ALASKA DEPARTMENT of TRANSPORTATION and PUBLIC FACILITIES

STATEWIDE MATERIAL SITE INVENTORY, SITE INSPECTIONS & GEOLOGICAL INVESTIGATIONS

CANTWELL HARD AGGREGATE DEVELOPMENT FEASIBILITY STUDY

AKSAS PROJECT NO. 79434

Prepared by:

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STATE OF ALASKA DOT&PF

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CANTWELL HARD AGGREGATE DEVELOPMENT FEASIBILITY STUDY

EXECUTIVE SUMMARY

Alaska Department of Transportation & Public Facilities (DOT&PF) is conducting a feasibility study to determine the cost effectiveness of producing hard materials for paving aggregates from the existing Hard Aggregate Site on Panorama Mountain near Cantwell, Alaska. As part of this study, a cost comparison was performed between using the Panorama Mountain source and two commercial west coast (outside) sources.

The west end of Panorama Mountain is interpreted to be underlain by basalt flows with associated sills and dikes of diabase and gabbro. Nineteen (19) Nordic abrasion samples tested from this area since 1996 have returned values between of 5.6 and 9.1 with one outlier at 13.7. Without a subsurface investigation, a surface evaluation indicates that there are an estimated 1,000,000 tons of material for producing hard aggregate at the Cantwell Hard Aggregate Site.

For each of the aggregate source possibilities, there are variations in the delivery methods to be considered. Utilizing the out of state sources requires barging the materials into either the Port of Anchorage or a private facility in Anchorage. From either of these delivery points, the aggregates have to be unloaded and transported to the batch plant by truck.

For the Panorama Mountain source, the primary option is to deliver the aggregate to the batch plant by rail. There are multiple locations to consider for a loading facility which will be required to load the aggregate into hopper cars. The considerations involved for each location are described in the body of this report.

This evaluation assumed that material from the Hard Aggregate Site at Panorama Mountain would be processed on-site and then transported to a loading facility at a relatively nearby point on the Alaska Railroad (ARR). The Alaska Railroad has repeatedly stated that a permanent loading facility will require a separate siding and that loading must be accomplished using a conveyor system with a method to accurately weigh the material loaded into each gravel hopper. However, this season a contractor was given tentative approval to load a dedicated gravel train along the main line utilizing loaders to fill hopper cars with aggregate obtained from DOT&PF MS 52-2-046-2 approximately 1 mile to the north of our evaluation site. Alaska Railroad has confirmed that this is a one-time allowance and this approach is not an option for future operations. Ultimately the contractor did not utilize this loading site, but instead used existing ARR facilities at Healy.

Three primary loading facility options near Cantwell are considered in this report:

- The existing Healy facility approximately 36 miles to the north of the site,
- A new siding and loading facility at a point approximately 12 miles to the south of Cantwell, and

- A new siding and loading facility at a previously utilized site 26 miles south at approximately Milepost 190 along the Parks Highway.

The only facility currently operational near Cantwell that the Alaska Railroad would allow to be utilized to load aggregate without special allowances being made is the Healy facility to the north. Based on the crushing costs and hauling per ton per mile costs utilized in this analysis, the costs per ton delivered to the batch plant in Anchorage would be on the order of $83.50 per ton.

The estimated range costs of aggregate delivered to a batch plant in Anchorage from a new siding and loading facility near the Cantwell site would be on the order of $64.00 to $76.00 per ton. The siding location closest to Cantwell would result in lower costs per ton but with higher capital improvement costs. This average cost per ton is based on one of the two new siding locations being operational and does not include estimated capital costs for the siding or loading facility construction.

The range of estimates received from outside sources including Port of Anchorage dry barge berth fees and contractor truck hauling costs is approximately $66.00 to $82.00 per ton. A local private freight company submitted an estimate to barge the material from either outside source and unload the barge at their facility into contractor trucks. However the final estimated costs utilizing this approach were substantially higher.

At the estimated average approximate rates, it would take approximately 11-51 years to recover the roughly $4,100,000 associated with developing a new siding and loading facility. When all variables were considered, the range of recovery time was between 5 and 145 years depending on which comparisons were used. This assumes an annual need for 20,000 tons of aggregate to be delivered. The overall range of estimated costs for each source and details regarding delivery method costs is included.

Based on this analysis, without special allowances being made from ARR to allow for loading materials on existing rail, it appears to be more economical to barge materials to Anchorage from outside sources, utilize the Port of Anchorage's dry barge berth, allowing the contractor to unload the barge and haul to the batch plant with their own equipment and personnel.

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1.0 INTRODUCTION

1.1 Background

The Alaska Department of Transportation and Public Facilities (DOT&PF) is investigating the opportunity to supply hard aggregate for paving projects throughout southcentral Alaska, which would increase the life of road surfaces. Currently there are two out-of-state sources for hard aggregate that can ship (via barge) material to Alaska when specified for a project. DOT&PF is interested in supplementing these sources with an in-state site near Cantwell, if such a site can be developed economically within the near future. A Vicinity Map showing the location of the site in relation to Anchorage and the Parks Highway/Alaska Railroad corridor is provided as Figure 1.

1.2 Contract Authorization

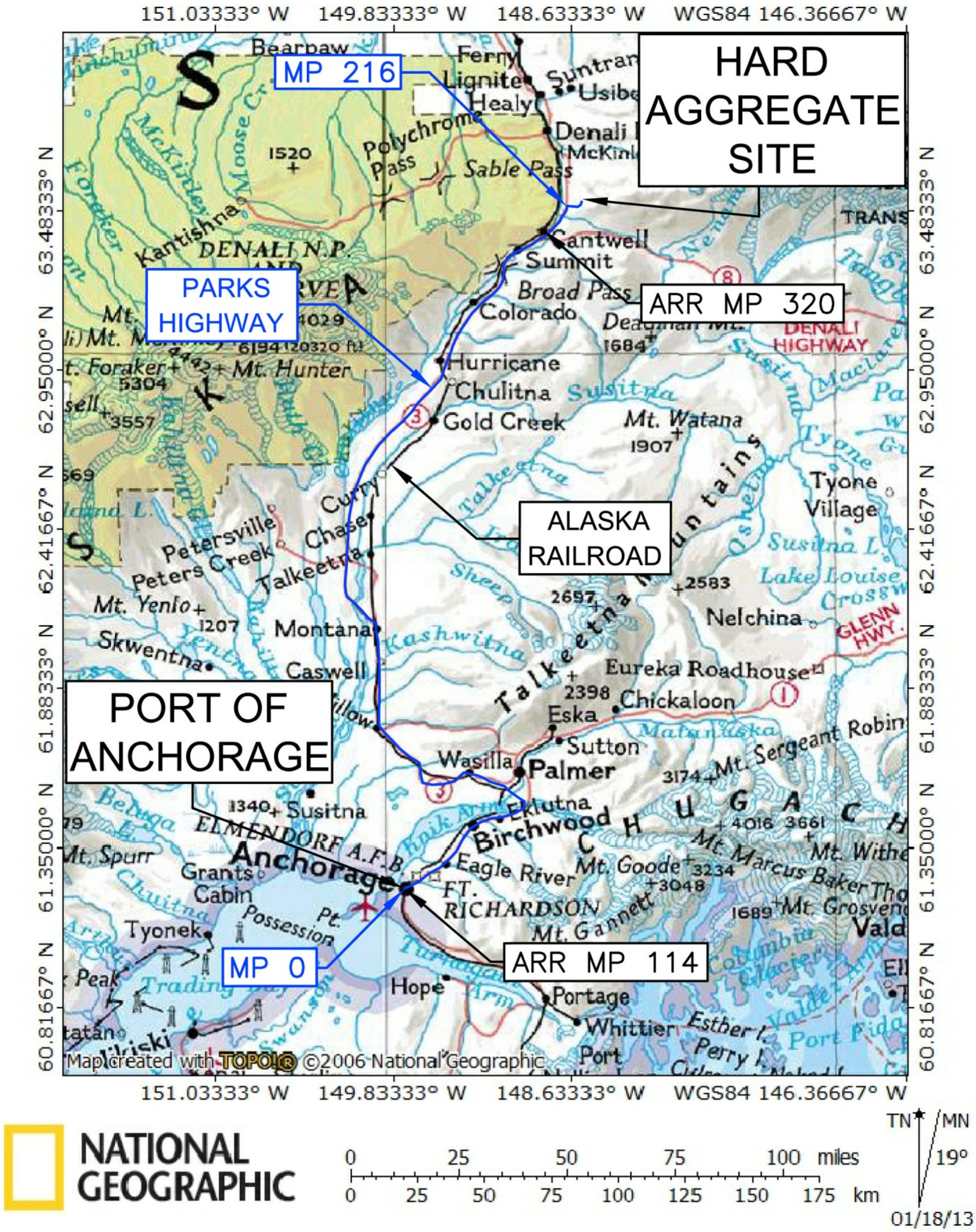
This study was conducted as part of Professional Services Agreement No. 02572001, Statewide Material Site Inventory, Site Inspections & Geological Investigations, between DOT&PF and R&M Consultants, Inc. Work was performed under Amendment No 9, NTP No.10 and consists of Subtasks A, B and C of Task 7 of the agreement.

1.3 Scope-of-Work

The Panorama Mountain area north of Cantwell is a potential area for an in-state hard aggregate material site. The area lies adjacent to the Parks Highway and is within about 25 miles of Alaska Railroad sidings close to the communities of Cantwell and Healy. There are three existing sites within this area (see Plate 1-A). The site of interest to this study is the Hard Rock Aggregate Site which lies to the north and northeast of Milepost (MP) 216 on the Parks Highway. The site covers approximately 35 acres and is owned partially by Ahtna Native Corporation and partially by the State of Alaska. A material site has been developed at this location by Mr. Jim Caswell (Alaska Lime Co., Inc.) on the state portion of the site. Previous testing by DOT&PF indicates that the Hard Aggregate Site has the potential to compete (in quality) with other out-of-state sources, however development and transportation costs were unknown at the start of this study.

This project was intended to compare the costs per ton of a developed Cantwell site to the two (2) existing out-of-state sources.

FIGURE 1
VICINITY MAP



Our initial scope-of-services included four tasks as outlined below:

1. Conduct a brief reconnaissance of the Cantwell material site on state land to determine site surface conditions and collect 10 rock samples for laboratory testing. Prepare maps using existing aerial or satellite imagery.
2. Perform Nordic Abrasion testing (ATM 312) on the samples.
3. Provide a conceptual mining plan for the site including costs for processing the rock to meet specification. Provide a transportation plan, including development of a loading facility along the Alaska Railroad for loading and unloading of this material with their existing rail cars.
4. Provide a cost per ton of processed hard aggregate delivered to the Port of Anchorage from the Cantwell site, and the two outside sources. Perform an economic analysis to determine the break-even point between the Cantwell site and the two outside sources.

Our revised scope-of-services (Amendment No. 14 dated April 22, 2013) includes the tasks as outlined below:

1. Provide a conceptual mining development plan for the Cantwell site including processing the material to meet specification, and associated costs for the on-site production of approximately 20,000 tons/year of hard aggregate (size range 4.75 mm to 10 mm) to be obtained from the site

2. Provide a conceptual aggregate material transportation plan (using train, truck, or a combination) from the Cantwell site to a loading facility along the Parks Highway corridor [including: 1) railhead site near Cantwell that may require the development of a loading facility for the Alaska Railroad (RR), and 2) private loading facility (PF) that may require development/leasing fees], and associated costs to deliver the aggregate to a hot-mix batch plant (BP) in the Anchorage area (e.g. AS&G Lang Street facility). At least three delivery options shall be considered to determine aggregate cost per ton:

   2a- Cantwell site to RR loading facility: by truck; RR loading facility to BP: by train
   2b- Cantwell site to PF: by truck; PF to BP: by train
   2c- Cantwell site to BP: by truck.

3. Provide a cost per ton of hard aggregate from the two existing out-of-state sources delivered to an Alaska port, unloaded then transported to the same BP considered above.

4. Compare costs and determine cost-effectiveness of developing the Cantwell site and transporting the produced aggregate to the Anchorage area versus importing aggregate from the two outside sources.

5. Estimate the number of years (assuming ~ 20,000 tons/year usage) and total number of tons of aggregate that will make the construction of a Cantwell rail siding economical, and make the Cantwell source competitive with outside sources.

6. Estimate the cost savings that may be realized by producing several years' worth of hard aggregate at one time and stockpiling in Cantwell for future use.

7. Submit a draft report describing work done in Tasks 7A, 7B, 7C, 7D, and 7E to the Project Manager for review and comments. The report shall include the Cantwell hard aggregate economic study and the hard aggregate source location study results.

8. Submit a final report that addresses review comments to the Project Manager.

1.4 Assumptions

Several assumptions were made during this study.

1. While only surficial sampling was conducted, all of the material at the Cantwell Hard Aggregate Site is assumed to be satisfactory for the desired purpose.
2. That the existing access road into Mr. Caswell's site at ADL 417419 would be available for use with no additional right-of-way cost. Upgrade and maintenance of the road would be required.
3. The two outside sources are CalPortland's DuPont Pioneer Aggregate Plant in DuPont, Washington and Jack Cewe's Jervis Inlet Site in British Columbia, Canada.

2.0 SITE CONDITIONS

The following information is based on a brief field reconnaissance by R&M Consultants, Inc. conducted in September 2012 and data acquired by DOT&PF during field programs between 1996 and 2003. Site photographs are provided as Figure 2.

Detailed exploration has not been performed at the site, therefore verification of the projected quality and quantities should be accomplished prior to mining.

2.1 Location

The Cantwell Hard Aggregate Site lies along the George Parks Highway corridor northeast of MP 216 on the north side of the Nenana River Crossing at Windy. This site is situated on the southern base of Panorama Mountain at the confluence of the Nenana and Jack Rivers (Plate 1-A). Denali National Park lies immediately to the west across the Nenana River from the Parks Highway.

The George Parks Highway (numbered Interstate A-4 and Alaska Route 3), usually called the Parks Highway, traverses 323 miles (520 km) from its junction with the Glenn Highway 35 miles (56 km) north of Anchorage to Fairbanks in the Alaska Interior. The highway, originally known as the Anchorage-Fairbanks Highway, was completed in 1971, and given its current name in 1975. The highway, along with the Alaska Railroad, follows one of the most important transportation routes in Alaska. It is the main route between Anchorage and Fairbanks (Alaska's two largest metropolitan areas), the principal access to Denali National Park and Preserve and Denali State Park, and the main highway in the Matanuska-Susitna Valley.

Mileposts along the Parks Highway do not begin with 0 (zero). Instead, they begin with Mile 35 (km 56), continuing the milepost numbering of the Glenn Highway where the two highways intersect near Palmer. The 0 (zero) mile marker for the Glenn Highway is at its terminus in downtown Anchorage at the intersection of East 5th Avenue and Gambell Street. Thus, mileposts along the Parks Highway reflect distance from Anchorage, which is not actually on the Parks Highway.

2.2 Geology

According to “Geology and Geochronology of the Healy Quadrangle” (Csejtey et al., 1992), the west end of Panorama Mountain is underlain by basalt flows with associated sills and dikes of diabase and gabbro with subordinate sedimentary rocks. Petrographic analysis of two samples from rubble at the base of the mountain was performed by Stevens Exploration in 2003 with the samples being identified as andesite and diorite (Figures 3 and 4). The low flat ridge along the south base of the mountain is underlain by a Cretaceous mélange, within which blocks of massive limestone are encountered. The Alaska Lime Company facility is located on one of these limestone blocks. The low ridge is bounded by the McKinley fault, part of the Denali fault system.

FIGURE 2
SITE PHOTOGRAPHS

Boulders on the surface of the Cantwell Hard Aggregate Site at Control Point 3 (2003).

Rock glaciers, looking west towards Parks Highway, Nenana River in background (DOT&PF, 2003).

FIGURE 3
PETROGRAPHIC ANALYSIS REPORT RUBBLE 6

PETROGRAPHIC ANALYSIS REPORT

Client: DOT & PF – John Fritz

Thin Section Number: Rubble No. 6 (3)

Project Number : 04 36 5016

Field Classification: Moderately dark gray-green diorite with CI 35-40. No effervescence.

COMPOSITION

Constituent	Optical/Physical Properties	Estimated %
Plagioclase ($An_{38\text{-}50}$: Andesine)	feldspar laths randomly intergrown in subophitic (?) texture; twinning & cleavage typical; mostly clear, unaltered, except for some patches of incipient epidote (?) (or leucoxene?), which is whitish in reflected light. Large laths have inclusions of the (sometimes altered) mafic. ≤4 mm. in length.	42%
Pyroxene/Augite	colorless, no pleochroism in plane light; high relief, low interference colors; high extinction angle; variously altered to chlorite and tremolite-actinolite (both green in plane light); ≤4 mm. in length. Chlorite includes some pennine with anomalous "Berlin blue" interference colors; fills interstices as well as being alteration products of mafics.	40%
Epidote-Clinozoisite	Clinozoisite minor, with high relief, 1^{st} order anomalous interference colors; epidote usually occurs as high relief, semi-opaque whitish (in reflected light) granular patches which are secondary; incipient patches fairly common.	8%
Opaques	those white in reflected light = leucoxene. Ilmenite/leucoxene occurs as skeletal crystals with ilmenite cores surrounded by leucoxene.	10%

TEXTURES AND STRUCTURES

Grain Size: Both pyroxene and plagioclase are ≤4 mm. in length; opaques (ilmenite/leucoxene) up to 2 mm. in diameter.

Textures: Subophitic, with plagioclase crystals better-formed, sometimes somewhat clumped together; pyroxene formed later, is more interstitial, yet not markedly so. Ilmenite formed even later; definitely interstitial.

Structures: Several small microfractures noted, mostly around edge of specimen. (These may have formed when the specimen was prepared-?) This is a fairly cohesive rock.

PETROGRAPHIC CLASSIFICATION: Diorite

PETROGENESIS: Igneous, possibly shallow intrusive.

COMMENTS:

Petrographer — Date: 8/14/03 — Approved by — Date: 8/14/03

FIGURE 4
PETROGRAPHIC ANALYSIS REPORT RUBBLE 7

PETROGRAPHIC ANALYSIS REPORT

Client: DOT & PF - John Fritz

Project Number : 04 36 5016

Thin Section Number: Rubble No. 7 (4)

Field Classification: Moderately dark greenish-gray, fine-grained porphyritic volcanic with CI ≈ 40 = andesite(?). No effervescence noted.

COMPOSITION

Constituent	Optical/Physical Properties	Estimated %
Plagioclase (An_{10-30}: Oligoclase)	largest grains ≤4 mm; some glomerophenocrysts; occur as larger discrete grains up to ≈ 2 mm. as clumped phenocrysts up to ≈ 3.5 mm. diameter, and as much smaller laths ≈ .37 mm. in length.	25%
Mafics/Augite?	chloritized; possibly/probably some hornblende?	15%
Chlorite + Actinolite	Pennine chlorite with anomalous "Berlin blue" colors occurs as interstitial patches (that may have once been volcanic glass?); also chlorite occurs as pleochroic shred and patches intimately mixed with higher-relief shreds of actinolite, all being alteration products of the pyroxene (augite?).	38%
Epidote	includes clinozoisite also. High relief, moderately high interference colors, pistachio green in plane light. Occurs as colorful granular clumps (occasionally), and as cloudy but colorful incipient epidote patches ubiquitous throughout the rock. Sometimes/often seemingly associated with ilmenite-cored leucoxene (white in reflected light.)	10%
Opaques	ilmenite altering to leucoxene, possibly altering to epidote?	10%
Calcite	high relief, high birefringence, typical rhombohedral cleavage; probably alteration products of Ca-plagioclase feldspars; ≤ 1.5 mm. diameter.	<2%

TEXTURES AND STRUCTURES

Grain Size: < .3 mm. diameter to ≈ 4 mm. diameter.

Textures: Glomeroporphyritic igneous rock with moderately fine-grained matrix; volcanic.

Structures: One open microfracture noted; another is filled with incipient epidote.

PETROGRAPHIC CLASSIFICATION: **Deuterically-altered Porphyritic Andesite**

PETROGENESIS: Volcanic flow that was subsequently buried and deuterically altered.

COMMENTS:

Carolyn H. Stevens — 8/14/03 — Donald L. Stevens — 8/14/03

Petrographer — Date — Approved by — Date

The existing Cantwell Hard Aggregate Site is located on the southern base of Panorama Mountain, along the north side of the Nenana River crossing near Windy. The site is at the bottom of an extensive complex of talus chutes that originate high up on the mountain. The Hard Aggregate Site encompasses the upper portion of a group of large tongue-shaped inactive rock glaciers (Wahrhaftig and Cox, 1959). These rock glaciers are composed of angular blocks of rock ranging up to 6 feet in diameter (see Figure 2) which stretch out to the south from the base of the mountain from the Cantwell Hard Aggregate Site to the two developed DOT&PF material sites (MS 52-2-046-2 and MS 52-2-068-2) that lie to the west of site (Plate 1-A).

According to Wahrhaftig and Cox (1959), the rock glaciers formed during post-Wisconsin time (less than 10,000 years ago). Fronts of active (moving) rock glaciers are bare of vegetation, are generally at the angle of repose and make a sharp angle with the upper surface. Inactive rock glaciers can be distinguished by gentle slopes that are rounded on top along with lichen and turf growth which not only covers, but joins boulders together, and typically takes more than 300 years to grow. Since these types of vegetation can be observed on the southern Panorama Mountain rock glaciers, it may be concluded that these rock glaciers were not active during the last cold period (A.D.1600 to 1900).

Rocky material found in the rock glacier has fallen from the steep cliffs on the mountain above and forms talus cones which flow into the rock glaciers. The material may become finer-grained at depth due to percolation of fine-grained material through the coarser surface material, or reducing of grain size by grinding movement near the base of the rock glacier. Typically, the top one-quarter of the thickness of a rock glacier is reportedly coarse rubble, below which is coarse rubble mixed with silt, sand, and fine gravel.

The existing Cantwell Hard Aggregate Site lies on the south side of the Alaska Range with permafrost ranging from isolated patches to sporadic occurrences. However, there may be remaining isolated pockets of permafrost underlying the inactive rock glaciers. Groundwater is generally associated with poorly drained low lying areas or with rivers and streams. Locally, groundwater can be perched on glacial till or bedrock.

The rock has been tested for hardness during at least three sampling programs since 1996. Known sample results are shown on Tables 1 through 3.

The first recorded sampling program was in 1996 as part of the “Studded Tire Wear Resistant Aggregate Study” (Johnson and Pavey, 2000). A material site referred to in that study as MS 52-2-058-2 (Plate 1-A) was sampled but no site boundaries were delinated. The tested site was located uphill of DOT&PF Material Site 52-2-068-2 on Ahtna Corporation lands. The contractor for the aggregate study reportedly arranged for purchase of the material from Ahtna. However, an undeveloped site formerly designated MS 52-2-058-2 already existed elsewhere and should not be confused with the site referenced in the aggregate study report.

TABLE 1
SUMMARY OF DOT&PF SAMPLE RESULTS
For MS 52-2-058-2* (Uphill of MS 52-2-068-2)
(No Sample Locations Available)

Location Name	Depth	Individual Nordic Abrasion Values	Average Nordic Abrasion Value	Degradation Value (ATM 13)	Los Angeles Abrasion Loss %
1996					
R96-8	Surface	6.9, 7.3, 6.9	7.0	79	9
R16	Surface	8.0, 8.2, 8.1	8.1	---	---
R17	Surface	8.4, 7.5, 7.9,	7.9	79	---

*The samples were all field identified as augite/andesite with a grain size of less than 1 mm.

TABLE 2
SUMMARY OF DOT&PF SAMPLE RESULTS FROM 2003

Location Name	Depth	Individual Nordic Abrasion Values	Average Nordic Abrasion Value	Location**	
				North Latitude	West Longitude
July 10, 2003					
Rub 06	Surface	Not Reported	9.1	63.464520	148.794479
Rub 07	Surface	Not Reported	7.3	63.464259	148.794096
September 23, 2003					
Rub 71	Surface	Not Reported	6.2	63.464802	148.791291
Rub 72	Surface	Not Reported	8.0	63.465487	148.789275
Rub 73	Surface	Not Reported	7.0	63.465482	148.787799
Rub 74	Surface	Not Reported	5.6	63.464591	148.789106

**Samples locations (NAD83) were derived from annotated maps and re-plotted in Google Earth to obtain coordinates (NAD83).

Rubble No. 6 was identified in thin section as a diorite (see Figure 3).
Rubble No. 7 was identified in thin section as a deuterically-altered porphyritic andesite (see Figure 4).

R&M's Bob Pintner, P.E. and Brian Mullen, E.I.T. collected 10 rock samples (~50 lb. each) from the surface of the state portion of the Cantwell Hard Aggregate Site using hand tools (sledge hammers) to break the rock into manageable pieces. The sampling took place on September 19, 2012. Access to the sampling area was along the existing access road to the Caswell site. Samples were submitted to R&M's Anchorage laboratory for further examination and testing. Test results are shown below. Additionally, Mike Wariner, P.E. of R&M and Barry Benko, C.P.G. of DOT&PF visited the site on November 20, 2012 to observe development and transportation conditions.

TABLE 3
SUMMARY OF R&M SAMPLE RESULTS
(Collected September 19, 2012)

Location Name	Depth	Individual Nordic Abrasion Values	Average Nordic Abrasion Value	Location*	
				North Latitude	West Longitude
1C	Surface	8.7, 9.0, 9.5	9.1	63.46391	148.79081
2G	Surface	7.5, 7.8, 7.5	7.6	63.46486	148.79029
3B	Surface	5.3, 6.4, 6.8	6.2	63.46360	148.78974
4E	Surface	6.9, 6.7, 7.1	6.9	63.46435	148.78902
4I	Surface	8.1, 8.7, 8.9	8.6	63.46552	148.78914
5A	Surface	8.5, 8.0, 7.9	8.1	63.46324	148.78840
6C	Surface	6.5, 7.6, 7.9	7.3	63.46388	148.78792
6J	Surface	8.3, 8.2, 8.2	8.2	63.46575	148.78804
7E	Surface	13.7, 13.6, 13.8	13.7	63.46443	148.78730
7G	Surface	5.9, 5.9, 6.8	6.2	63.46497	148.78731

*Samples locations (NAD83) were recorded using recreational grade GPS units.

Other laboratory data for the material in this area, including Los Angeles abrasion loss, sodium sulphate soundness loss, specific gravity and degradation values are available from DOT&PF.

3.0 PREVIOUS WORK AND ESTIMATED QUANTITIES

The area around the south base of Panorama Mountain has been investigated and developed for material sources since the construction of the Denali Highway in the 1950's. The material has primarily been used for embankment construction, aggregates and riprap. Since the 1990's, DOT&PF has been considering exploiting the hardness of the material in this area for paving aggregate that can resist the wear caused by studded tires.

3.1 Construction of Denali Highway

Material sites were opened along the base of Panorama Mountain during 1957 for construction of the Denali Highway (Plate 1-A). A free use permit was issued to the Bureau of Pubic Roads for MS 52-2-046-2 in 1956. An indefinite right-of-way grant was issued to DOT&PF by BLM in 1962. This portion of the Denali Highway became part of the Parks Highway in 1971 when the Parks Highway was completed. An indefinite right-of-way grant was issued to DOT&PF for MS 52-2-068-2 by BLM in 1964.

3.2 Alaska Lime Company and Existing Rubble Quarry

An interim conveyance (IC 443) was issued in 1981 by BLM to Ahtna, Incorporated (subsurface) and Cantwell Yedatene NA, Corporation (surface) for the land in Township 17 South, Range 7 West, Fairbanks Meridian. Tentative approval (TA F-034875) was given in 1982 to the State of Alaska for lands in Township 17 South, Range 6 West, Fairbanks Meridian.

Mr. James Caswell established the Alaska Lime Company, an agricultural limestone quarry operation and processing plant, on the low ridge along the front of Panorama Mountain during the early 1990s (Plate 1-A).

According to information provided to R&M by DOT&PF, the proposed Hard Aggregate Site lies on State Land in Section 6, T17S R6W, FM. It lies entirely within the boundaries of a negotiated material sale contract issued to Mr. James Caswell of Cantwell (ADL 417419) on September 19, 2008. According to DNR case file abstracts, the contract presently expires on September 18, 2013. Mr. Caswell reported mining 2,319 cubic yards of material in 2010 and 2011. Mr. Caswell has also built a road to provide access to the site. A public easement to the site (ADL 417426) was authorized in 2007.

3.3 DOT&PF Investigations

In the 1990's, DOT&PF conducted a "Studded Tire Wear Resistant Aggregate Study" (Johnson and Pavey, 2000). Material from MS 52-2-058-2 on Panorama Mountain was hauled to Anchorage and processed into paving aggregate. Test sections were placed along the Seward Highway and on 5th and 6th Avenues. The sections were then compared with those made of aggregate from the Matanuska Valley. The Panorama Mountain aggregate reportedly exhibited 45 percent less wear than the aggregate from the Matanuska Valley.

DOT&PF also conducted a field investigation of the area around the Cantwell Hard Aggregate Site in 2003. Nordic abrasion tests and petrographic analyses were performed. A survey control point (CP-3) was also placed on the township line between State of Alaska and Ahtna Lands by R&M in 2003.

3.4 Estimated Available Quantity of Material

Conservatively, there is an estimated 1,000,000 tons of material available for manufacturing hard aggregate at the Cantwell Hard Aggregate Site. Even with no subsurface exploration, it has been assumed for the purposes of this estimate that an average of 15 feet of material will be useable from the site. The estimated quantity of material available is based on a 15-foot working depth over both the State and Ahtna portions of the site and uses a factor of 1,000 c.y. per acre to estimate the quantity, i.e. (Acres) x (Average working depth) x (Factor) = (Quantity Available in Cubic Yards).

TABLE 4
ESTIMATED QUANTITIES

Area (acres)	Average Working Depth (ft.)	Factor	~ Quantity (c.y.)	~ Quantity (tons)
State Land				
18.4	15	1,000 c.y./acre	276,000	480,000
Ahtna Land				
19.1	15	1,000 c.y./acre	287,000	500,000

There may be significantly more material available. Working depths of greater than 60 feet may be achievable, however quantity and quality has not been verified. The surface of rock glaciers tend to be characterized by blocks and smaller stones but all sizes and shapes are possible. The surface appearance is misleading, however, in that the interior of rock glaciers, where known, usually consist of a diamicton in which fines may be plentiful (Washburn, 1980).

A conceptual site development plan is presented on Plate 1-B.

4.0 MINING, PROCESSING AND HAULING TO RAIL LOADING FACILITY

This study assumes that the aggregate will be crushed on site and then will be hauled from the Hard Aggregate Site to Anchorage either by Alaska Railroad trains or over the Parks Highway via trucks.

Options considered for transportation by rail were dedicated trains consisting of 86 gravel hopper cars or adding approximately 15-20 hopper cars to scheduled trains that had capacity traveling to Anchorage. Depending on the loading option to be utilized, the crushed material would either be stockpiled on site until a train was available for loading or hauled to the loading site for stockpiling there prior to loading the rail cars.

Consideration was given to multiple potential areas for railroad loading sites as follows.

1. The closest site would have involved constructing a bridge across the Jack River to the south of the Nenana River. This would have had the shortest haul distance (~2 miles) to the railroad of any potential area. However, suitable land adjacent to the railroad is apparently owned by the National Park Service and would not likely be made available.
2. A second loading option abuts the existing railroad right-of-way at the community of Cantwell with a haul distance of approximately 8.7 miles. However, construction of one mile of siding would require building a new bridge and crossing a bog. It also would interfere with the existing sidings and railroad facilities in Cantwell. Additionally, aggregate would have had to be hauled through a 40 mph speed zone within the community. The combination of these conditions eliminated this location from consideration.
3. A third loading option is approximately 12.7 miles to the south near a point where the railroad crosses the Parks Highway at MP 204 (Plate 1-C). The surrounding land is apparently owned and managed by the Ahtna/Yedatene NA Corporation (Cantwell). This location would require the construction of access roads, stockpile area, loading facility and a railroad siding. A photograph of the area is included as Figure 5.
4. The Alaska Railroad has a loading facility near Healy that could be utilized to stockpile and load aggregate into hopper cars. This facility is approximately 36 miles to the north of the Cantwell Site. The railroad provided information regarding utilization of this location for loading aggregate. This loading site was reportedly used by a hard aggregate producer during Spring of 2013 when a site at MP 190 of the Parks Highway still contained winter snow.
5. An upgrade to the existing Alaska Railroad site at track mile marker 301-302 or approximately Parks Highway Milepost 190 may also be a possibility (Plate 1-D). This location was scheduled to be utilized by a contractor to load Cantwell aggregate onto a dedicated gravel train during the 2013 season for projects in Anchorage, however the existing Healy site was ultimately used. For this specific project the railroad was allowing gravel hopper cars to be loaded on the mainline utilizing front loaders under very strict guidelines. However, it has been

repeatedly reiterated by the Alaska Railroad that for any future loading a conveyor system will be required to load the hoppers and that loading must be completed on a siding.

Due to the length of haul to the railhead and the quantities (20,000 tons annually) being considered for production, it was felt that crushing of the aggregate on-site is the more economical solution. It should be noted that for smaller quantities, it may not be worth mobilizing a crusher to the site, i.e. for the 100 tons required for the 1998 test sections the material was transported to Anchorage and then processed (Johnson and Pavey, 2000).

4.1 Mining, Processing and Stockpiling at Hard Aggregate Site

The on-site material is very coarse, angular and dense. This will require large equipment to excavate and move this material. It may also be necessary to selectively remove and set larger boulders aside. The hardness of the rock may cause wear and tear to excavating equipment in excess of that which would normally be expected in a typical mining operation.

There is sufficient room on the site (or adjacent to the site) to place a crusher. Stockpiled aggregate could also be placed on-site or adjacent to the site (Plate 1-B). There appears to be sufficient room to stockpile 100,000 tons should that be required. It would appear that the most economical approach to on-site activities would be to crush and stockpile the needed quantity of material on the state land that could then be hauled to the railroad loading station as needed each season. The overall cost savings of producing more than one season's materials at a time are relatively minor because the majority of the costs associated with utilizing this site are due to the trucking and haling activities, not the crushing operations. Also, if individual contractors are going to utilize this material as a source for different projects, this may not be practical. For the cost analysis in this study, it is assumed that the individual contractor will mobilize as needed to mine, crush and stockpile only the material needed for each project. As described in our scope-of-work, we will use 20,000 tons of material for cost analysis purposes.

Based on our experience in crushing operations and conversations with multiple contractors regarding the approach and equipment typically used for this size operation, we would expect the following equipment to be used to accomplish the on-site operations. Crushing and separation of materials would likely be completed by a 42"x28" Jaw Crusher and a 300 HP Cone Crusher feeding a screening plant. With expected capacity of approximately 200 cy/hr and anticipated net density of material to be approximately 126 pounds per cubic foot after accounting for void space in loader buckets, our anticipated output would be 340 tons per hour. Support equipment would consist of a dozer, two front-end loaders and minimal materials lab equipment.

The percent of materials crushed that meet the particle size requirements to be used as coarse aggregate in paving activities varies for each operation. During our research we had multiple conversations with representatives from a local contractor who is currently utilizing a DOT&PF site approximately 1 mile north of the study site and they indicated that they are realizing 30% generation of acceptable material. For this analysis, we used the 30% factor because it represents actual work accomplished. This payable yield percentage translates into approximately 66,667 total tons to be processed to provide 20,000 tons of acceptable aggregate.

The operation described above including necessary personnel should be able to accomplish the crushing of 20,000 tons of acceptable material in approximately 3 weeks of crushing activities.

Utilizing typical industry wage scales and hourly costs of operations for the listed equipment, we calculated a crushing cost for a useable ton of coarse aggregate to be $22.04 per ton.

This could likely vary by as much as $4.00 per ton depending on equipment production rates, useable yield percentages during crushing, the size of staff utilized and the daily work schedule of the contractor.

TABLE 5
ESTIMATED COST FOR EXCAVATION, PROCESSING & STOCKPILING ON SITE

Crushing Equipment							
Equipment	**Each**	**Hours / Day**	**Days / Months**		**Unit Rates**	**Markup**	**total**
42"x28" jaw crusher	1	-	1	Month	$31,000.00	15%	$35,650.00
300HP cone crusher	1	-	1	Month	$38,000.00	15%	$43,700.00
Screening Plant	1	12	16	Days	$75.00	0%	$14,400.00
Materials Lab	1	0	1	Month	$2,000.00	0%	$2,000.00
Dozer	1	12	16	Days	$195.00	15%	$43,056.00
5 CY Front Loader	2	12	16	Days	$155.00	15%	$68,448.00
Pickup	1	12	16	Days	$17.00	15%	$3,753.60
Mob/Demob	1	-	-	-	$55,000.00	0%	$55,000.00
					Equipment Total:		**$266,007.60**

Labor Costs							
Position	**Each**	**Rate/hr**	**Hrs/Day**	**Days**	**Straight**	**Overtime**	**Total**
Dozer Operator	1	$115.00	12	16.0	$14,720.00	$ 11,040.00	$25,760.00
Loader Operator	2	$118.00	12	16.0	$30,208.00	$ 22,656.00	$52,864.00
Crusher Operator	1	$118.00	12	16.0	$15,104.00	$ 11,328.00	$26,432.00
Materials QC	1	$90.00	12	16.0	$11,520.00	$ 8,640.00	$20,160.00
Laborer I	1	$105.00	12	16.0	$13,440.00	$ 10,080.00	$23,520.00
Crew per diem	6	$210.00	0	96	$20,160.00		$20,160.00
					Labor Total:		**$168,896.00**
					Total Crush & On-site Stockpile:		**$434,903.60**
						Royalty:	**$5,878.89**
Cost to crush	11,758	CY of Rock for 20,000.00 Tons of Usable Material					
			$ 22.04	**Per Ton of Usable Material**			

4.2 Truck Hauling of Acceptable Aggregate to Rail Loading Sites

In order for the aggregate to be transported to Anchorage via railcars, the acceptable crushed aggregate will have to be hauled from the site near Panorama Mountain by truck over the Parks Highway to the loading point determined to be the most beneficial. Three different railroad loading options appear to be feasible.

- A potential site located approximately near Parks Highway Milepost 204, 12.7 miles to the south of the hard aggregate site.
- An existing Railroad access area at approximately Parks Highway Milepost 190 on the Parks Highway, 26 highway miles south of the hard aggregate site.
- The existing Healy facility approximately 36 highway miles to the north of the hard aggregate site.

Each location has advantages and challenges and varying associated costs. The site specific conditions for each are discussed in the following section. In order to provide a relatively consistent comparison of the costs associated with trucking useable materials to each location, we kept the hauling operation consistent with regard to the pieces of equipment utilized, crew staffing and length of shifts worked. This approach ties the haul costs directly to the number of miles the haul trucks are required to drive at specific speed limits between the source location and the unloading area.

The proposed operation would consist of one loader, 15 haul trucks, 1 water truck and a grader along with associated personnel. The haul team schedule would consist of 12 hour work days, 5 days per week with overtime pay for the personnel taking effect after 8 hours each day. An evaluation of these conditions utilizing typical operating costs and personnel wages results in the following haul times and associated costs per ton:

- Potential Site at MP 204: 6 Days Hauling; $21.12/Ton Hauled
- Improved Site at MP 190: 9 Days Hauling; $31.67/Ton Hauled
- Healy Site: 11 Days Hauling; $38.71/Ton Hauled

4.3 Required Site Development

A major factor in the evaluation of each location is the requirement from the Alaska Railroad that loading of railcars be accomplished with the cars on a siding to avoid conflict with scheduled rail traffic. Additionally, all loading at an established location must be completed using a conveyor system including a scale to accurately weigh aggregate to avoid overloaded railcars. The existing Healy facility has the infrastructure in place to accomplish this. The other two potential locations would require improvements including the construction of a new siding and conveyor loading system.

Healy Location

In order to utilize the existing rail loading site that ARR operates in Healy, there would not be additional infrastructure development required. This site would require close coordination with the railroad regarding stockpiling material prior to loading the railcars and scheduling trains so as not to interfere with previously scheduled deliveries. The most likely windows of opportunity for scheduling deliveries would be late fall or very early spring. Consideration was given to hauling smaller shipments via railcars added to existing trains already scheduled to come from the Healy site. However, after evaluation of this suggestion by ARR, they determined that this piece meal approach would dramatically increase the overall cost per ton of aggregate and would be extremely limited in hopper availability since the majority of the gravel hoppers are committed to the two designated gravel trains already in operation. The Healy location could be utilized to load dedicated 86-car gravel trains already in operation.

Potential New Site at Parks Highway Milepost 204

There is an area adjacent to Parks Highway Milepost 204 which could provide a potential location for a siding and stockpile area to be developed. As part of the evaluation of this location we assumed a 4-acre parcel of land would be purchased or leased. The access roads and necessary improvements required would be made to the area to allow for stockpiling of the materials and to construct a siding of at least 1 mile in length. We anticipate utilizing materials from the Cantwell source to level the site and develop a pad for stockpiling pay materials prior to loading onto the railcars. The total anticipated cost to develop this site to the point it would be useable for stockpiling and loading would be on the order of $4,094,000.

FIGURE 5
PHOTOGRAPH OF POTENTIAL LOADING AREA
AT PARKS HIGHWAY MP 204

Looking West toward Potential Stockpiling/Loading Site in the Trees (Google Earth, 9/2011).

Improved Site at Parks Highway Milepost 190

At approximately Milepost 190 on the Parks Highway, there is an area that has previously been utilized by the railroad as an aggregate source. This area could be utilized as a stockpile area and for construction of a siding for loading purposes. This site provides the benefits of having an existing access road and already having a larger roughly level area. Some site work would still be required to develop a siding of sufficient length to allow for the full gravel train (approximately 5,200 feet) to be loaded without affecting the mainline traffic. The total anticipated cost to develop this site to the point it would be useable for stockpiling and loading would be on the order of $4,074,000.

General Site Considerations

For both the potential new loading sites, the following information was incorporated into the development costs for each location.

An estimate was obtained from Thor Global for a conveyor with an inline scale that will provide the capacity needed to load the train in the time allotted. The same belt system would be used at either location.

FIGURE 6
EXAMPLE CONVEYOR LOADER/STACKER

A hopper would be placed at one end for loaders to feed the belt.
From: http://www.thorglobal.ca/data/product-photos/52-176.jpg

Calculation of the cost to build the siding were completed using material costs developed for the Cantwell crushing operation and construction costs for the actual track and switches provided by

ARR. According to the railroad, each mainline switch costs $500,000 to install which dramatically increases infrastructure development costs along the mainline. A siding of a circular nature similar to the Healy site would be a potential for each location. The railroad indicated that construction of the track costs approximately $200 per linear foot installed once grade is established. As shown by the estimated construction totals for both potential sites, the majority of the costs are associated with the switches, track work and loading equipment.

During several discussions related to this study, ARR representatives responded to questions regarding loading on the mainline with front loaders by an Anchorage contractor for their project this season. The railroad team responded by stating that this was a one time trial run and that the loading time was limited to only 6 hours. They went on to reiterate that any location set up to be a regular loading facility would require a conveyor system with an inline scale as previously described.

5.0 HAULING TO ANCHORAGE

5.1 Hauling to Anchorage by Railroad

For the purpose of this portion of the study, we are assuming that the aggregate will be hauled to Anchorage in existing gravel trains consisting of two engines on each end with 86 gravel hopper cars between. Trains will be scheduled at the Alaska Railroad's convenience, thus allowing the Alaska Railroad to incorporate the aggregate trains into its gravel train schedule. Each gravel hopper is capable of hauling 100 tons of aggregate. Assuming that consideration will be taken to avoid overloading a hopper, we utilized 95 tons per car in our cost estimations. Figure 7 includes a photograph of Alaska Railroad's hopper cars.

FIGURE 7
ALASKA RAILROAD HOPPER CARS

From http://alaskarailroad.com/Portals/6/Images/Web_Truck-vs-Train.jpg

Based on an assumed 126 pounds per cubic foot for the crushed aggregate, each car would contain approximately 60 cubic yards of material and thus each train would hold approximately 5,160 cubic yards of aggregate.

5.2 Operational Costs for One 86 Hopper Car Train

The total estimated operational cost for loading one 86-car train is based on the operational effort involved in loading the train within the 8-hour time frame required by ARR. Loading operations would be accomplished by two front loaders feeding a conveyor system with 1,200 tons per hour capacity. At this load rate, assuming that each car is loaded with 95 tons of aggregate in order to avoid any overage penalties, it would take approximately 4.5 minutes to load each car. For the estimate, we assumed 1 minute would be required to move between cars. Actual time may be less. This assumption results in an overall load time of 5.5 minutes per car or just under 8 hours per 86 car train. Based on our estimate of operational costs for the loading equipment and the referenced schedule, a cost of approximately $1.46 per ton was calculated.

Updated hauling costs were requested and provided by ARR. The most recent update includes a discounted rate for utilizing the existing facility in Healy while rates for the two greenfield sites are equal.

FIGURE 8
ALASKA RAILROAD QUOTE

PO Box 107500
Anchorage, Alaska 99510-7500
907-265-2485

Alaska Railroad Rate Quote Worksheet

ALASKA RAILROAD CORPORATION
Business Development

DATE: 06/21/2013

CUSTOMER NAME:	Mike Wariner
COMPANY NAME:	R & M Consultants
CUSTOMER PHONE:	907-646-9674
PRODUCT DESCRIPTION:	Aggregate
ORIGIN:	MP 301
DESTINATION:	Anchorage, AK
DIMENSIONS:	LENGTH: WIDTH: HEIGHT: WEIGHT:
EQUIPMENT:	Hopper
BILLABLE UNIT:	Per Ton (PT)
RATE:	$12.50 PT
ROUTING:	ARR
PREPARED BY:	Tim Williams, 907-265-2669 Director, Freight Sales & Marketing

NOTES:

1 - Rate is from siding to siding. Shipper responsible for loading railcar at origin and consignee responsible for unloading railcar at destination.
2 - Rate is based on moving a minimum of 80 railcars per train and 100 ton minimum per railcar.
3 - Rate is based on availability of railcars. Depending on timing for moving aggregate, approval may have to be obtained from AS&G or QAP to use consist.
4 - Rate includes fuel surcharge.
5 - Rate is based on maximum of 2 days to cycle each train, to include train movement, loading and unloading. (Assumes 8 hours to load)
6 - Gross weight of railcar cannot exceed 263,000 lbs.
7 - Alaska Railroad Real Estate Department must be contacted to obtain approval and permit to stage aggregate in Alaska Railroad right-away for loading railcars.
8 - Rate valid for 60 days.
9 - Subject to Rules, Regulations and Provisions as provided in Tariff ICC-ARR 3016 and 9003.
10 - Payment shall be made to the Alaska Railroad Corporation, ATTN: Treasury, P.O. Box 103515, Anchorage, AK 99510-3515 NOTE: NET terms only on credit approved accounts.

Unloading costs were estimated utilizing the existing unloading facilities at the AS&G facility at O'Malley and Old Seward Highway in Anchorage.

Combined transportation costs are presented in Table 6.

TABLE 6
RAILROAD TRANSPORTATION COST COMPARISON

Cantwell Crushing and Stockpiling Cost Estimate					
MP 204 Greenfield Site		MP 190 Improved Site		Healy Existing Site	
$ 22.04	Per ton	$ 22.04	Per ton	$ 22.04	Per ton

Truck Haul to Rail Loading Facility Estimate for Crushed Rock					
MP 204 Greenfield Site		MP 190 Improved Site		Healy Existing Site	
$ 21.12	Per Ton	$ 31.67	Per Ton	$ 38.71	Per Ton

Rail Car Loading Facility Estimate for Crushed Rock					
MP 204 Greenfield Site		MP 190 Improved Site		Healy Existing Site	
$ 1.46	Per Ton	$ 1.46	Per Ton	$ 1.46	Per Ton

Rail Hauling Estimate for Crushed Rock					
MP 204 Greenfield Site		MP 190 Improved Site		Healy Existing Site	
$ 12.50	Per Ton	$ 12.50	Per Ton	$ 12.00	Per Ton

Rail Car Unloading Facility Estimate for Crushed Rock					
MP 204 Greenfield Site		MP 190 Improved Site		Healy Existing Site	
$ 1.19	Per Ton	$ 1.19	Per Ton	$ 1.19	Per Ton

	Summary Costs For Cantwell Area Utilizing Railroad						
	MP 204 Greenfield Site		MP 190 Improved Site		Healy Existing Site		
Crush	$ 22.04	Per Ton	$ 22.04	Per Ton	$ 22.04	Per Ton	Crush
Haul to Rail	$ 21.12	Per Ton	$ 31.67	Per Ton	$ 38.71	Per Ton	Haul to Rail
Loading	$ 1.46	Per Ton	$ 1.46	Per Ton	$ 1.46	Per Ton	Loading
Rail costs	$ 12.50	Per Ton	$ 12.50	Per Ton	$ 12.00	Per Ton	Rail costs
Unloading	$ 1.19	Per Ton	$ 1.19	Per Ton	$ 1.19	Per Ton	Unloading
Oversight	$ 5.83	Per Ton	$ 6.89	Per Ton	$ 7.54	Per Ton	Oversight
Totals	**$ 64.14**	**Per Ton**	**$ 75.75**	**Per Ton**	**$ 82.95**	**Per Ton**	**Totals**

5.3 Hauling to Anchorage by Highway

A second transportation alternative assumes that the aggregate would be hauled directly from the Hard Aggregate Site to the AS&G facility in trucks. The haul distance is approximately 233 miles one-way including the distance from the site to the highway and from there to the AS&G facility. Despite several discussions with multiple trucking companies, we could not obtain estimates from local trucking companies for this project. Therefore, we estimated the costs based on established unit rates. The haul vehicle was assumed to be a tractor-belly dump or side dump with a 25-ton highway legal load and Davis-Bacon wages were assumed. These calculations showed an expected cost per ton delivered to be in the range of $141.34.

We attempted to obtain estimates from hauling companies to utilize tandem trailers or any other means possible to obtain an estimate for this scope. The freight companies indicated that the workload elsewhere was more beneficial to them when comparing time and effort with revenue. One company did indicate that they could potentially place the aggregate in containers, load them on flatbed trailers and transport them to the Anchorage facility, but we did not pursue this option due to the immediate added complexity and handling charges that would have been involved.

6.0 BARGING FROM OUTSIDE SOURCES TO ANCHORAGE

Two outside sources of hard aggregate for paving have been used in the past for DOT&PF projects; one in DuPont, Washington and the other in Jervis Inlet, British Columbia, Canada.

6.1 Outside Sources and Barging

CalPortland DuPont Pioneer Aggregate Plant

The CalPortland DuPont Pioneer Aggregate Plant (Figure 9) is a large commercial aggregate site in DuPont, Washington. DOT&PF (Pavey et al., 2012) has records showing Nordic abrasion values ranging from 6.1 to 19 for the site.

FIGURE 9
CALPORTLAND PIONEER AGGREGATE PLANT

From: http://clui.org/sites/default/files/imagecache/ludb-image/ludb/wa/6548/5662906375_6d49cbe9c5_o.jpg

The DuPont operation is one of the largest sand and gravel operations in the United States, and is a major source for building material in Washington State. Seven miles of conveyors move material around the site and out to a barge loading dock, from where most of the material is shipped to customers. Gravel from this operation was quoted at a per ton cost of $10.98 which includes a $1.00 per ton Environmental Compliance Charge.

Island Tug and Barge provided a quote to utilize a 7,500-ton barge to transport material from the DuPont location to the Port of Anchorage. Based on their submittal, the barging costs for material from DuPont would be on the order of $46.67 per ton.

Jack Cewe Ltd.

Jack Cewe Ltd. of Coquitlam, British Columbia maintains a bedrock quarry on the southeast shore of Jervis Inlet in British Columbia, Canada (Figure 10). The rock is reportedly a granitic rock. DOT&PF (Pavey et al., 2012) has records showing Nordic abrasion values ranging from 6.9 to 9.9 for the site.

FIGURE 10
JACK CEWE LTD. SITE ON JERVIS INLET

From: http://www.cewe.com/road_construction/wp-content/uploads/2012/07/aggregate_supply_2.jpg

Cewe's quoted cost was $9.50 per ton. Jack Cewe Ltd.'s submittal included estimated barging costs from Western Towboat for a 9,500-ton barge at a unit rate of $33.34 per ton delivered to the Port of Anchorage.

The barging costs included in both of these estimates are highly dependent on fuel prices and are expected to fluctuate if the price of fuel changes more than 1% from prices shown in each estimate. Additionally, up to one year lead time may be needed to schedule certain barges.

6.2 Port of Anchorage Fees

During our investigation, we had several conversations and met with representatives from the Port of Anchorage. They were excited about the opportunity to provide docking and wharfage services through their new dry barge berth and provided current rates and optional services associated with the utilization of that facility. From a financial perspective an advantage of utilizing the new dry barge berth is the opportunity for contractors to unload materials with their own equipment and personnel since there is not a precedence set which requires the utilization of the longshoreman associated with the established port facilities. This provides the contractor the opportunity to realize savings on multiple levels including utilizing their own equipment and their standard labor rates for the operators, and not having to handle the material twice to load it into their trucks after another entity unloads the barge and stockpiles it in the yard.

Port fees added to the docking costs for either barge described below would include a wharfage fee of $1.00 per ton and a security fee of $0.58 per ton for a total added expense of $1.58 per ton on top of the docking fees.

Current docking fees at the dry barge berth for the 7,500-ton barge proposed to be utilized by Island Tug hauling materials from the DuPont plant would be $1,098 per 24-hour period. This combined with the per ton fees shown above result in POA costs of $1.73 per ton for DuPont materials.

Current docking fees at the dry barge berth for the 9,500-ton barge proposed to be utilized by Western Towboat hauling materials from the Jack Cewe plant would be $1,206 per 24-hour period. This combined with the per ton fees shown above result in POA costs of $1.71 per ton for Jack Cewe materials. Utilizing a larger barge reduces the cost per ton.

An additional service that the Port of Anchorage offered that doesn't directly apply to the process we are investigating at this time, but could provide for several alternatives, is a storage area near the dry barge berth for a large aggregate stockpile. The rates associated with this area are $0.105 per square foot per month. The configuration of any stockpiled materials would dramatically effect the cost per ton for aggregate storage, but if a specific need arises, it would be a relatively straightforward calculation to determine the footprint of a specifically sized stockpile and calculate the associated storage rates for that stockpile.

6.3 Unloading and Hauling Costs

Estimating costs associated with unloading the barges and hauling aggregate to the Anchorage facility used as a reference point for our study was controlled by needing sufficient equipment and personnel to unload either barge within the initial 24 hours of docking. By utilizing 2 loaders with 5 cy buckets and 23 haul trucks with 10 cy of capacity the unloading and hauling of aggregate from either barge could be accomplished.

It was estimated that the 7,500-ton Island Tug barge for use with the DuPont aggregate could be unloaded and hauling completed in just less than 15 hours. The unloading costs for this shift would be on the order of $1.20 per ton and the haul costs would be approximately $14.27 per ton.

It was estimated that the 9,500-ton Western Towboat barge for aggregate from the Cewe facility could be unloaded and hauling completed in just less than 19 hours. The unloading costs for this shift would be on the order of $1.16 per ton and the haul costs would be approximately $13.88 per ton.

6.4 Private Local Barging and Unloading

As part of our evaluation of other options for transportation and unloading of aggregate to the Anchorage area, we contacted a private local transportation contractor in Anchorage. They agreed to perform an evaluation of the services they could provide and submit rates for as large a portion of this scope as possible. Multiple members of their team participated in the analysis and in the end they provided an estimate for a barge carrying 9,200 tons of materials from either source location to their private dock in Anchorage. At that facility they would unload the materials to a stockpile or into contractor's trucks for hauling to the batch plant location. Their submittal indicates that their costs per ton to haul the material and unload it at their facility would be $67.50 per ton for the Cewe materials and $74.50 for material from the DuPont facility.

Based on our estimated cycle times for a 10 cy end dump truck, 35 trucks would be needed to match the pace at which they plan to unload the barge. Utilizing 35 trucks for 12 hours at standard equipment and operator rates maintained throughout our analysis, we estimate that hauling the material to the AS&G facility would cost approximately $13.88 per ton.

TABLE 7
BARGING DELIVERY SUMMARY

<table>
<tr><th></th><th colspan="2">Jack Cewe /
Western Towboat</th><th colspan="2">DuPont /
Island Tug</th><th colspan="2">Cewe /
Private</th><th colspan="2">Dupont /
Private</th></tr>
<tr><td>Agg</td><td>$ 9.50</td><td>Per ton</td><td>$ 10.98</td><td>Per ton</td><td>$ 9.50</td><td>Per ton</td><td>$ 10.98</td><td>Per ton</td></tr>
<tr><td>Barge</td><td>$ 33.34</td><td>Per ton</td><td>$ 46.67</td><td>Per ton</td><td rowspan="3">$ 67.50</td><td rowspan="3">Per ton</td><td rowspan="3">$ 74.50</td><td rowspan="3">Per ton</td></tr>
<tr><td>Port Costs</td><td>$ 1.71</td><td>Per ton</td><td>$ 1.73</td><td>Per ton</td></tr>
<tr><td>Unloading</td><td>$ 1.16</td><td>Per ton</td><td>$ 1.20</td><td>Per ton</td></tr>
<tr><td>Haul to BP</td><td>$ 13.88</td><td>Per ton</td><td>$ 14.27</td><td>Per ton</td><td>$ 13.88</td><td>Per ton</td><td>$ 13.88</td><td>Per ton</td></tr>
<tr><td>Oversight</td><td>$ 5.96</td><td>Per ton</td><td>$ 7.48</td><td>Per ton</td><td>$ 9.09</td><td>Per ton</td><td>$ 9.94</td><td>Per ton</td></tr>
<tr><td>Total</td><td>$ 65.54</td><td>Per ton</td><td>$ 82.32</td><td>Per ton</td><td>$ 99.96</td><td>Per ton</td><td>$109.29</td><td>Per ton</td></tr>
</table>

6.5 Barging to the Alaska Railroad Facility in Seward

As part of our evaluation of other options for transportation of aggregate to the Anchorage area, we investigated the possibility of barging the material to the AAR's facility in Seward which is typically utilized to ship coal from Alaska to outside markets. Initially, enthusiasm was high related to this option with the hopes that the rail shipping costs would be greatly reduced by backhauling with coal trains. However, discussions with the railroad lead to the conclusion that this would not be a possibility due to the large quantity of coal residue left in the hopper cars after unloading. This residue coating and contaminating the aggregate would likely make it unusable in asphalt mixes. The costs and efforts associated with cleaning the cars combined with the delays in schedule rendered the coal car backhaul option to be unrealistic.

We contacted the outside barging companies regarding shipping to Seward and surprisingly the costs per ton were approximately $1.00 higher to ship to the Seward facility rather than the Port of Anchorage. We also asked the railroad to provide information regarding a dedicated gravel train to haul aggregate from Seward to the AS&G facility in hopes that the rail shipping costs would be low enough to overcome the unloading, truck haul and POA expenses for the Anchorage deliveries. Their evaluation of the equipment and engines required to deliver aggregate from Seward resulted in the maximum number of hopper cars to be 70 cars. At the anticipated 95% capacity level, this would limit each train's load to 6,650 tons. With the smallest barge being considered for delivery at 7,500 tons, a customer would either have to pay for the barge and only haul the tonnage limited by the railroad or stockpile materials in Seward until the quantity of stockpiled excess material grew sufficiently to require a dedicated train. With these complications and the minimal area available in the Seward facility to stockpile materials, this approach was eliminated as a feasible option.

7.0 COST COMPARISON AND CONCLUSIONS

7.1 Cost of Cantwell Material Delivered to AS&G Facility in Anchorage

As expected, the options available for the transportation of acceptable hard aggregate materials from the Cantwell site results in a wide range in the cost per ton of aggregate delivered. The factor most dramatically affecting the delivery costs are the costs associated with trucking the materials from the proposed Cantwell stockpile to the loading site. Additionally, the initial capital investment required to develop sites capable of servicing the proposed scope at 2 of the 3 locations is substantial. Based on the research we performed and the estimates outlined in the body of this report, approximate costs per ton for each of the 3 options are shown below.

TABLE 8
AGGREGATE DELIVERY COMPARISON SUMMARY

	Summary Costs For Cantwell Area Utilizing Railroad									
	MP 204 Greenfield Site			MP 190 Improved Site			Healy Existing Site			
Crush	$	22.04	Per Ton	$	22.04	Per Ton	$	22.04	Per Ton	Crush
Haul to Rail	$	21.12	Per Ton	$	31.67	Per Ton	$	38.71	Per Ton	Haul to Rail
Loading	$	1.46	Per Ton	$	1.46	Per Ton	$	1.46	Per Ton	Loading
Rail costs	$	12.50	Per Ton	$	12.50	Per Ton	$	12.00	Per Ton	Rail costs
Unloading	$	1.19	Per Ton	$	1.19	Per Ton	$	1.19	Per Ton	Unloading
Oversight	$	5.83	Per Ton	$	6.89	Per Ton	$	7.54	Per Ton	Oversight
Totals	**$**	**64.14**	**Per Ton**	**$**	**75.75**	**Per Ton**	**$**	**82.95**	**Per Ton**	**Totals**

Over the road truck hauling directly from the Cantwell site is estimated to cost $141.34 per ton.

7.2 Cost of Outside Material Delivered to AS&G Facility in Anchorage

The two sources for hard aggregate approved for use on DOT&PF projects provided estimates on a cost per ton basis for acceptable aggregate. Two shipping options were evaluated for each source. Initial evaluations utilizing independent barging companies delivering materials to the new dry dock berth at the Port of Anchorage and then a contractor unloading the barge and trucking the materials to the AS&G facility.

Additionally, an Anchorage private freight company provided an estimate to haul the material to their facility in Anchorage and then have a contractor haul the materials to the AS&G facility utilizing dump trucks. Approximate costs for each delivery method are as follows.

Source	Outside Barging	Private Freight
Jack Cewe, BC	$65.54/Ton	$99.96/Ton
DuPont, WA	$82.32/Ton	$109.29/Ton

7.3 Break Even Quantity for Cantwell Hard Aggregate Site

The Cantwell Hard Aggregate Site appears to be competitive with hard aggregate barged in from outside sources. The most significant issue now becomes the initial investment required to construct the infrastructure for hauling on the railroad or negotiating a lease to utilize the Healy site. For comparison purposes we will assume that any increases in fuel costs will affect each mode of transportation equally and that the demand for 20,000 tons per year will remain consistent. Additionally, our break even analysis only considers costs associated with shipping from the two sites where capital improvements will be required to utilize that site.

TABLE 9
COST COMPARISON AND BREAK EVEN CALCULATIONS IN YEARS

Values	Rail	Barge	Savings/Ton	Years
Average Values (Including Private Freight)	$69.95/Ton	$89.28/Ton	$19.33	11
Greatest Difference (Including Private Freight)	$64.14/Ton	$109.29/Ton	$45.15	5
Average Values (Outside Barges / Contractor Unloading)	$69.95/Ton	$73.93/Ton	$3.98	51
Greatest Difference (Outside Barges / Contractor Unloading)	$64.14/Ton	$82.32/Ton	$18.18	11
Lowest Cost Difference	$64.14/Ton	$65.54/Ton	$1.40	145

The overall average recovery time for capital improvement costs based on 20,000 tons per year and assumptions, calculations and estimates provided in this report would be between 11 and 51 years.

Thus, the crux of the issue is that if the aggregate from the Cantwell area is to be utilized as a competitive source, a railroad siding and loading yard will need to be constructed. The costs incurred by trucking the aggregate from the Cantwell source to the existing ARR loading facility in Healy elevates the cost per ton to equal or higher prices than the outside sources appear to provide.

In addition to hard aggregates, the sites on the south side of Panorama Mountain can also provide high quality material for highway construction and maintenance within the local area or be hauled to other project sites including the Fairbanks area. Additional uses for the aggregate could include riprap, normal aggregates, and general fill. With the addition of infrastructure at Cantwell, it may be feasible to haul riprap by rail to other locations in Alaska. The material sites may also become a source of material for the proposed Susitna Dam Project or its ancillary projects. Any facilities built to haul materials out can also be used to haul materials into the area. For instance the siding and loading areas can be used to support construction of the proposed Susitna Dam, mining projects, or other construction projects in the area.

8.0 REFERENCES

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