surplus supply, is likely to experience 2-3 more years of sustained price pressure before eventually benefiting from anticipated mine deficits around the end of the decade. Copper prices are forecast to remain flat at $2.20/lb through 2018. A wave of new supply has hit the market at the same time that demand growth has moderated, and further capacity additions are expected over the coming two years. With prices settling roughly around cash (plus sustaining capex) costs, there is little reason at present for producers to cut output, but there is also little incentive to invest in new production capacity, raising the odds of a deficit and price spike around the turn of the decade."*[32]

Zinc prices are currently at about $1.25 per pound, higher than had been predicted for 2016. Zinc prices have been trending up since January and are expected to continue trending up slowly over the next decade.

Table 7. Global Zinc Price History and Outlook

				2016-2025 Forecast					
	2013	2014	2015	2016	2017	2018	2019	2020	2025
Nominal $									
$/Metric ton	$1,910	$2,161	$1,932	$1,850	$2,200	$2,224	$2,248	$2,273	$2,400
$/Pound	$0.87	$0.98	$0.88	$0.84	$1.00	$1.01	$1.02	$1.03	$1.09
Constant $									
$/Metric ton	$1,801	$2,041	$1,828	$1,719	$2,011	$2,001	$1,991	$1,981	$1,925
$/Pound	$0.82	$0.93	$0.83	$0.78	$0.91	$0.91	$0.90	$0.90	$0.87

Source: (World Bank Group, July 2016). Constant $ are 2010 U.S. dollars.

[32] http://www.gbm.scotiabank.com/English/bns_econ/bnscomod.pdf

Lead is currently at about $1.05 per pound, also higher than had been predicted for 2016. Lead prices have been on the upswing since January and are expected to continue trending up slowly.

Table 8. Global Lead Price History and Outlook

				2016-2025 Forecast					
	2013	2014	2015	2016	2017	2018	2019	2020	2025
Nominal $									
$/Metric ton	$2,140	$2,095	$1,788	$1,775	$1,827	$1,880	$1,935	$1,992	$2,300
$/Pound	$0.97	$0.95	$0.81	$0.81	$0.83	$0.85	$0.88	$0.90	$1.04
Constant $									
$/Metric ton	$2,018	$1,979	$1,692	$1,649	$1,670	$1,691	$1,713	$1,736	$1,845
$/Pound	$0.92	$0.90	$0.77	$0.75	$0.76	$0.77	$0.78	$0.79	$0.84

Source: (World Bank Group, July 2016). Constant $ are 2010 U.S. dollars.

Global Base Metal Supply and Demand

Copper: Alaska base metal producers and mine developers operate in a highly competitive market. Global copper mine production totaled 19.3 million metric tons (mmt) in 2015 (as now planned, Arctic would produce an average of about 65,000 tons of copper per year). Chile is the world's largest copper producer, accounting for about a third of global mine production.[33] Peru was the world's second largest producer in 2015, followed by China and the United States.

Chile, Peru, and Australia are the world's largest exporters of copper ores and concentrates, while China, Japan, and India are the world's largest importers. In 2015, China consumed half the world's refined copper (11.5 million tons out of 22.7 million tons).[34] The U.S. was the second largest consumer, at 1.8 million tons.

Escondida copper mine in Chile is the world's largest copper mine, with annual production capacity of 1.2 million metric tons of copper, about five percent of global production. Six of the world's ten largest copper mines are in Chile. The Morenci Mine in Arizona is the largest copper mine in the U.S. and the third largest in the world, with annual production capacity of 520,000 metric tons of copper.[35]

Trilogy seeks to identify about 4.5 million metric tons of copper resource in the Ambler district. Known world reserves total 700 million metric tons and Identified resources total 2.1 billion metric tons.

Zinc: Global zinc mine production in 2015 totaled 13.4 mmt. China is the top mine producer at 4.75 mmt, followed by Australia (1.7 mmt), and Peru (1.4 mmt). The U.S. is the world's fifth largest producer at 0.8 mmt. Red Dog Mine accounted for 567,000 metric tons of copper contained in concentrates in 2015, 70 percent of

[33] (World Bank Group, July 2016)
[34] (World Bank Group, July 2016, p. 41)
[35] International Copper Study Group, 2016. http://www.icsg.org

the U.S. total.[36] Global refined zinc consumption totaled 13.9 mmt in 2015. China accounts for 46 percent of the consumption (6.5 mmt), followed by the U.S. with 0.9 mmt in total annual consumption.

Lead: Global lead mine production in 2015 totaled 5.1 mmt, with China accounting for nearly half of that production (2.34 mmt), followed by Australia (0.7 mmt), and the U.S. (0.375 mmt). Refined consumption totaled 10 mmt, with China consuming 3.8 mmt, and the U.S. 1.6 mmt. Red Dog produced 118,000 tons of lead contained in concentrates in 2015.

Summary: The metals markets slump that began in 2011 has had a severe impact on investment in exploration. In Alaska, exploration spending dropped from $365 million in 2011 to $96 million in 2014.[37] Though there are signs of recovery in some markets, spending on exploration remains low relative to historical trends.

Analysis of base metal prices and markets highlights the importance of Chinese consumption to base metal market trends. China is by far the world's largest consumer of copper, zinc, and lead. The future of poly-metallic mine development in Alaska is likely to be closely tied to conditions in China's economy.

With respect to copper, trends in favor of Alaska, over the long-term, include declining ore grades in Chile and other parts of the U.S. and reliance on coal to generate power at many mines (climate change concerns may increase operating costs at these mines).

Interior Alaska Metallic Mineral Development Projects

In addition to development in the Ambler District, potential future markets for Port MacKenzie rail service include advanced mineral exploration projects in Interior Alaska. Several of these projects are described below.

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 Livengood deposit holds 525 million tons of Measured and Indicated resources and 53 million tons of Inferred resources.

The Livengood Gold Project Feasibility Study, completed in 2013, is based on a 100,000 ton-per-day mining operation. The results of a mine plan optimization study, announced September 8, 2016, indicate an optimal mine and mill production scale of 52,600 tons per day. At this scale of operations, capital (development) costs would total $1.84 billion.[38]

If developed, the Livengood mine would produce a gold doré rather than a concentrate requiring shipment to a smelter. In this case, the freight transportation requirements for the project are related to inbound shipments, including materials and equipment need for mine development and supplies needed for routine mine and mill

[36] (Teck, 2015)
[37] (Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys, 2014)
[38] http://www.ithmines.com/project/livengood_alaska/

operations. Inbound freight volumes required for mine operations can be substantial, as described elsewhere in this report.

The 2013 feasibility study considered a range of freight transportation options for the movement of inbound supplies and materials from tidewater to a Fairbanks receiving yard.[39] While the study notes "Railroads have very detailed size-weight restrictions but are pound for pound the most cost effective method to move materials and equipment to Fairbanks," trucking is the primary mode considered in the study. The following trucking routes are analyzed:

- Anchorage to Fairbanks (360 miles, 6 hours)
- Valdez to Fairbanks (365 miles, 7 hours)
- Seward to Fairbanks (485 miles, 8 hours 30 minutes)
- Whittier to Fairbanks (417 miles, 7 hours 30 minutes)

Port MacKenzie was not considered in the 2013 feasibility study. However, if lower-cost shipping options were available through Port MacKenzie, those options would be utilized.

The report notes that CAT, Komatsu, and other heavy equipment dealers use rail to ship equipment to Alaska. The study further states "Rail should be considered for any producer with national rail contracts selling FOB Fairbanks. Also, any mining contractor moving equipment from the lower 48 states to Alaska should consider rail."[40]

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 $1,265, consistently higher gold prices will be required to support investment in Livengood mine development. In any case, inbound shipping of supplies, materials and fuel would likely be modeled after Fort Knox, which relies on a combination of container ship, rail barge, and conventional barge, coupled with rail and truck transport to Fairbanks.

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 bioxidation gold extraction. At a cut-off grade of 0.3 grams per ton, the deposit includes 133 million tons of Indicated and Inferred resources. 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.[41] 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. Like Fort Knox and the proposed

[39] (Samuel Engineering, September 2013).
[40] (Samuel Engineering, September 2013, p. 111); (Abrams, 2015)
[41] (Tetra Tech, May 2016)

Livengood mine, Golden Summit would produce a gold doré. Therefore, shipping implications of the project are related to inbound movement of equipment, materials, and supplies for mine development and operations. Next steps for Freegold at Golden Summit are to expand through additional drilling the heap-leachable oxide resource.[42]

Shorty Creek

Freegold Ventures also has the Shorty Creek Project, an early stage project located about 75 miles northwest of Fairbanks. Freegold has recently conducted geophysical and geochemical surveys, along with drilling programs in 2015 and 2016, evaluating the resource potential of a porphyry copper-gold-molybdenum system. No resource estimates have been made, though results of drilling in 2016 are encouraging, with one drill intersect of 45 meters grading 1.06 percent copper equivalent.[43] Another drill hole found 93.5 meters grading 0.55 percent copper equivalent.[44]

Next season, Freegold plans to continue working to define the characteristics of the deposit. If additional drilling is promising, a preliminary economic analysis will be conducted.

Shorty Creek is the type of deposit and mining project that would require very efficient surface transportation access to tidewater, potentially by rail. Like the Arctic Project in the Ambler District, it would produce large volumes of concentrates requiring shipment to overseas smelters for final metal extraction. If this project were to advance from its current early-stage status to detailed mine feasibility analysis (several years away at best), Port MacKenzie (as the closest port) and the rail extension would figure prominently in the analysis.

Caribou Dome

Coventry Resources Ltd.'s Caribou Dome project is located about 155 miles north of Anchorage with road access from the Denali Highway. A 2016 drilling program has 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.[45] 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 similar to the very rich Kennicott copper deposit. Preliminary metallurgical testing including conventional floatation has produced concentrates of about 25 percent copper.[46] Coventry expects to initiate pre-feasibility studies in late 2016. If developed, Caribou Dome would require shipment of concentrates to tidewater, potentially including trucking and rail to Port MacKenzie.

[42] Personal communication, Kristina Walcott, President and CEO, Freegold Ventures, Oct. 26, 2016
[43] http://www.freegoldventures.com/s/NewsReleases.asp?DateRange=2016/01/01...2016/12/31
[44] http://www.freegoldventures.com/i/pdf/2016-10-26_NR.pdf
[45] http://www.coventryres.com/caribou-dome-copper-project
[46] http://www.coventryres.com/uploads/downloads/CYY%20AGM%20Investor%20Presentation%20-%2015%20April%202016.pdf

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.[47] White Rock hopes to conduct additional drilling in 2017. Like the Caribou and Shorty Creek projects, Red Mountain would require very efficient shipment of concentrates to a deepwater port. Port MacKenzie is the nearest port.

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.[48] In 2016, Endurance completed four drill holes totaling about 2,000 feet. The results of that drilling program are pending. Elephant Mountain was the target of drilling by Placer Dome, Inc. in the 1990s. Mine development at Elephant mountain would likely be modeled after Fort Knox (low grade high tonnage surface mining and milling producing gold doré). Though this type of mine does not involve production of concentrates, inbound shipment of substantial tonnages of freight and fuel would be required to support operations, potentially through Port MacKenzie.

Endurance Gold has also acquired 100 percent interest in the McCord Gold Project, an early-stage prospect evaluation effort in the Livengood District.

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.[49] In early 2017 Peak Gold expects to complete a comprehensive resource estimate, following an extensive 2016 drilling program.[50] Given its location in eastern Interior Alaska, Port MacKenzie and the rail extension would not be expected to play a significant role in construction or operation of the Tetlin project, should it prove at some point in the future to be economically feasible to develop. Its supply logistics would likely be modeled after Pogo (described elsewhere in this report).

Pogo Area Prospects

In general, the region around Pogo is the target of significant exploration interest, mainly focused on gold mineralization. Great American Minerals Exploration, Inc. has the Monte Cristo and Uncle Sam prospects, now

[47] http://www.whiterockminerals.com.au/
[48] http://www.endurancegold.com/s/elephant.asp
[49] Tetlin Gold Project, Tok Mining District, presentation by Brad Juneau, President, Contango ORE, Inc. September 19, 2016.
[50] http://www.contangoore.com/press.html

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.[51] Similarly, Millrock Resources Inc, in joint venture partnership with Newcrest, is examining the West Pogo prospect, located within 2 miles of the Pogo Mine deposit. The prospect is described as having 2 million ounce gold resource potential.[52]

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.[53] 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. Ore would be hauled 29 miles from the mine to a processing plant on the Parks Highway.[54] While Port MacKenzie could be used to move construction and other materials to the mine, the rail extension would have no direct impact on the project due to the relatively short distances involved and handling costs associated with rail on-load and off-load.

Shipping Needs of Alaska's Hard Rock Mines

The cost to transport materials and supplies to and from Alaska mines is a critical aspect of mine feasibility. It is instructive to examine other mines in Alaska, to inform the analysis of how mine development in Interior Alaska might rely on a rail extension to Port MacKenzie.

Mines producing concentrates have proven economically feasible in Alaska, but only if located near port facilities. The 2,200 ton-per-day Greens Creek mine (near Juneau), which produces approximately 180,000 tons of silver-gold-zinc-lead concentrates annually, is located immediately adjacent to tidewater and a deep-water dock capable of serving deep draft freighters. Red Dog Mine, in northwest Alaska, is approximately 52 miles from the Chukchi Sea. The 11,000 ton per day mine produces approximately 1 million tons of zinc concentrate and 200,000 tons of lead concentrate annually. Concentrates are trucked to storage and handling facilities located on the coast. The zinc and lead concentrates are stored for most of the year, then during a 100-day summer window transported via shallow draft barges to ocean-going freighters anchored off shore.

Greens Creek and Red Dog take advantage of proximity to tidewater for shipping out concentrates and for shipping in supplies. These mines, along with the Pogo, Fort Knox, and Kensington gold mines, all require a substantial and continuous inbound supply of fuel and other consumables. Mining requires rock drilling supplies, blasting supplies, cement (for back-filling), ground stabilization hardware, grinding steel, a variety of

[51] http://www.petroleumnews.com/pnads/515901563.shtml
[52] https://www.millrockresources.com/projects/alaska/west-pogo/
[53] (Hard Rock Consulting, LLC, March 2016)
[54] http://www.goldtorrentinc.com/projects/

reagents for ore processing, tailings additives, fuel for equipment and power generation, and replacement parts and equipment, and many other miscellaneous supplies and materials.

A detailed accounting of inbound freight volumes and transportation modes to Alaska's mines is not available, but in general inbound freight (excluding fuel) volumes for Alaska's metallic mineral mines range from 40,000 to 60,000 tons per year. Southeast Alaska's mines are supplied entirely by barge. Alaska's Interior mines (Fort Knox and Pogo) operate with a multimodal supply chain. Fort Knox is supplied via conventional barge, rail barge, and container ship to Southcentral ports (Anchorage and Whittier), then by rail or truck to Fairbanks, and finally by truck from Fairbanks to the mine site.

Mining can also require high volumes of fuel for power generation and operation of mobile equipment. For power generation, some mines tie into regional power grids while others must be totally self-sufficient and transport millions of gallons of diesel to feed on-site power plants. All of Alaska's mines have substantial fuel requirements for haul trucks, loaders, and other mobile equipment.

Plans for the Donlin Gold Project include some detailed information around inbound freight volumes. The Donlin Gold Project, located in western Alaska near Crooked Creek along the Kuskokwim River, would be a large scale surface mine. The operation would mine and mill 59,000 tons of ore per day over a 27-plus year mine life. The mine would be supplied by barge up the Kuskokwim river, along with a natural gas pipeline from Cook Inlet. An annual average of approximately 105,000 tons of general cargo would be required annually during routine operations.[55] Approximately 85 percent of the general cargo would be containerized, with the remainder shipped as break-bulk. Back-haul of mostly empty containers would average approximately 4,130 TEU (20-foot equivalent units) annually. Fuel consumption would average 40 million gallons annually (about 110,000 gallons per day). While no specific estimates are available, information provided in Donlin Gold planning documents suggests that mine development will require a total of approximately 500,000 to 600,000 tons of materials and equipment.

This overview of inbound shipping requirements illustrates that, while concentrate shipping can be a key determinant in the feasibility of base metal mines, all mines are dependent on efficient movement of inbound materials and fuel. The freight logistics challenge is to optimize multimodal transportation chains for the wide range of supplies and materials sourced from various places in the U.S. and Canada.

Metal Mining Industry Related Railroad and Port Revenues

Transport of equipment and materials in support of mine development, transport of inbound consumable freight and fuel in support of routine mine operations, and especially transporting mineral concentrates from mine to tidewater all have the potential to be accomplished more efficiently with rail than trucking, under the right circumstances and at the right scale of operations.

[55] (SRK Consulting (U.S.), Inc., February 2013)

Ambler District Development

Trilogy's Arctic Project is the most advanced mine development effort within reach of the Railbelt. As currently planned, the mine would produce an annual average of 300,000 tons of concentrate requiring shipment to a deepwater dock. The proposed scale of mining is likely to change as work continues to evaluate the feasibility of mining the Arctic deposit and the nearby Bornite deposit. If rail were used to transport concentrates from Fairbanks to Port MacKenzie, the following table illustrates order-of-magnitude estimates of potential railroad revenue over the mine's projected 12-year life.

Table 9. Estimates of Annual Rail Revenue from the Arctic Mine ($millions)

Year	1	2	3	4	5	6	7	8	9	10	11	12
Outbound Concentrates	$2.6	$5.1	$7.1	$9.1	$12.0	$10.1	$10.7	$9.4	$7.8	$10.3	$8.2	$4.6
Inbound Supplies	$0.6	$1.2	$1.6	$2.0	$2.7	$2.3	$2.4	$2.1	$1.8	$2.3	$1.9	$1.0
Total	$3.2	$6.3	$8.7	$11.1	$14.7	$12.4	$13.1	$11.5	$9.6	$12.6	$10.1	$5.6

Source: McDowell Group estimates.

These revenue estimates are based on an assumed rail transport cost of $0.06 per ton-mile for outbound concentrates and $0.09 per ton-mile for inbound supplies.

Estimates of railroad revenues generated by transportation of inbound supplies conservatively assume that approximately half of general inbound cargo would come in via Port MacKenzie, with all other general cargo arriving via container ship (through Anchorage) or rail barge through Whittier.

In summary, railroad revenues would average an estimated $10 million annually over the 12-year mine life, ranging from $3.6 million to $15 million annually. It is essential to stress that these revenue estimates are hypothetical and based on the best available information at the time of this analysis. Actual revenues could vary widely from these estimates depending on a variety of factors.

The savings that might be realized by using ARRC to transport concentrates from Fairbanks to Port MacKenzie rather than truck would depend on several factors, such as:

- Fuel prices (and surcharges, if any)
- Handling costs associated with transfer from truck to rail in Fairbanks
- Cost to develop concentrate transfer facilities (rail to ship or truck to ship) at Port MacKenzie, and the cost and efficiency of operating those transfer facilities
- Back-haul cost differentials and/or efficiencies
- Truck restrictions on public highways, or industrial truck use surcharges

Detailed analysis of these and other relevant factors is beyond the scope of this study. However, rail could offer key economic and operational advantages resulting in significant savings over trucking concentrates. Trains are inherently more efficient than trucks in moving large amounts of commodities over long distances. In addition,

Parks Highway traffic conditions, and related truck travel time delays, could further constrain the efficiency of truck transportation.[56]

The Arctic PEA places a cost of $20 per wet metric ton for port storage and handling.[57] At that rate annual costs would range from $2.6 million to $10.7 million, averaging $8.1 million per year. A portion of that cost would be revenue to Port MacKenzie, including wharfage and dockage fees. At Port MacKenzie's anticipated rate for conveyed bulk commodities ($2 per ton), annual wharfage revenues would range from about $250,000 to $1 million, averaging about $750,000. Dockage revenues, at $1.25 per foot per day, would be small comparable to wharfage revenue.

Ambler region mine development, if it is to be economically feasible, will require (in addition to rich mineral endowment) development of an extremely efficient surface transportation network over the 785 miles between the mining district and Port MacKenzie. Trilogy Metals, AIDEA, ARRC, and Port MacKenzie would jointly be involved in designing handling systems and cost arrangements that meet the financial and operational needs of each stakeholder. Substantially more detailed planning and analysis is required, including pre-feasibility and feasibility studies for the Arctic project (including detailed analysis of inbound and outbound shipping options and costs) and completion of the AMDIAP EIS.

With regard to timeframe, Ambler region mine development is possible within 10 years if base metal prices improve substantially, but sometime beyond ten years is more likely. The critical path includes two to three years for EIS preparation, followed by construction of AMDIAP (likely to be a two-year project) and finally by mine development, which could partially overlap with road construction, but would also require two to three years. In the meantime, robust and stable base metal markets would be required and investors in the project secured.

Other Metallic Mineral Mining Potential

Previous studies have noted the hypothetical mineral development potential along Alaska's railbelt. Within a 100-mile-wide band along the railbelt (50 miles on each side of the railroad), there are 887 known mineral occurrences. Deposit types with the greatest potential for development include Sedimentary Exhalative Zinc-Lead deposits, Kuroko Volcanogenic Massive Sulfide Copper-Zinc-Lead-Silver-Gold deposits, and Porphyry Copper-Molybdenum-Gold deposits.[58] By modeling mine development and operations at scales of operation typical for similar deposits located elsewhere in the world, annual concentrate production levels have been calculated, along with corresponding rail freight revenue. In a 2007 study, *Economic Analysis of Rail Link Port MacKenzie to Willow, Alaska, Phase II Possible Rail Extension Users Analysis*, development of a Sedimentary Exhalative Zinc-Lead deposit was anticipated to occur first, within the 10-year period following the date of the study. That hypothetical mine would produce 365,000 tons of concentrate annually over a ten-year mine life, and generate $7.9 million in railroad revenue (assuming $0.06 per ton-mile). Development of a Porphyry

[56] Transporting concentrates to Seward via rail is a possibility but would require an additional 142 miles of travel.
[57] (Tetra Tech, September 2013, p. 22:11)
[58] (Metz, 2007)

Copper-Molybdenum-Gold deposit was envisioned as a possibility at some point beyond ten years, but within 20 years. Porphyry deposits typically require large-scale operations. The modeling indicated 1.6 million tons of concentrates would be produced over a 30-year mine life, generating $36 million in annual railroad revenue. Finally, the analysis had both a Porphyry Copper-Molybdenum-Gold mine and a Kuroko Volcanogenic Massive Sulfide Copper-Zinc-Lead-Silver-Gold mine in operation during a period 20 to 30 years into the future. Those two hypothetical mines would together produce approximately 1.9 million tons of concentrates annually, and $41 million in annual railroad revenues.

The 2007 study offers an analysis of rail revenues if mine development occurs at a certain scale over a general timeframe. It is important to note that the analysis was conducted at a period when global demand for base metals was very strong, prices were at historically high levels, and the strength of the U.S. dollar was not acting as a drag on the competitiveness of U.S. products in global markets (as it has been over the past several years). In any case, the timing and scale of new mine development in Interior Alaska will depend on many factors including:

- Base and precious metal price trends (both a function of global economic forces)
- Conditions in capital markets, which are the source of the substantial funds needed to identify and measure potentially commercial mineral deposits, then permit and finally develop new mines
- Perceptions of Alaska as an attractive target for mining industry investment (related to Alaska tax regimes and permitting requirements) relative to competing jurisdictions around the world
- New infrastructure development in Alaska, including energy and transportation infrastructure, which could reduce development and operating costs, relative to what those costs would be in the absence of new infrastructure.

State of Alaska Revenues from the Mining Industry

The mining industry generates significant revenues to the State of Alaska through several mechanisms, including mining license fees, rental, royalties, material sales, and other fees. These revenues are described below.

Mining License Tax

The Alaska mining license tax is a graduated tax (capped at 7 percent) levied on the net income of all mines in the state, less exploration and other credits. Specifically, there is no tax if net income is $40,000 or less; $1,200 plus 3 percent over $40,000; $1,500 plus 5 percent over $50,000; and $4,000 plus 7 percent over $100,000. New mining operations are exempt from the mining license tax for a period of 3.5 years after production begins. The state collected $38.6 million in mining license tax in FY2015. The Arctic PEA estimates the mine would pay a total of $115 million in mining license taxes over the life of the project.[59]

[59] (Tetra Tech, September 2013, p. 29)

Corporate Net Income Tax

The State of Alaska levies a corporate net income tax based on 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.

Total annual State corporate income taxes paid by the mining sector is highly variable year-to-year. The State of Alaska collected $17.3 million in corporate income tax from Alaska's mining sector in FY2015, $15.2 million in FY2014, and $26.8 million in FY2013.

The Arctic PEA estimates the mine would pay a total of $158 million in State corporate income taxes over the life of the project.

Annual Claim Rental

The Annual Rental law (AS 38.05.211) requires locators and holders of State mining locations to pay an annual cash 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 a 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 $0.88 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. In FY2015, the mining industry paid $6.9 million in annual State of Alaska claim rentals.

The Arctic Project includes 875 40-acre and 481 160-acre State of Alaska claims. As such, by the time production begins, claim rental payments would likely total approximately $0.5 million annually.

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 produced on state land. The production royalty is 3 percent of net income as determined under the Mining License Tax statutes (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:

1) Owning, leasing, and operating a mining property,

2) Owning a mining property and receiving lease fees, royalty payments based on production, or a combination of lease fees and royalty payments from the property,

3) Leasing a mining property from another person and operating the property, or

4) Possessing a mineral interest, whether an economic or production interest, in a producing property, including royalty, receiving lease fees, working or operating interests, net profits, overriding royalties, carried interests in, and production payments.

In FY 2015 $4.6 million in production royalties were paid to the State of Alaska. For purposes of this study it is assumed production royalties from the Arctic Project would total approximately half of the amount paid in mining licenses taxes, or approximately $58 million over the life of the project.

Coal Mining

Interior Alaska is richly endowed with coal resources and shipment of coal has been an important source of revenue for ARRC for many years. With more than 500 million tons of proven reserves in Healy, Usibelli Coal Mine (UCM) has more than 250 years of supply at current production levels.[60] Going forward, coal will continue to play an important role in meeting Interior Alaska's energy supply needs. Coal accounts for approximately 30 percent of the Interior's electricity generation capacity. Coal is the lowest-cost source of energy on a per kilowatt hour basis, at about one-sixth the cost of diesel and half the cost of natural gas fired electricity transported over the Intertie from Southcentral.[61]

Export markets, where UCM's ultra-low sulfur coal is used as a blend with high-sulfur coals, have been a much less reliable market for UCM.[62] Alaska is always challenged to remain competitive in Pacific Rim markets that include large, low-cost suppliers such as Indonesia, where labor costs are far lower and regulation more limited than in Alaska. Recently, demand for Alaska coal has been further constrained by declining demand in China and unfavorable monetary exchange rates. A strong dollar relative to other currencies has presented challenges for all of Alaska's export products, including coal.

Healy Coal Production Trends

UCM production totaled 1.2 million tons in 2015, well below the record 2.2 million tons produced in 2011. Production of coal for the Alaska market, mainly used to generate power in Interior Alaska, has been relatively stable in recent years, while the export market has declined sharply, from 1.2 million tons in 2011 to 150,000 tons in 2015. Following a 75,000-ton shipment in July 2016, the Seward coal loading facility (operated by Aurora Energy Services, a UCM subsidiary, and owned by ARRC) has been placed in "cold storage" status, pending improvement in overseas coal markets.

Table 10. Usibelli Coal Mine Production (000 tons), 2007-2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Export	310	540	890	1,080	1,200	970	630	550	150
Alaska Market	990	960	1,010	1,020	1,000	1,030	970	950	1,050
Total Production	1,300	1,500	1,900	2,100	2,200	2,000	1,600	1,500	1,200

Source: UCM, 2016

Coal prices have recently rebounded, as excess production capacity elsewhere in the Pacific Rim has diminished. Nevertheless, while coal will remain a critical source of energy globally for many years, concerns about coal's

[60] (McDowell Group, January 2015)
[61] (McDowell Group, November 2013)
[62] UCM has exported coal to South Korea, Japan, and Chile.

impact on climate change and related shifts to low-cost natural gas are likely to constrain upside potential for coal prices. The World Bank Group (WBG) forecasts essentially flat market conditions for coal over much of the next decade (as measured in inflation adjusted dollars), with Australian benchmark coal at approximately $48 per ton through 2025, well below recent highs of $66 in 2014 and $80 in 2013. However, a recent jump in coal prices illustrates the uncertainty inherent in predicting prices. The November 2016 price for Australian thermal coal was $107 per ton, marking a return to prices last seen in the 2011-12 period (the December 2016 price slipped back to $93).

Table 11. Global Coal Price History and Outlook

				2016-2025 Forecast					
	2013	2014	2015	2016	2017	2018	2019	2020	2025
Nominal $									
$/Metric ton	$84.6	$70.1	$57.5	$51.0	$51.9	$52.9	$53.8	$54.8	$60.0
Constant $									
$/Metric ton	$79.7	$66.2	$54.4	$47.4	$47.5	$47.6	$47.7	$47.8	$48.1

Source: (World Bank Group, July 2016) Prices are Australian benchmark. In constant 2010 U.S. dollars.

Wishbone Hill

UCM's Wishbone Hill project, located about 10 miles northeast of Palmer, has 14.4 million tons of proven coal reserves. Preliminary mine planning would have production ramping up to a peak of 500,000 tons per year. UCM has been seeking final government approval to initiate mining operations at Wishbone, but the project has been stalled by litigation, including a recent U.S. district court decision ruling against UCM's permit to mine. If the permit is ultimately invalidated (UCM has filed a motion to reconsider), a restart of the entire permitting process would be required, a several-year undertaking. Meanwhile, weak overseas coal markets have affected the economics of the project.

Other Alaska Coal Resources

Hypothetical coal resources in Alaska have been estimated at as much as 5,500 billion short tons, an amount greater than all other states combined. The North Slope holds 120 billion tons of identified coal resources and hypothetical (undiscovered) resources estimated at 3,900 billion metric tons. The Central Alaska-Nenana coal resource includes 6.4 to 7.7 billion metric tons of identified coal and 10 billion tons of hypothetical resources. Southern Alaska-Cook Inlet holds 2.9 to 12 billion metric tons of identified coal resources and 970 to 1,600 billion tons of hypothetical resources.[63] Alaska's coal resources have a low sulfur content, averaging 0.2–0.4 percent. Alaska's North Slope coal resources will remain untapped pending substantial investment in transportation infrastructure to the region and a major long-term improvement in coal prices. To the extent demand grows for Alaska coal, resources in Healy are readily available to meet that demand.

[63] (Romeo M. Flores, 2003)

Coal Mining Implications for the Port MacKenzie Rail Extension

Shipping coal via rail through Port MacKenzie would have a 142-mile advantage over Seward. All other factors being equal, Port MacKenzie would save approximately $60,000 for each train load of coal (about 7,000 tons) and $680,000 for a 75,000-ton coal ship. Other estimates have placed the savings as high as $1.8 million per ship.[64] However, these cost savings would be offset by capital investment required to construct coal storage and handling facilities at Port MacKenzie, perhaps totaling $15 to $20 million. With sufficient tonnage, such an investment would be warranted, but market conditions are expected to continue constraining Alaska's export opportunities. As those constraints ease, UCM will look for opportunities to reenter the export market in the most cost effective way possible, using ARRC's fully permitted, established facility in Seward. Assuming market conditions improve and UCM resumes exports, it is likely the company would choose to use Seward to its full capacity (about 2 million tons) before investing in another coal loading facility. Above 2 million tons of annual exports, coal loading facilities at Port MacKenzie would be necessary.

Limestone

Interior Alaska contains significant limestone resources that may, at some point in the future, have potential for large-scale development. The Globe Creek limestone deposit, located about 38 miles from Fairbanks, is the largest known resource in the Railbelt region, containing 1.6 billion tons of high-purity limestone.[65] Lime and Portland cement are the two primary products derived from limestone. A small amount of limestone is mined now at Globe Creek, for various local uses.

Lime is produced from limestone through a heating process. Typically, crushed limestone is conveyed into a rotary kiln where it is calcined into lime. Portland cement production also requires very high temperature heating as well as mixture with other minerals to produce "clinker." The clinker is then finely ground and mixed with other constituents to produce cement. Efficient production of cement requires much larger-scale of operations than production of lime.

In Alaska, the mining industry is a large consumer of lime. Lime is used in froth flotation (for production of metal-bearing concentrates) and leaching circuits (for precious metal processing to ensure proper pH). Lime is also used for drinking water and waste water treatment purposes, as well as to remove toxic compounds from coal-burning power plants. Interior Alaska lime demand has been estimated at approximately 100 tons per day.[66]

Lime consumption is widely dispersed around Alaska, with some potential advantages associated with rail transport. The Donlin Creek gold mine, if developed, would be a large-scale consumer of lime. If lime were produced at Globe Creek at some point in the future, it might be shipped by rail to Port MacKenzie, then barged

[64] (VanDongen, 2017)
[65] (Metz, 2007)
[66] (Metz, 2007, p. 13)

to the mine. Determining whether that would be competitive with lime sourced on the West Coast is beyond the scope of this study.

Nearly all of Alaska's cement supply needs are imported through Port of Anchorage facilities. Approximately 110,000 tons of cement are shipped in each year. Competitive cement production requires low-cost energy and product transportation from plant to distributor or consumer. While gas line construction could place a relatively low-cost fuel close to Interior limestone deposits (such as Globe Creek), it is difficult to envision any large-scale limestone resource development in the near future. Longer-term, it is possible Alaska could find a toe-hold in the lime and cement production industry. In addition to access to low-cost energy, to do so will require lower cost product transportation than is possible today, with the Port MacKenzie rail extension potentially playing a role.

Global cement and lime production is heavily dominated by China, which produced 57 and 66 percent of these commodities, respectively, of global totals in 2015. Other countries produced comparatively small amounts, with none accounting for more than 7 percent of the global total for either commodity. In 2015, plants in the U.S. produced 83 million tons of cement (average value of $105 a ton) and 19 million tons of lime (valued at $116 to $140 a ton). Very little cement or lime is exported from the U.S. (1.3 million tons of cement and 300,000 tons of lime in 2015).[67]

[67] (United States Geological Survey, January 2016)

Other Resources and Freight Opportunities Analysis

Forest Products

Alaska Resource

Alaska's boreal forest runs from the Kenai Peninsula to the Tanana Valley near Fairbanks and beyond to the foothills of the Brooks Range. Major owners of potentially developable timberland in Southcentral and Interior Alaska include the State of Alaska, University of Alaska, Alaska Mental Health Land Trust, MSB and other local governments, Native Corporations, and other private land owners. The primary products with potential to be exported from these timberlands, according to stakeholders interviewed, are white spruce saw logs over 9 inches in diameter and wood chips from a mix of species.

With respect to use of the Port MacKenzie rail extension, perhaps the most promising timber resources are those in the Tanana Valley. In 2013, a detailed timber inventory was conducted of the 2.15 million acres of timberland in the Tanana Valley State Forest and additional forest classified state lands in the Tanana Valley.[68] The inventory estimates an allowable cut of 13,974 acres per year for these lands.[69] Using average species and volume information detailed in the inventory, an estimated 49,000 tons of white spruce sawlogs and 440,000 tons of woods chips could theoretically be produced annually from these Tanana Valley lands.

Other timber resources in the Tanana Valley include an estimated 1,786 million board feet (MMBF) of standing timber on lands owned by various Native Corporations in the area.[70] In addition, the Alaska Mental Health Land Trust owns roughly 60,000 acres of timberland in the Fairbanks area, which has been inventoried to contain 1.329 million tons of standing timber over 5 inches in diameter.[71]

Using an analysis similar to that described above for the Tanana Valley, a 2014 inventory of state lands in the Susitna Valley (covering 488,735 acres of timberlands) yields a possible annual production of 10,800 tons of white spruce sawlogs and 127,000 tons of wood chips.[72] It is important to note that the majority of state timberlands in the Susitna Valley are remote with limited access.

MSB forest resources include 79,363 acres of commercial forest land, with an estimated 97.2 million cubic feet of standing timber.[73] Past exports of wood chips and logs through Port MacKenzie consisted of products logged from MSB land and other nearby private land. In general, forest products within roughly 100 road miles of Port MacKenzie are assumed to be more economic to transport by truck due to the handling costs associated with loading and unloading rail cars.

[68] (Hanson, 2013)
[69] Current timber development on the Tanana Valley State Forest is minimal in comparison, ranging from 400 to 2,052 acres per year. (Meany, 2015)
[70] (Fairbanks Economic Development Corporation, 2007)
[71] (Hanson, 2012)
[72] (Hanson, 2014)
[73] (Matanuska-Susitna Borough, 2013) Numbers updated to reflect changes in 2016 to MSB forestry policies.

Pacific Rim Markets

A strong and growing market for forest products, especially wood chips, exists in the Pacific Rim. In 2014, 20 million bone dry metric tons (BDMT) of hardwood chips were imported into Asian markets, dominated by Japan (50 percent of the total) and China (43 percent). Taiwan and South Korea made up the remainder of the market. The Pacific Rim hardwood chip market represents roughly 90-95 percent of the global market.

Imports have grown significantly in recent years due rapid growth in China, which went from a net woodchip exporter in 2005 to importing roughly 8.6 million BDMT in 2014.[74] Chinese imports are forecasted to continue to rise, though at a slower rate, to roughly 10.5 million BDMT in 2019. Japanese imports, on the other hand, are expected to hold steady or decline slightly. Japan is known for demanding higher quality chips (for paper products), though a growing market is expected for low-quality chips for use as fuel (resulting from a movement away from nuclear and coal power in the country). Significant growth in wood chip imports is expected in India, which will put upward pressure on prices.[75]

In 2014, major suppliers of hardwood chips to Asian markets included Vietnam (36 percent) and Australia (22 percent), followed by several countries with around 10 percent of the market (Thailand, Chile, and Indonesia) and a number of smaller players.[76] Vietnam surpassed Australia in 2011 to become the world's largest supplier of woodchips. Some have questioned whether the growth in Vietnam's exports is sustainable and expect lower exports in the future.

Forest Products-Related Outlook for Port MacKenzie

A fully developed Port MacKenzie is likely to see use by wood chip exporters, with resources delivered to the port both by rail and by truck. Strong demand in China and Japan, reduced transportation costs due to the rail link, and substantial available resources contribute to a positive outlook. Industry representatives indicate that shipping to Asia is cheaper from Port MacKenzie than comparable ports in the Pacific Northwest and British Columbia. Port MacKenzie is 3,742 nautical miles (nm) from Shanghai (for example), significantly closer than Prince Rupert (4,652 nm), Vancouver (4,873 nm), and Seattle (4,960 nm).

In addition, existing wood chip consumers in Interior Alaska, specifically Superior Pellet Fuel's pellet and pellet log manufacturing facility near North Pole, could help build economies of scale for wood chipping operations.

Currently, Astoria Forest Products – an active forest products exporter based in Oregon – is in the process of setting up an operation in the MSB. Together with local partners, the company plans to harvest timber in the MSB region and export wood chips and other forest products to Asian markets. Other products, such as butt logs, may also be shipped to domestic mills.

[74] (KSH, March 2015)
[75] (New Forests, 2015)
[76] (KSH, March 2015)

Petroleum Products

Liquefied Natural Gas (LNG) Shipping to Interior Alaska

A promising use of the rail extension is to transport liquefied natural gas (LNG) by rail from Southcentral to the Interior Alaska. AIDEA and AARC are involved in projects related to this concept.

INTERIOR ENERGY PROJECT

The Interior Energy Project (IEP) is an effort to reduce the cost of energy in Interior Alaska through development of an integrated natural gas or propane supply chain. House Bill 105 provided AIDEA with resources to create the infrastructure necessary produce, transport, and distribute fuel to Interior consumers.

Titan Alaska (owned by AIDEA) operates an LNG facility near Port MacKenzie which supplies trucked LNG to Fairbanks Natural Gas (FNG, also now owned by AIDEA), a small natural gas utility serving around 1,100 customers. Approximately two 10,500 gallon tanker trucks per day leave the Titan Alaska facility.[77] Titan Alaska recently experimented with extra-large trailers capable of carrying 13,000 gallons and has purchased four of the large capacity units.

In March 2016, AIDEA entered negotiations with Salix to build additional LNG production capacity. Salix has since sold its interest in the project to AIDEA, which continues to pursue expansion of LNG production capacity to supplement Titan's exiting capacity. Once an optimal expansion plan is identified, the project will move to Front End Engineering and Design (FEED). Presently, AIDEA is working to secure a natural gas supply sufficient to serve the Fairbanks Natural Gas and Interior Gas Utility service areas. Titan has a gas supply agreement in place through 2017.

Meanwhile, in 2015, ARRC received permission to transport LNG by intermodal container (also known as ISO container), the first approval issued by the Federal Railroad Administration in the nation. Test shipments from Anchorage to Fairbanks were successfully conducted in Fall 2016. Shipments were trucked 70 miles from AIDEA's Titan LNG plant near Port MacKenzie to the Anchorage rail yard before being loaded on a northbound train.

ARRC has the approval to operate up to three trains per week with 12 ISO containers per train until the end of 2017 when the allowed capacity increases to a maximum of 60 ISO containers every four days. Each ISO container can carry 7,000 gallons (27,000 pounds) of LNG. Double stacking of the containers is not allowed.[78]

Current natural gas demand in Fairbanks is approximately 860 million cubic feet annually (the equivalent of about 1,500 ISO containers).[79] Potential demand has been estimated at about nine times that, at between 7 billion and 8 billion cubic feet annually.

[77] (AIDEA, October 2016)
[78] (Lauby, November 2015)
[79] http://www.interiorenergyproject.com/Resources%20and%20Documents/LNG%20DEMAND%20STUDY%202.pdf

The complex and continuously evolving effort to develop LNG production capacity, storage facilities, and transportation network to serve Fairbanks makes estimating the timing of potential railroad revenue very difficult. Several factors are at play:

- Uncertainty around Cook Inlet gas supply
- The timeframe for expansion of production capacity at the Titan facility (or elsewhere near Port MacKenzie)
- The pace of build-out of Fairbanks natural gas distribution infrastructure
- The price of competing fuels
- Uncertainty around North Slope gas pipeline construction

If ARRC were to move the maximum permitted (after 2017) number of ISO containers (approximately 5,500 containers), revenues could total more than $5 million annually, based on a proxy tariff of $0.15 per gallon. The actual tariff on LNG would be closely negotiated and established in contract.

Trucking ISO containers 70 miles from the Titan plant to Anchorage for loading on to rail cars would be costly and likely impractical at high volumes. ARRC would look for ways to reduce that cost. A rail spur directly to the LNG plant or near the plant would be highly advantageous, avoiding southbound trucking costs as well as minimizing shipping through urban areas.

Other Proposals

Resource Energy Inc.

Resource Energy Inc. (REI) has proposed development of an LNG export facility, which would be located at or near Port MacKenzie. The facility would have capacity to produce approximately 100,000 gallons of LNG per day. The $1 billion facility would liquefy Cook Inlet natural gas before export to Japan. REI may begin engineering and design work in 2017. The facility could have the capacity to fill containers of LNG to be transported north by truck or rail, if demand warranted investment.

If the rail extension was available during construction, the company indicates it could be used during construction.[80] And even in the absence of the extension, the port should anticipate a temporary but substantial increase in port volume if the plant was constructed. Construction materials would be brought into the port at the dock or by barge.

Central Alaska Energy

Central Alaska Energy (a Vitus company) has plans to develop a tank farm at Port MacKenzie that would have the capacity to store nearly 7 million gallons of ultra-low sulfur diesel (ULSD) and gasoline. Product from the tank farm would be used to supply Railbelt markets, including construction and mining industry trucks and equipment. Located near the planned rail extension, it would be possible to transport refined products by rail

[80] Personal Communication, Brian Murkowski, VP Government and Regulatory Affairs, Resource

and truck. Discussions with the company indicate they would like to move forward with the project, but market conditions need to stabilize.

Natural Gas Pipeline Logistics

Port MacKenzie is anticipated to provide support if current natural gas pipeline construction plans are successful. A variety of natural gas projects have been proposed in recent decades, from relatively small, in-state pipelines, to a pipeline connecting North Slope gas resources through Canada to the North American market.

A 2008 study examined costs associated with building a pipeline connecting the North Slope to Alberta, with a spur line to Southcentral.[81] The analysis compared the total cost of upgrading port and road/rail infrastructure and transporting the necessary 1.5 million tons of construction materials through various Southcentral ports.[82] Pipe and fuel needed during construction were the two largest categories by volume, accounting for an estimated 80 percent of total project freight volume.

Five ports were included in the analysis: Port MacKenzie, Seward, Anchorage, Valdez, and Whittier. Assuming all needed freight volumes would be moved through a single port, a fully developed Port MacKenzie was found to be the most cost-effective, totaling approximately $190 million ($2008) – more than $100 million less costly than all other options.

The analysis specifies several factors supporting Port MacKenzie's competitiveness relative to other ports:

- Reduced distance from tidewater to staging areas.
- Rail loop allows efficient loading of materials.
- Newly built rail extension will be relatively maintenance free.
- Significant amount of available uplands for staging.
- Efficiency of rail versus trucking.

In the event a natural gas pipeline is completed, it is assumed Port MacKenzie's competitive position identified in this report will be similar. It should be noted that the cost estimates described above are for a larger project on a different route and therefore of less relevance today. While the assumption that all freight would enter through a single port is unrealistic, the analysis does reflect advantages associated with Port MacKenzie. Current gas line construction plans, both of which are in the initial phases of design and permitting, are described in more detail below.

The Alaska LNG Project

The Alaska LNG Project would bring currently stranded natural gas 800 miles from the North Slope to an export terminal in Nikiski, crossing Cook Inlet approximately 40 miles Southwest of Port MacKenzie. Currently in the pre-FEED (front-end engineering and design) stage, depressed global energy markets remain a challenge for

[81] (Northern Economics, 2008)
[82] Note: This study assumes completion of the Port MacKenzie rail extension.

the project. The 42-inch pipeline would have the capacity to move 3 billion cubic feet (BCF) of natural gas per day. Anticipated to cost between $45 and $65 billion, construction would take place over a seven-year period.

Project documents filed with the Federal Energy Regulatory Commission (FERC) offer specifics on how construction materials would be brought into Alaska.[83] While the Port MacKenzie rail extension is noted as a possible development, the documents do not assume it will be available for use in time for pipeline construction.

According to these filings, Anchorage and Seward will be the primary ports to handle the construction materials needed for the project.[84] The Port of Anchorage will serve as the main entry point for construction supplies, excluding pipe. Shipments would be handled by TOTE and Matson, the companies providing regularly scheduled shipping services from Puget Sound. Freight volumes would average more than 27,000 forty-foot equivalent units (FEU) annually, peaking in 2024 at 43,000 FEU. Slightly more than 190,000 FEU would be moved through the port.

ARRC'S Seward port is designated as the primary point of entry for pipe. It would also see significant movement of container and breakbulk freight over a three-year period, according to the FERC filings. Annual volumes in Seward would average nearly 11,000 FEU. At the same time, an average of more than 38,000 sticks of pipe would be moved through the port per year, totaling nearly 116,000.[85] Pipe and other materials would leave Seward via truck, rail, and barge. Preliminary estimates indicate 31,100 truckloads and 10,975 rail car loads of pipe will be required. In addition, 57,000 truckloads of other materials and equipment and 4,000 rail car loads of other materials (pipe bends, fuel, consumables, mainline block valves, etc.) would be required, though it is not clear what portion of these is likely to arrive via which port.

Other ports and landing facilities around the state will also play supplementary roles to the ports of Anchorage and Seward:

- The Port of Whittier's rail barge capacity will be used primarily for incoming fuel shipments, in addition to some containerized and break bulk shipments. While the rail barge offers an efficient connection with Seattle and Prince Rupert rail connections, limited uplands and constraints (dimensional and scheduling) caused by tunnels, are a challenge.
- Two material offload facilities would be built near Nikiski and Beluga. These facilities would be able to handle roll-on/roll-off barge shipments and equipment. The Nikiski development is anticipated to receive nearly 200 shipments of bulk materials, pipe, and prebuild modules over the construction period. The Beluga facility would handle more than 400 barge loads over the same time.
- Port MacKenzie is listed as a potential distribution center for concrete coated offshore pipe.[86] Further use of Port MacKenzie is described as dependent on the completion of the ARRC rail spur.
- Marine facilities in Dutch Harbor, Homer, Valdez, and Prudhoe Bay will also play some role in the project.

[83] (Alaska LNG, 2016)
[84] (Alaska LNG, 2016)
[85] Sticks refers to 40-foot lengths.
[86] (Alaska LNG, 2016, p. 1:117)

Alaska Stand Alone Pipeline (ASAP)

The Alaska Stand Alone Pipeline would stretch 727 miles from the North Slope to existing pipelines near Big Lake. A spur would deliver natural gas to Fairbanks. Estimated to cost $10 billion, the 36-inch pipeline project would be capable of moving 500 MMCF per day. Construction is estimated to occur over a 4-year period.

The Port of Seward is designated in project documents as the main entry point for pipe and pipeline equipment, primarily a result of rail connectivity and available acreage for staging.[87] A total of 420,000 tons of pipe is estimated to be required, delivered in 28 shipments. Loaded drafts of less than 30 feet are expected due to the high volume to weight ratio of pipe shipments.

Marine facilities at Anchorage, Whittier, Valdez, and Port MacKenzie are noted as capable ports which could play a minor role.

Gas-Line Related Outlook for Port MacKenzie

The pipeline project reports described above do not assume the existence of a rail connection to Port MacKenzie. With such a connection completed, the competitiveness of Port MacKenzie will increase significantly.

Port MacKenzie's advantages relative to Seward include a larger amount of space available for staging and other activities. According to Alaska LNG resource reports, a limitation exists in Seward, as Handymax-sized vessels delivering a full load of pipe would require an estimated 5.18 acres of staging space to place the pipe to ground for inspection – more than is currently available.[88] Congestion could lead to slow turnaround times for vessels and make the port unavailable for other shipping activities for extended periods of time. Once pipe is offloaded, the next step is for it to be trucked or railed to a double-jointing plant for combining into 80-foot sections. Alaska LNG documents indicate that double-jointing plants are likely to be built near the port of offloading (for pipe destined for spreads south of Fairbanks) as well as in Fairbanks (for all other pipe).

Additional advantages of Port MacKenzie include the lack of tunnels and easier rail access to pipe storage and laydown areas along the pipeline route. Alaska LNG resource reports note that limitations on load sizes and cargo types are placed on trains running through the Anton Anderson Memorial Tunnel accessing Whittier and the three railroad tunnels between Seward and Anchorage. In light of these limitations, "The Applicants would consider use of the Port MacKenzie rail spur if completed prior to the start of this Project."[89]

It should not be assumed that Port MacKenzie will accommodate all pipe or rail shipments for either the AK LNG or ASAP project. The lack of rail-barge capacity will place Port MacKenzie at a competitive disadvantage to facilities in Whittier which can receive shipments without additional material handling. In addition, the ARRC has substantial resources invested in Seward and Whittier, with plans to upgrade infrastructure at both ports.

[87] (Alaska Gasline Development Corporation, June 2014)
[88] (Alaska LNG, 2016, p. 5:175)
[89] (Alaska LNG, 2016, p. 1:120)

Overall, the sheer volume of materials required ensures that all Southcentral ports are likely to see a significant amount of increased activity during construction of either the Alaska LNG or ASAP pipeline.

Finally, these gas line proposals are far from certain. A Fall 2016 analysis by Wood MacKenzie indicates that the competitiveness of the Alaska LNG pipeline ranks poorly compared to other projects competing to supply markets in North Asia.[90]

Aggregates

Sand, gravel, crushed rock, and other types of aggregate are used extensively in construction projects throughout the state. Most projects and communities have ample access to local resources to supply these materials. Where long distance shipping is required, the ARRC has served an important role.

In 2015, the ARRC moved 2.29 million tons of gravel from Palmer to serve construction markets in Anchorage. These shipments have trended down slightly over the last 8 years, but consistently remained above 2 million tons per year (see Table 2, on page 17). Construction spending in Alaska was forecasted to drop 18 percent in 2016 due to low oil prices and greatly reduced state capital budgets.[91] These factors are likely to remain an issue for several years, reducing demand for gravel and other construction aggregates to some degree.

In 2016, the ARRC completed loading and storage improvements needed to begin moving hard aggregate from quarries near Cantwell to serve Southcentral road construction projects. A total of 8 trains carrying 24,425 tons is expected to be hauled in 2016.[92] The rock resource near Cantwell is unique, with especially hard rock that has proven to be effective at decreasing wear on heavy traffic asphalt and is projected to be in increasing demand. A 2013 study conservatively estimated at least a million tons of hard rock is available on adjacent parcels of land owned by the State of Alaska and Ahtna Corporation.[93] The study also concluded that Cantwell hard rock resources were not quite competitive with hard aggregate imports from out of state, though this appears to be changing somewhat with improved rail access.

Aggregate Outlook for Port MacKenzie

Significant quantities of aggregate resources are available in the Port MacKenzie area.[94] However, well-established gravel operations with rail linkages, such as those described above, have significant resources already permitted and available to continue to supply Anchorage and Southcentral markets for the foreseeable future.

Port MacKenzie, with local resources and an efficient conveyor loading system, is well-placed to compete in markets served by barge, such as to POA for port improvements and to Bethel and other areas in Western

[90] (Wood Mackenzie, 2016)
[91] (Institute of Social and Economic Research, UAA, 2016)
[92] (Alaska Railroad Corporation, 2016)
[93] (R&M Consultants, Inc., 2013)
[94] (Metz, 2007) indicates that in excess of 100 million cubic yards is available.

Alaska that lack suitable local resources. In 2008, Port MacKenzie supplied over 450,000 tons of gravel to support POA expansion construction.

While barge-supplied markets present some potential for Port MacKenzie, use of the rail extension for outbound or inbound movement of aggregate resources is less certain. A feasibility study is outside the scope of this project but would help refine the outlook for gravel exports from Port MacKenzie.

Agriculture

In 2015, a total of 750 farms operated in the state. Some of the major products produced include hay (20,000 tons), potatoes (7,000 tons), barley (3,500 tons), milk (1,750 tons), and oats (750 tons).[95] According to industry representatives interviewed, sporadic export of Alaska agricultural products exists, but not on a regular basis or in significant quantities. The largest use of the railroad related to Alaska agriculture is for transport of inbound fertilizer shipments to the Interior. Roughly 40-50 rail cars carrying fertilizer per year arrive by rail barge from Prince Rupert.

[95] (United States Department of Agriculture, 2016)

Overview of Potential Rail Freight Tonnages

The purpose of this chapter is to summarize the long-term outlook for freight tonnages that could move to and from Port MacKenzie via rail. This exercise involves significant uncertainty, as a large percentage of potential tonnage is project-based and/or contingent upon future commodity values. The timing of future mine development projects (likely the largest source of future rail freight), for example, is not possible to predict with any certainty. Nevertheless, by making transparent assumptions about the timing and scale of major development projects, a "concept-level" measure of possible rail-related tonnage to Port MacKenzie over the next 20 years can be tabulated.

Sealed multi-modal mineral concentrate container of the type that could be used to move Interior Alaska concentrates to Port MacKenzie.

The tonnages presented in the following table are based on the following key assumptions:

- Arctic mine development occurs in the 6-10 year period, with production beginning in year 11, averaging 370,000 tons annually through Port MacKenzie.
- Development of Arctic spurs other mine development in the Ambler region, resulting in increased tonnages in the 16-20 year window, averaging 500,000 tons annually.
- Other base metal and precious metal mine development in Interior Alaska begins generating in-bound rail freight in the 6-10 year period, and generates 300,000 tons of outbound concentrates and 75,000 tons of in-bound supply after year 15.
- Strong recovery in the Pacific Rim coal market results in 300,000 tons exported annually through Port MacKenzie after year 10 and 500,000 tons annually after year 15.
- Forest products tonnages average 25,000 tons initially, 50,000 tons in the 6-10 year period, 100,000 tons in years 11-15, and 150,000 tons thereafter.
- North-bound LNG rail shipments account for 15,000 tons initially, 25,000 tons in the 6-10 year period; 50,000 tons in the 11-15 year period and 75,000 tons thereafter.
- Over the first five years, Port MacKenzie gradually increases general rail freight tonnage to about 10 percent of total Southcentral in-bound non-containerized waterborne freight (non-petroleum), or approximately 50,000 tons, increasing to 100,000 tons within ten years, then to 150,000 tons.
- A portion of gas line construction-related freight is moved through Port MacKenzie and transported on rail; approximately 500,000 tons total annualized over the 6-15 year period.
- Other miscellaneous freight (construction materials, cement, limestone) account for 50,000 tons initially, increasing to 100,000 tons after year 10.

Table 12. 20-Year Concept-Level Summary Outlook for Port MacKenzie Rail Freight (Annual Tons)

Freight Category	Years 1 - 5	Years 6 - 10	Years 11 - 15	Years 16 - 20
Ambler District Mining		**50,000**	**410,000**	**550,000**
In-bound (materials & supplies)		50,000	40,000	50,000
Out-bound (concentrates)			370,000	500,000
Other Interior Alaska Mining		**25,000**	**50,000**	**375,000**
In-bound (materials & supplies)		25,000	50,000	75,000
Out-bound (concentrates)				300,000
Coal Exports			**300,000**	**500,000**
Forest Products Exports	**25,000**	**50,000**	**100,000**	**150,000**
Oil & Gas-Related	**15,000**	**75,000**	**100,000**	**75,000**
LNG Rail	15,000	25,000	50,000	75,000
Gasline Construction		50,000	50,000	
General Freight	**50,000**	**100,000**	**100,000**	**150,000**
Other	**50,000**	**75,000**	**100,000**	**100,000**
Total	**140,000**	**375,000**	**1,160,000**	**1,900,000**

The assumptions underlying these tonnage estimates imply optimism about resource development in Alaska over the next 10 to 20 years. Interested parties with other opinions about the timing and scale of development in Interior Alaska (and other areas potentially served by a rail link to Port MacKenzie) can use this compilation to develop other freight forecasts. Similarly, as projects evolve and new information becomes available, the freight outlook can be updated and refined.

Overview of Other Port MacKenzie Rail Freight Opportunities

Other studies have generated high-level estimates of potential Port MacKenzie rail freight volumes. These studies might also inform further analysis of the type, tonnage, and timeframe of rail freight moving along the Port MacKenzie rail extension.

A 2007 study prepared for Matanuska-Susitna Borough, *Economic Analysis of Rail Link, Port MacKenzie to Willow, Alaska, Phase II – Possible Rail Extension Users Analysis* (Metz, 2007), included a rail freight tonnage forecast. Predicted annual tonnages included:

- Coal exports, 1 million tons
- Mineral aggregate exports, 100,000 tons
- Lime and Portland cement, 50,000 tons
- Forest products, 60,000 tons
- Petroleum products, 200,000 tons
- Mineral concentrates, 365,000 tons, increasing to more than 1.6 million tons after 10 years
- In-state coal shipments to a newly-developed power plant at Port MacKenzie, 1 million tons

The forecast also included 960,000 tons per year, for two years, of pipeline sections and other construction materials, associated with gas line construction.

Freighter carrying mineral concentrate containers.

The 2015 *Alberta to Alaska Railway Prefeasibility Study*, prepared by The Van Horne Institute examined connecting Alberta's petroleum resources to tidewater ports in Alaska. [96] The study considered the feasibility of rail transport of bitumen from Alberta to Delta Junction (approximately 1,500 miles), then to Valdez via pipeline. The business plan has since been revised to include Port MacKenzie as the primary transshipment port. The feasibility study considered 1.0 million barrel per day (mbpd) and 1.5 mbpd rail operations. According to company officials, Port MacKenzie would initially receive five 196-car trains daily starting in late 2020, increasing to nine trains daily in 2022 (Falcetta, 2017). Each train would carry 122,500 barrels of bitumen. As noted previously, the capital cost associated with the A2A rail project has been estimated at between $28 and $34 billion ($2013 Canadian). This estimate is based on a primary shipping route via newly constructed railway from Fort McMurray to Delta Junction and the existing Trans-Alaska Pipeline to Valdez. Capital cost estimates are not available for facilities necessary for rail transport, storage, and loading facilities at Port MacKenzie.

Mineral resources along the A2A rail corridor are also anticipated to be developed and add to freight traffic to Port MacKenzie. Metz estimated the total rail freight requirements for mineral development along a 1,100-mile long section of the A2A rail corridor (from Fort Nelson to Delta Junction) at 11 million tons annually over a 30-year period, including approximately 10 million tons of outbound concentrates and 1 million tons of inbound freight. [97] There are 1,717 known metallic mineral occurrences along the rail corridor. Metz also notes that even larger volumes of industrial minerals and coal would also be developed and transported along the A2A rail corridor.

[96] (The Van Horne Institute, 2015)
[97] (Metz, 2014)

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Chris Fedele, Alaska Scrap and Recycling

Chris Taylor, Alaska Basic Industries

Curt Freeman, CEO, Avalon Development Corporation

Dale Wade, VP Marketing and Customer Service, ARRC

Dave O'Donnell, President, Ahtna Construction and Primary Products Corporation

Doug Hanson, Forester, Alaska Department of Natural Resources

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Mary Ellen Tuttle, Project Manager, AIDEA/Dowl, AMDIAR

Mike Pestrikoff, Senior Project Manager, Granite Cove Quarry, Koniag Incorporated

Mike Satre, Manager of Community & Government Relations, Greens Creek Mine

Nick Szymoniak, Energy Infrastructure Development Officer, Alaska Industrial Development and Export Authority

Paul Metz, Ph.D., Consulting Economic and Mining Geologist

Paul Slenkamp, Senior Resource Manager, Alaska Mental Health Trust Land Office

Ray Nix, Resource Manager, Matanuska-Susitna Borough

Rick Van Nieuwenhuyse, CEO Trilogy (Ambler District, Arctic and Bornite Projects)

Rob Brown, V.P. Business Development, Usibelli Coal Mine

Ron Arvin, RA Environmental

Stan Runnels, Yard Manager, Astoria Forest Products

Steve Borell, former Executive Director, Alaska Miners Association

Steve Colligan, Alaska Rock Products Association

Steve Ribuffo, Port Director, Port of Anchorage

Sue Alexander, Program Manager, Pacific Northwest Research Station, U.S. Forest Service