KNIK RIVER ACCESS: PALMER HAY FLATS STATE GAME REFUGE

Project No.: CED 2021.04

DESIGN STUDY REPORT

UNIVERSITY OF ALASKA ANCHORAGE CIVIL ENGINEERING DEPARTMENT ON BEHALF OF THE ALASKA DEPARTMENT OF FISH & GAME

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FAAME Engineering

April 2021

DESIGN STUDY REPORT

For

Knik River Access: Palmer Hay Flats State Game Refuge

Project No.: CED 2021.04

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LIST OF ACRONYMS

ADA	Americans Disabilities Act
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
DOT&PF	Alaska Department of Transportation and Public Facilities
HMA	Hot Mix Asphalt
MOA	Municipality of Anchorage
MSB	Matanuska-Susitna Borough
NFIP	National Flood Insurance Program
PJD	Preliminary Jurisdiction Determination
SGR	State Game Refuge
SHPO	State Historic Preservation Office
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

1.0 PROJECT DESCRIPTION AND OBJECTIVES

1.1 Project Location and Site Description

FAAME Engineering, in cooperation with the Alaska Department of Fish and Game (ADF&G) propose to implement improvements to the Knik River Access facility of the Palmer Hay Flats State Game Refuge (SGR). The Knik River Access facility is located at the north bank of the Knik River, adjacent to the Glenn Highway near MP 31. The site is located within the Palmer Hay Flats State Game Refuge, which includes 28,000 acres of coastal and freshwater wetlands. The project site is located between both the Municipality of Anchorage and the Mat-Su Borough, however, an agreement between the two entities results in the Mat-Su having jurisdiction over the area. See Figure 1 for Location & Vicinity Map.

The topography of the project site can be described as flat with the occasional higher ground around the perimeter of Reflections Lake. Additionally, much of the site is already developed through the existing parking facility, Reflections Lake trail, and Glenn Highway embankment or has been influenced by past development such as the abandoned gravel pit that is now Reflections Lake. The surrounding area is near sea level and the entire area occasionally floods aided by tidal guts that originate at the Knik River and extend into the surrounding forest. The vegetation at the site consists of marshy grasses and shrubs as well as stands of mature birch, spruce, and cottonwood trees. Before the 1964 Earthquake the area was primarily dry grasslands, but after the earthquake the land subsided two feet or more which transformed the area into the wetlands it is currently. The area is home to a rich diversity of different types of habitats and wildlife, due to this the Palmer Hay Flats State Game Refuge is one of the most important recreation areas in Alaska.

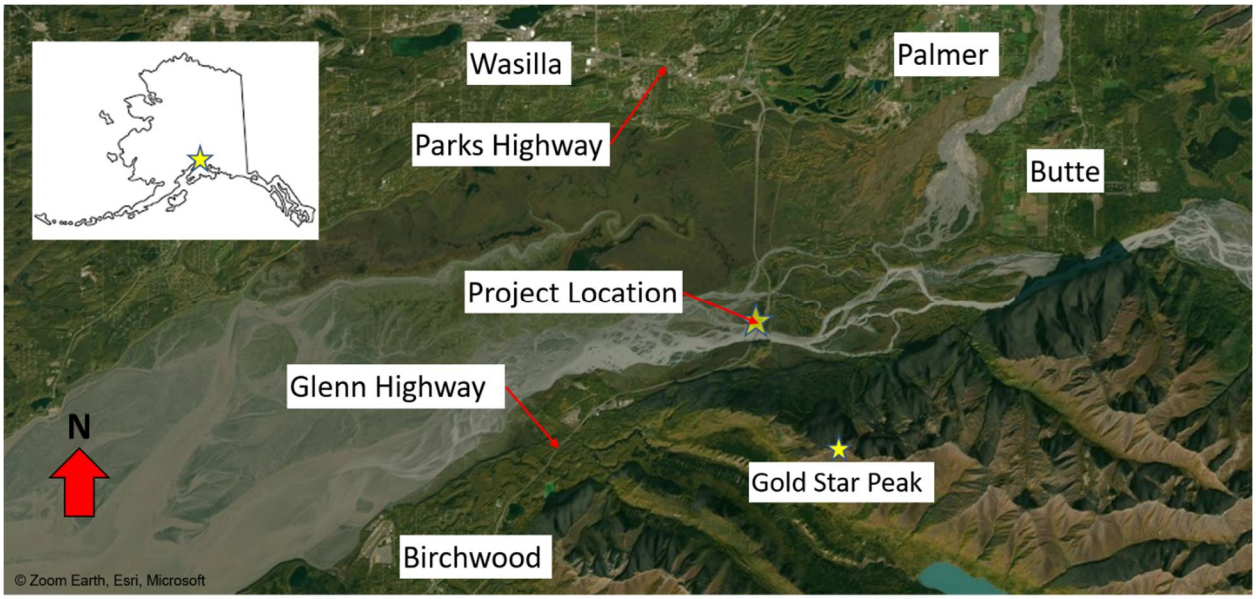

Figure 1: Location & Vicinity Map

1.2 Existing Facilities and Land Use

The Knik River Access: Palmer Hay Flats State Game Refuge project is located at Reflections lake within the Palmer Hay Flats Alaska State Game Refuge. In Figure 2, the existing facilities located at our project site can be seen in an aerial view.

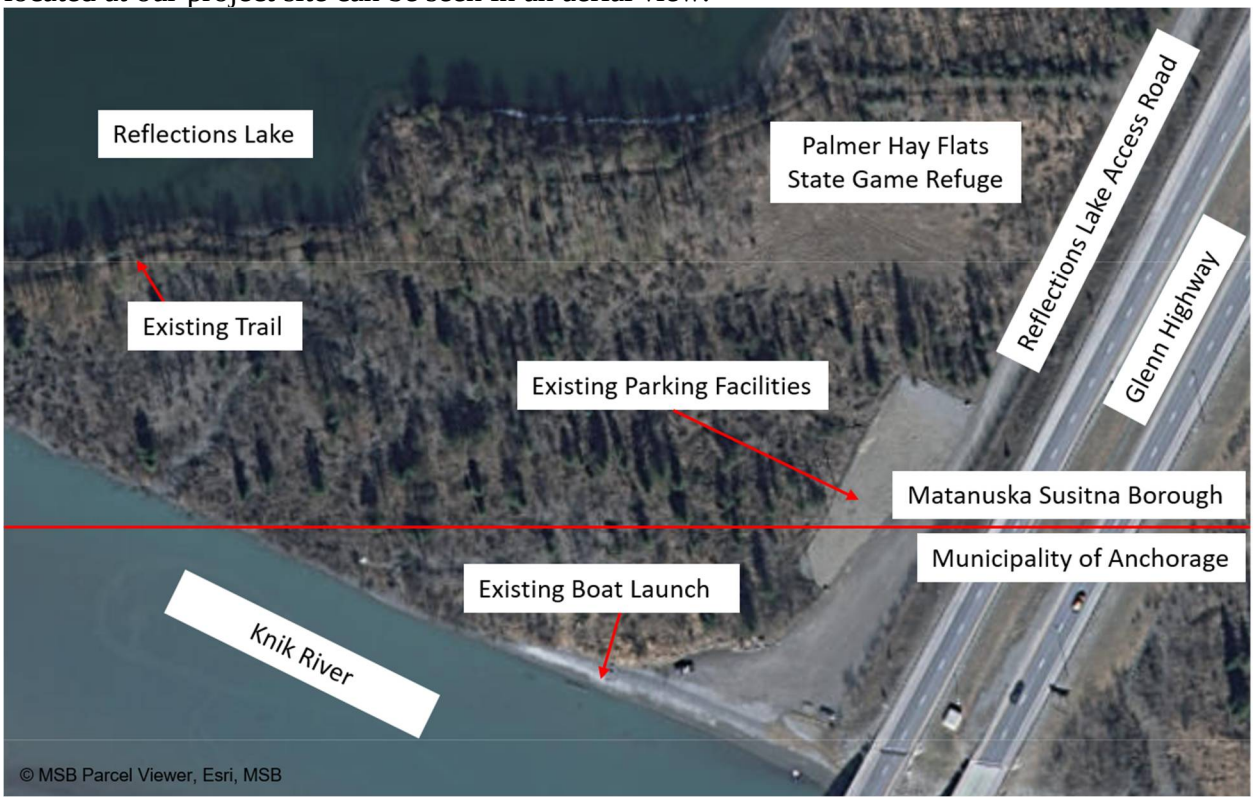

Figure 2: Project Overview & Existing Facilities

Historically, the rest stop was nicknamed as Rambo Rest Stop due to the amount of people who utilized the area as an illegal shooting range, dumping grounds, and for vehicle burning. In 2003, the Alaska Department of Fish & Game began cleanup efforts in coordination with the community, state, and federal agencies to remove trash and mitigate the hazardous lead-contaminated soils.

As a result of this cleanup, restrooms, kiosks, and a 1-mile loop trail with boardwalks and a bridge were installed. The location's primary users now consist of outdoor enthusiasts as well as families seeking outdoor recreation opportunities. The types of activities the current users engage in include hiking, swimming, fishing at Reflections Lake, and boating both within Reflections lake and launching into the Knik River with the existing boat launch on site. Currently, the new demand of the location is greatly exceeding the overall capacity of the current facilities which further exacerbates the need for improved amenities at the location.

1.3 Purpose and Need

The purpose of the proposed project is to improve the existing facilities. The aim of the project can be broken into three primary goals:

- Improve the facility to meet user demands and expectations.
- Encourage the use of the site from motorists travelling along the adjacent Glenn Highway.
- Expand the use of the site beyond purely recreational purposes through the Gold Star Families Memorial Monument.

A major element of the project is the construction of the Gold Star Monument at the site location. This project location was handpicked by Kirk Alkire, the Alaska Gold Star Families Memorial Monument Project Chairman. The project was handpicked due to it being directly adjacent from Gold Star Peak. His vision for the monument at the project site location is to allow Gold Star Families who may not be able to make the 2.4-mile arduous hike up Gold Star Peak the ability to reflect and mourn the loss of their servicemembers.

Overall, as it has been identified in our primary goals, the current demand of the site location's facilities is much greater than the site is able to handle, and improved facilities need to be constructed to meet the primary user's expectations.

To meet these expectations, the project scope has been broken down into the following major elements:

- Replace current gravel parking lot with a larger, paved, signed, and striped lot and tie into the existing frontage road that connects the site to the Glenn Highway.
- Construct amenities, such as a picnic shelter, vaulted toilet, and information kiosk.
- Implement drainage control measures through a biofiltration swale.
- Construct a memorial site for a Gold Star Monument.
- Construct a boardwalk to connect to the existing trail around Reflections Lake and newly constructed memorial site.
- Replace old signage.

2.0 PREFERED ALTERNATIVE

The project, as received from the University of Alaska Anchorage College of Engineering, had already identified an alternative, and the design team was asked to bring the design to 95% completion. Rather than having to weigh out alternatives, the team was able to start quantifying and designing for the desired alternative.

The preferred alternative consists of a paved parking lot and facility amenities, elevated boardwalk, and Gold Star Families Memorial Monument. The new paved parking lot will create 15 extended parking spaces for truck with trailer design vehicles, and 15 parking spaces for passenger vehicles that include 2 van accessible spaces. Additionally, there are two paved pads that will serve as the locations of the picnic shelter and tables, orientation kiosk, and public restroom. Barrier boulders and concrete parking bumpers will be placed at the edges of the parking lot to prevent vehicles from leaving the parking area.

The design also proposes a paved path running the length of the parking lot and tying the entire site together and providing connectivity to the existing boat launch, and proposed picnic shelter,

restroom, orientation kiosk, and elevated boardwalk. A biofiltration swale will be constructed west of the proposed parking facility and will convey stormwater to the lowlands north of the site. The elevated boardwalk will consist of helical piles, timber construction and light penetrating fiberglass decking. The boardwalk design is aimed at minimizing the impacts on the surrounding vegetation and enhancing user connection to the Palmer Hay Flats SGR. The Boardwalk will connect the parking lot, Gold Star Families Memorial Monument, and will tie into the existing Reflections Lake Trail.

The final component of the design is the Gold Star Families Memorial Monument. A site visit was conducted and the location for the memorial was chosen to provide a view of Gold Star Peak. The location is also beneficial because it provides a vegetation buffer to Glenn Highway and is secluded from the other facilities. The monument itself is a two-sided tribute made of black granite that sits on a concrete foundation and is surrounded by a concrete footing. A concrete pathway surrounds the footing, and 4 benches are situated around the monument. All these features sit on an aggregate foundation.

3.0 TYPICAL AND STRUCTURAL SECTIONS

Parking Lot: The existing structural section at the parking facility based on ADF&G contract documents consists of 3 inches of D-1 Aggregate, 9 inches of Selected Material Type A, and Geotextile fabric. The existing parking lot is generally flat with grades rarely exceeding 1%. The drainage that does occur trends towards the lowlands to the North. The insufficient drainage at the site has resulted in significant ponding and potholing at the site.

The proposed structural section consists of:

- 2” of Type IIA HMA
- 4” of D-1 Aggregate
- A minimum of 8 inches of Selected Material Type A
- Separation Geotextile Fabric.

The structural section was chosen based on the requirements of the AKDOT&PF Highway Preconstruction Manual and the expected traffic experienced at the site. The nature of the facility is non-highway related, therefore the pavement design did not require the use of the Alaska Flexible Pavement Design Manual, however, the pavement is sufficient for the design equivalent single axle load of less than 10,000. The base course and subbase were both designed to provide support for the pavement and the geotextile fabric is proposed to prevent the movement of material between the structural section and existing ground.

The parking lot was designed with a 2% cross slope to provide adequate drainage. The improved structural section along with the improved drainage at the parking lot will prevent potholing and extend the life of the new structural section.

Boardwalk: The typical section along the boardwalk will include the following:

- 8’ wide surface, composed of 2-4' Fiber Glass Decking sections
- 2 – 4x4 Toe Boards
- 2 – 2x8 Joists connected

- 4x10 Beam supported by 2 Helical Piles

The surface of the boardwalk was chosen in order to create a light penetrating surface. The toe boards were put in place as a safety measure, as well as, to avoid having to implement handrails on the boardwalk, as it would not fit the aesthetic that we are aiming to create.

Memorial: The typical section of the memorial includes:

- 4" of Class A Concrete or Topsoil
- 4" of Aggregate Base Course Grading D-1
- 66" of Structural Fill
- Separation Geotextile Fabric

The structural section was chosen to provide adequate bearing capacity for the concrete memorial foundation and pad as well as preventing frost heave by replacing the poor fine-grained soil at the site with well graded material. The monument pad will measure 85' x 60' and the cross slopes will be 2% to provide adequate drainage.

The typical sections are provided in Appendix A.

4.0 BOARDWALK

For our boardwalk, our two most prominent concerns, were the ways in which the users would interact with the boardwalk, and how it would impact the surrounding environment. The boardwalk design was rooted 3 primary documents:

- 2010 ADA Standards for Accessible Design
    - This design reference guide impacted things, such as the maximum grade of our ramps, the maximum rise our ramps can have over a set distance, and the dimensions for our boardwalks surface.
- 2015 International Building Code
    - This reference guide primarily dictated our maximum elevation. We wanted to ensure that we would not be required to implement a handrail, as this would not fit the aesthetic that we aim to create. We were also concerned about the environmental impact it may have, by interrupting the natural path through the site.
- 2018 National Design Standards for Wood Construction
    - This design guide focused on our materials, and their respective properties and strengths. The choice to construct a timber boardwalk was rooted in the site itself. Our client, an environmentally conscious individual, will have limited resources for maintenance and operation, thus, the lower initial cost of timber was desirable. The choice for timber also had to do with the properties of the material, providing the required strength, while also not being as prone to the failures that plague steel and concrete boardwalks.

The boardwalk's structural section was analyzed in terms of allowable strength. Earthquake loads were not taken into consideration, due to the nature of the boardwalk, in which someone

can easily evacuate should there be a seismic event. For our live load, we reasoned that 50 psf would be sufficient, as it would be a fair representation of geometrical restrictions, along with site usage. Finally, based off of our clients limited resources, we went with a snow load of 60 psf, to account for regional snow loads and limited clearing abilities. Using these loads, and the information provided in the 2018 National Design Standards for Wood Construction, we were able to properly assess our material sizing.

4.1 Horizontal Alignment

The Horizontal Alignment of the boardwalk will align with the client's vision of creating a meandering trail through the wetlands. This was for three main reasons. The first reason is in relation to the planned memorial site for the Gold Star Monument, as it would allow those who are visiting the site the opportunity to contemplate and reflect through each turn. Our second reason was to provide a more grandiose reveal when a visitor finally has the opportunity to see the monument, rather than being able to see it from the parking lot. The third reason was to create a more natural approach to our boardwalk, rather than being a forceful linear path. The horizontal alignment also took into consideration things such as topography and was oriented accordingly to mitigate environmental impacts. The landscape of the site is relatively flat, until it nears the existing trail around Reflections Lake, in which it rises by 3’ - 4’ in some spots. It was important to find a tie in point that would have the smallest elevation change, as we wished to avoid earthwork in this regard.

4.2 Vertical Alignment

The Vertical Alignment of the boardwalk will serve to mitigate environmental impacts. One measure that will be put in place to meet this goal is to create an elevated boardwalk. This was done to also avoid possible impacts from any standing surface water that may exist in the site. The horizontal and vertical alignment combined to find a common route, in which no large cuts will need to be made to attain their purpose. The boardwalk elevation was also calculated as to avoid the need for a guardrail, which could be obstructive to the natural aesthetic desired. The vertical alignment was designed for the specifications listed in the 2010 ADA Standards, as well as the International Building Code.

5.0 DRAINAGE

The parking lot will be graded at a 2% cross slope with drainage trending towards Reflections Lake. The project will establish a flat bottom biofiltration swale with a longitudinal slope of 0.25% along the west and north ends of the parking lot, picnic, and restroom facilities pavement structure. The swale will output approximately 100 feet north of the project area into existing low-lying area to avoid direct stormwater discharge into the Knik River to the south. Existing drainage features at the site consist of a ditch on each side of the access road. The west ditch will tie directly into the biofiltration swale leg at the north end of the parking lot. The ditch on the east side of the access road and running along the length of the pavement structure will remain unchanged. Rainfall into the project area will be directed away from this ditch into the biofiltration swale by parking lot cross slope.

6.0 COST ESTIMATE

A summary of estimated project costs for the proposed improvements is shown below. A detailed construction cost estimate is included in Appendix D.

Table 1: Construction and Design Cost Estimate

PROJECT SUMMARY	BASIC BID (BB) TOTAL	$1,269,000
	PROJECT CONTINGENCY - 20% of BB	254,000
	DESIGN SERVICES - 5% of BB	64,000
	CONSTRUCTION ADMINISTRATION - 10% of BB	127,000
	PROJECT TOTAL	$1,714,000

7.0 ENVIRONMENTAL COMMITMENTS AND CONSIDERATIONS

The project is located within the Palmer Hay Flats State Game Refuge and has the potential to be within wetlands. Wetlands are incredibly important, because they help maintain water quality by slowly filtering excess nutrients, sediments, and pollutants, before water seeps into rivers, streams, and underground aquifers. Due to this, the necessary precautions must take place to ensure no negligent discharges occur that will harm the environment. It was identified by ADF&G that maintaining the site location environment is of upmost importance. Due to this the design of a biofiltration swale was performed to ensure no negligent discharges. This area also includes a variety of fish, plants, and wildlife, because of this many different permit applications must be completed before construction can begin. Draft Applications of the required permits can be found in Appendix C Environmental Permits.

7.1 Biofiltration Swale

Preserving the environmental aspects of a state game refuge is a primary consideration for drainage design in this project. A biofiltration swale was determined to be the best solution to treat stormwater runoff at a reasonable cost for a project area of this size (less than 1 acre). Benefits specific to this site include excellent pollutant filtering, trash interception, aesthetics, and water quality treatment.

Calculations used in the biofiltration swale design are outlined in the 2017 Anchorage Stormwater Manual. Runoff flowrate from the parking lot was determined at multiple locations using the Rational Method for the water quality design event of 0.12 inches per hour. Manning's equation was utilized to determine the ensuing flow velocity and a minimum channel length was determined to ensure a minimum hydraulic residence time of 5-9 minutes for storm water entering at any point along the parking lot boundary.

Vegetation for the biofiltration swale was determined by the Rational Method runoff flowrate value to ensure vegetation height remains higher than the depth of flow. Chosen vegetation also needs to be viable for the local climate, have a high filtering capacity, and low upkeep. Based off these conditions a mix of bering hairgrass, red fescue, and annual ryegrass was chosen to vegetate the swale.

7.2 Required Permitting

U.S. Army Corps of Engineers – Section 404 Permit
The USACE Section 404 Permit regulates the discharge of dredged or material into waters of the United States, including wetlands. Since the project is located within undisturbed ground a Preliminary Jurisdiction Determination (PJD) must be performed in the field with the U.S. Army Corps of Engineers (USACE) within the summer months. If it is determined that our project is located within wetlands, then a USACE Section 404 Permit must be completed. This process can take three to four months and must completed as early as possible.

Alaska Department of Fish & Game – Special Use Permit
Since the project is located within the Palmer Hay Flats State Game Refuge it is required to complete an Alaska Department of Fish & Game (ADF&G) Special Use Permit. Construction has the potential to impact fish, wildlife, or habitats, and the ADF&G Habitat Section develops management plans from these permits to oversee all activities located within State Game Refuges.

Municipality of Anchorage-Matanuska Susitna Borough Floodplain Permit
The project is split within both the Municipality of Anchorage (MOA) and the Matanuska-Susitna Borough (MSB), because of this it is required to complete floodplain permits for both governing agencies. These permits are required to ensure that proposed development projects will meet the requirements of the National Flood Insurance Program (NFIP) and the MOA/MSB floodplain management ordinance. NFIP was established by the National Flood Insurance Act of 1968 due to the need to offer primary flood insurance to properties with significant flood risk, and to reduce flood risk through the adoption of floodplain management standards. This allows for the transfer of some of the financial risk of property owners to the federal government and mitigates the nation's comprehensive flood risk through the development of floodplain management standards.

Alaska Department of Environmental Conservation Requirements
The Alaska Department of Environmental Conservation (ADEC) issues a Certificate of Reasonable Assurance for projects that involve runoff treatment systems, such as the biofiltration swale proposed in this project.

ADEC is also responsible for issuing the Approval to Construct and Approval to Operate wastewater systems such as the proposed vaulted toilet. The purpose of these approvals is to ensure the proposed system meets the minimum engineering standards associated with both State and Federal requirements. The approval to construct can take up to 30 days of review and must be initiated early in the project. Once the project has been substantially constructed the Approval to Operate must be requested by the registered engineer who is responsible for construction of

the facilities. After the review has been completed by ADEC, the Final Approval to Operate will be issued once the department receives satisfactory documentation the facility meets all requirements. The Certificate of Reasonable Assurance, Approval to Construct, and Approval to Operate requirements are initiated by submitting permit packages to ADEC.

Request for State Historic Preservation Office Section 106 Review
All publicly funded projects need the State Historic Preservation Office (SHPO) to review them for the potential to affect historic properties, this must be initiated by the governmental agency involved. The requirement can be fulfilled by requesting review from the SHPO by letter.

U.S. Fish and Wildlife Service Requirements
The project is located within an area that has a variety of wildlife and wildlife habitats. As a result, there is the potential for there to be Bald and Golden Eagles on the location. A survey would need to be performed in coordination with the U.S Fish and Wildlife Service (USFWS) to visually inspect whether there are eagle nests within 660 feet of the project location. If it has been determined that there are Eagle nests located within the project, an Eagle Take Permit must be completed. Another requirement is USFWS has a clearing window to avoid disturbing migratory birds' nests, all land disturbance must be completed within this clearing window of May 1-July 15.

8.0 MAINTENANCE CONSIDERATIONS

Maintenance will remain the responsibility of the Alaska Department of Fish & Game. The client specified that the department does not have a large budget for maintenance, therefore, the design was focused on providing long-lasting facilities and minimizing future maintenance costs. Throughout the project, separation geotextile fabric will be used to inhibit the movement of material and the migration of fines into and out of the structural section. At the parking facility maintenance efforts will be reduced through construction of an improved structural section that will reduce frost heave and conveying water away from the parking lot to prevent potholing. Drainage from the parking lot will be conveyed away from the parking lot to the lowlands north of the site through the proposed biofiltration swale which will have very minimal maintenance requirements. The proposed elevated boardwalk will reduce maintenance costs by installing helical piles. This option will reduce maintenance efforts compared to an on-grade walkway which would suffer from the high-water table and poor soil conditions at the site. The memorial features a foundation design that will account for the poor soil conditions and high water table at the site.

9.0 CONCLUSION

The Knik River Access: Palmer Hay Flats SGR project will improve the existing parking and signage while adding public restrooms, covered picnic facilities, an information kiosk, a Gold Star Families Memorial Monument, and an elevated boardwalk connecting these new facilities to the existing Reflections Lake hiking trail. These improvements will increase public awareness and access opportunities to the Palmer Hay Flats State Game Refuge.

The proposed design addresses the objectives listed by the client by improving facilities to meet user demand, encourage use from motorists traveling along the adjacent Glenn Highway, and

create awareness and stewardship for the site. Adding a paved parking lot, elevated boardwalk, Gold Star Memorial Monument, and facility amenities like a public restroom, orientation kiosk, and picnic shelter add to the appeal of the site and provide current users the amenities they require. This will also take pressure off the existing Reflections Lake Trailhead that is often at maximum capacity during summer months.

The addition of the public restroom and orientation kiosk could also serve as important features in the use of the site as a rest stop. Travelers could stop to make use of the restroom facility and the proximity to the orientation kiosk will allow people new to the Palmer Hay Flats SGR the opportunity to learn more about the site. The implementation of the Gold Star Monument creates awareness and stewardship for the site by adding a meaningful connection for Gold Star Families and other veterans and their families. Instead of being a recreational-only site, the monument expands what the site means for all Alaskans, especially those who have lost their servicemembers. The project will also reduce congestion along the frontage road through the expansion of the parking lot. Furthermore, by developing the improved facilities as described the primary user's expectations will be met and ADF&G's goals will be accomplished.

REFERENCES AND DESIGN STANDARDS

- A Policy on Geometric Design of Highways and Streets (PGDHS or "Green Book"), 6th Edition, American Association of State Highway and Transportation Officials (AASHTO), 2011.
- Alaska Highway Preconstruction Manual (HPCM), DOT&PF, 2005 as amended.
- ADA Standards for Accessible Design, United States Department of Justice, 2010.
- Alaska Highway Drainage Manual, Alaska Department of Transportation and Public Facilities, 2006
- Anchorage Stormwater Manual, Project Management and Engineering Department, 2017
- Biofiltration Swale Design Guidance, Caltrans, 2012
- International Building Code (IBC), International Code Council (ICC), 2015.
- Manual on Uniform Traffic Control Devices (MUTCD), United States Department of Transportation (US DOT), FHWA, 2009.
- National Design Specification for Wood Construction (NDS), American Wood Council, 2018.

APPENDIX A

Typical Sections

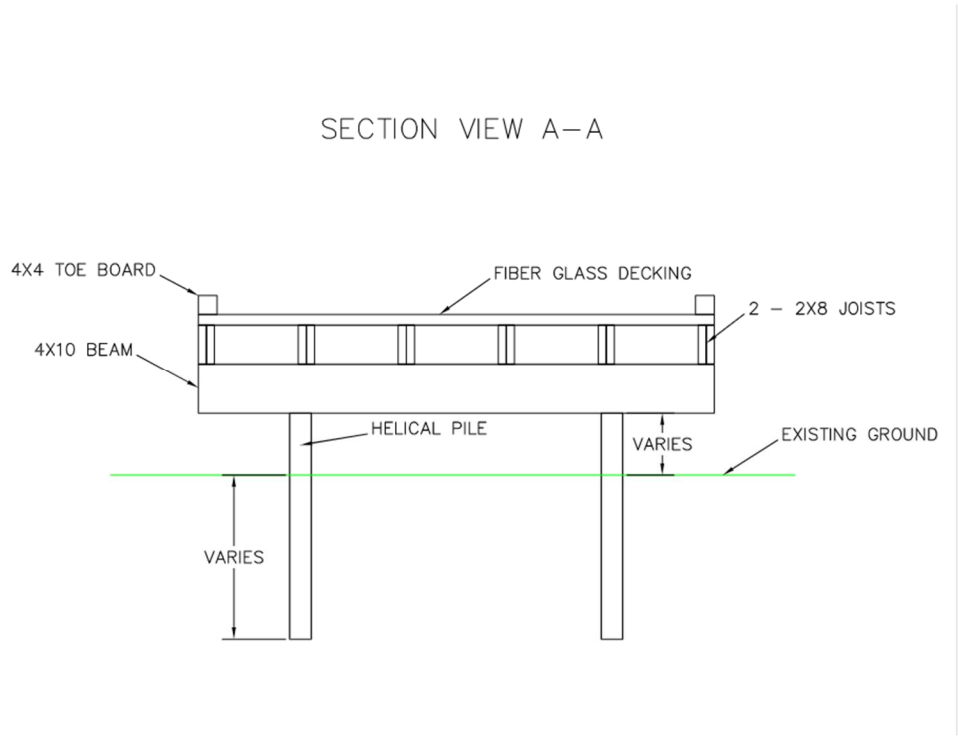

Figure 3: Typical Section for Boardwalk

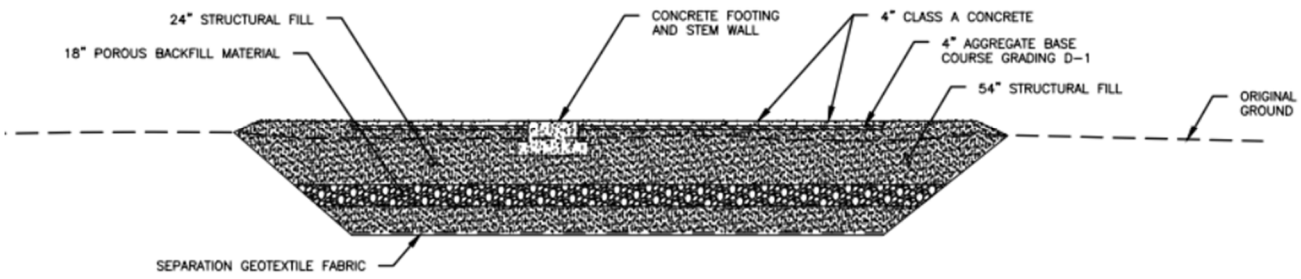

Figure 4: Typical Section for Gold Star Families Memorial Monument

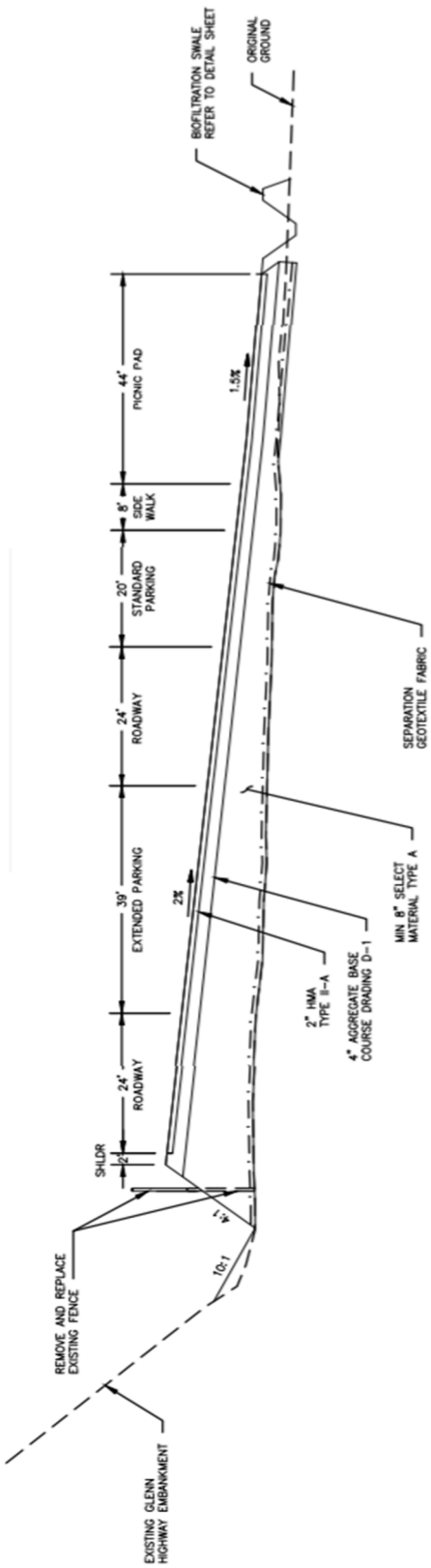

Figure 5: Typical Section for Parking Lot

APPENDIX B

Geotechnical Data

Geotechnical Report
Reflections Lake Pedestrian Bridge
Wasilla, Alaska

April 2009

SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Excellence. Innovation. Service. Value.
Since 1954.

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32-1-02038

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GEOTECHNICAL REPORT
REFLECTIONS LAKE PEDESTRIAN BRIDGE
WASILLA, ALASKA

1.0 INTRODUCTION

This report presents the results of our subsurface explorations, laboratory testing, and geotechnical engineering analyses for a proposed pedestrian bridge at Reflections Lake in Wasilla, Alaska. The purpose of this geotechnical study was to assist the State of Alaska Department of Fish and Game with the foundation design of a pedestrian bridge to be located along the proposed loop trail around Reflections Lake near Knik River. Presented in this report are descriptions of the site and project, subsurface exploration and laboratory test procedures, subsurface conditions, and our geotechnical recommendations for the proposed new structure.

Authorization to proceed with this work was received in the form of Delivery Order Number 11-J-106-09 signed by Mr. Chris Lewis, Procurement Specialist, dated March 19, 2009. Our work was conducted in general accordance with our March 18, 2009 cost estimate.

2.0 SITE AND PROJECT DESCRIPTION

The project area is located at Milepost 30.6 (Knik River Access exit) on the Glenn Highway in the Palmer Hay Flats Refuge near Wasilla, Alaska. Based on the USGS Anchorage B-7 NE Quadrangle map, this site is located in Section 10, Township 16 North, Range 1 East, Seward Meridian. A vicinity map is included as Figure 1.

The site is currently used for a variety of recreational activities and at the time of our explorations was covered with snow. The new bridge is expected to span an exit slough for Reflections Lake, and will provide access to a proposed loop trail around the lake. It is our understanding that the bridge may be approximately 104 feet long and 12 feet wide. We understand that the design of this bridge will not be in strict accordance with the July 2004 *Guide for the Planning, Design, and Operation of Pedestrian Facilities published by the American Association of State Highway and Transportation Officials*. Specifically we understand that the available construction budget was not sufficient to construct a deep foundation that may be needed to mitigate seismically-induced settlement of the structure. We also understand that scour is not being considered in the design of the structure. Our study was therefore tailored to meet these constraints.

3.0 SUBSURFACE EXPLORATIONS

Subsurface explorations consisted of advancing and sampling two borings at the site on March 23, 2009. One boring was located near each end of the proposed bridge abutment locations, which had been staked by others prior to our explorations. Boring locations were selected for proximity to staked locations and accessibility. The borings were advanced to depths of approximately 50.5 to 51.5 feet below the ground surface (bgs). The approximate locations of the borings are presented in Figure 2.

The soils that were encountered were visually classified in the field according to the Unified Soil Classification System, which is presented in Figure 3, and later verified through laboratory analysis. Frost classifications were determined for the soil types based on laboratory evaluation and are shown with grain size classification results on the boring logs. The frost classification system is presented in Figure 4.

Drilling services for this project were provided by Discovery Drilling of Anchorage, Alaska, using a track mounted CME 850 drill rig. The borings were advanced with 3-1/4-inch inner diameter continuous flight hollow-stem augers. An experienced geologist from our firm was present continuously during drilling to observe drill action, collect samples, log subsurface conditions, and observe groundwater. At the completion of each boring, cuttings removed during the drilling activity were used to backfill the hole.

As the borings were advanced, samples were typically recovered with a 2-inch outer diameter (OD) split spoon sampler using Standard Penetration Test (SPT) Procedures. In this test, samples were recovered by driving the sampler into the bottom of the advancing hole with blows of a 140-hammer free falling 30 inches onto the drilling rod. The number of blows required to advance the sampler the final 12 inches of a total 18-inch penetration is termed the Penetration Resistance, which was recorded for each sample. These values are shown graphically, on the boring logs adjacent to the sample depth. The values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. Bulk samples of auger cuttings were also collected in the top 2 to 3 feet of each boring to characterize the near surface soils.

Boring locations shown on Figure 2 were established with a hand held global positioning system (GPS) with approximately 25 feet of horizontal accuracy. Surface elevations on the boring logs

were estimated relative to each other. The boring locations and elevations included in this report should therefore be considered approximate.

4.0 LABORATORY TESTING

Laboratory tests were performed on select samples recovered from the borings to confirm our field classifications and to estimate the index properties of the typical materials encountered at the site. The laboratory testing was formulated with emphasis on determining the materials gradation properties, in situ water content, frost characteristics, and compaction characteristics. This data plus estimated strength and density properties determined from Standard Penetration tests provided information used in formulating our recommendations.

Water content tests were performed on samples collected from the borings above the water table. These tests were generally conducted according to procedures described in ASTM-International (ASTM) method D-2216. The results of the water content measurements are presented graphically on the boring logs in Figures 5 and 6.

Grain size classification tests were conducted to confirm the field classification of the soils encountered. The gradation testing generally followed mechanical sieve procedures described in ASTM D-422. The grain size testing results are presented on Figure 7 and summarized on the boring logs as percent gravel, percent sand, and percent fines.

In addition, tests were conducted to estimate the amount of material passing the Number 200 sieve (P-200) on soils encountered. These tests were performed in general accordance with ASTM D-1140. The P-200 test provides an estimate of the fines (silt and clay) content. The results of these tests are presented on the boring logs on Figures 5 and 6 and shown as percent fines.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions are presented on the boring logs in Figures 5 and 6. In general, the material encountered in the borings consisted of silty sand over silt and clean to slightly silty sand.

In Borings B-1 and B-2, we encountered approximately 2 to 4 feet of slightly gravelly to gravelly, silty sand containing 25 percent fines by weight at the surface. Frozen soil depths were estimated at approximately 1 foot bgs. Below this, we found medium stiff to stiff silt with varying amounts of sand. Fines content for this unit, as tested in our laboratory, ranged from 95 to 97 percent by

weight. Blow counts ranged from 4 to 11 blows per foot and moisture contents ranged from 15 to 34 percent. Beneath the silt, we encountered loose sand with varying amounts of silt and gravel. Blow counts ranged from 5 to 10 blows per foot and fines content for the sample tested was approximately 6 percent. Beneath the loose sand, we found medium dense to very dense, clean, gravelly sand to the bottom of the holes. Fines content for the samples tested was approximately 3 percent.

Ground water was encountered at approximately 7.5 feet bgs in Boring B-1 and at approximately 20 feet bgs in Boring B-2 during drilling. Ground water levels may vary seasonally and should be considered approximate.

6.0 SEISMIC CONDITIONS

According to the 2006 International Building Code (IBC), the site class for the subsurface conditions described above in the proposed bridge footprint would be F due to the potentially liquefiable sands encountered in the boring. Liquefaction of loose, saturated, cohesionless soils due to seismic loading has been studied over the past 35 years, resulting in methods based on both laboratory and field procedures to evaluate liquefaction potential. The most widely used methods are empirical, and based on correlations between Standard Penetration Test (SPT) resistance (N-value), peak ground acceleration (PGA), and earthquake magnitude. Ground motions at the site, in the form of PGA, were estimated from probabilistic seismic hazard analyses (PSHA) performed by the USGS (Frankel et al., 1996).

We used three methods to evaluate liquefaction potential at this site:

Youd et al. (2001)
Seed et al. (2003)
Idriss and Boulanger (2004)

An important factor in evaluating liquefaction potential is the fines content (percent of soil by weight smaller than 0.075 millimeter [mm] or a No. 200 sieve) of the soil deposit. We performed grain size analyses and fines content tests to measure the fines content of the subsurface soils at the site. Where we did not perform laboratory tests, we visually estimated the fines content.

We performed our liquefactions analyses for an earthquake of magnitude 9.2 and a soil PGA of 0.30g. These seismic parameters are representative of a 2 percent probability of exceedence in 50 years (2,475-year return period) adjusted for pseudo-static analysis.

Liquefaction is generally associated with loose, saturated, cohesionless soils. The methods above are specifically intended for cohesionless soils, which are generally granular in nature. However some fine-grained soils exhibit cohesionless or "sand-like" behavior. Soft, cohesive soil layers may be subject to strength loss from ground shaking; however, if they exhibit cohesionless behavior, they could be considered "liquefiable." Seed et al. (2003) and Boulanger and Idriss (2006) provide recommendations to evaluate whether a fine-grained soil is liquefiable. Their recommendations are based on experimental research and liquefaction field case studies.

We analyzed the liquefaction potential at each boring location using the ground motion parameters defined above. The analyses show that the soils beneath the site generally have a factor of safety (FS) less than 1.0 against liquefaction given the assumed seismic event. Each boring has a zone of potentially liquefiable sand immediately beneath the silt and approximately 10 to 15 feet thick.

Densification of the site soils above and below the water table may occur when subject to earthquake shaking, resulting in potential ground settlement at the site. We used the relationship by Tokimatsu and Seed (1987) and Pradel (1998), relating earthquake ground motion and penetration resistance with volumetric strain, to estimate the magnitude of ground settlement that may occur at the site. The relationships estimate total ground settlements on the order of six inches to one foot at the ground surface for the ground motions assumed in our liquefaction analyses. Differential settlements will likely be limited to about ½ of the total seismic settlement over the width of the bridge foundation.

Greater settlements may occur during liquefaction for areas where the bottoms of the footings are established directly above or within liquefiable soil layers. Footings could "punch" through liquefiable layers and displace liquefiable soils upward (with boiling) or laterally. The magnitude of settlement associated with "punching" is difficult to quantify, but depending on the seismic event and weight of the bridge, could be on the order of 1 to 3 feet.

7.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

The proposed pedestrian bridge will consist of a single-span structure to span the existing body of water and connect the trail. Some areas of loose sand were encountered during our

explorations. We believe that loose to medium dense sands beneath the water table at this site are locally susceptible to liquefaction under seismic loading, it is our opinion that if it occurs, the effects may include sand boiling, localized differential settlement, and/or lateral spreading in the direction of the lake or slough.

To prevent this seismically induced settlement, a deep foundation (such as driven piles) would need to be founded beneath the liquefiable soil and be designed to resist the loads imposed by the bridge and down drag forces imposed by the liquefaction. We understand that the budget for construction is limited and that the preferred foundation for the bridge abutments is shallow spread footings and stem walls. The medium stiff to stiff silt and loose sand in the two borings reveal similar support conditions. In our opinion these conditions are generally suitable for shallow foundations. Our recommendations assume static loading conditions and do not account for potential influence from liquefaction and/or soil strength loss during a seismic event.

7.1 Bridge Foundation

Design of footings for bridge abutments must consider the bearing support capabilities of the soils, and the amount of settlement or frost heave that can be tolerated. To estimate frost penetration at the site, we used the one-dimensional finite element computer program, Berg2. The program accepts climatic and soils/materials thermal data and calculates frost and thaw penetrations. The climatic conditions assumed in our analysis are based on data from Anchorage and should be applicable to the site. The soil profile used in our thermal analysis is built on the assumed foundation configuration described below. Allowing Berg2 to analyze frost depth under these input conditions, we estimate that seasonal frost will penetrate an average of approximately 9 feet.

The soils encountered in our borings are susceptible to frost action (F3 to F4 frost classification) in the zone of active frost penetration. Because of this condition, we recommend that the footings extend at least 10 feet below final grade. The embedment depth applies to the cover over the abutment footing on the downslope side of the bridge abutment where the soil slopes down to the trail at 2 horizontal to 1 vertical permanent slopes.

Alternately, if two-inches of insulation are placed two feet below grade, the bottom of footing can be completed at five feet below final grade. The embedment depth applies to the cover over the abutment footing on the downslope side of the bridge abutment where the soil slopes down to the trail at 2 horizontal to 1 vertical permanent slopes. The insulation is assumed to consist of

extruded polystyrene (blueboard) insulation with a thermal resistance (R-value) of 4.5 per inch thickness.

This frost protected configuration was also checked using the American Society of Civil Engineers (ASCE) October 2005 *Design and Construction of Frost-Protected Shallow Foundations*. Considering the environmental input parameters, the recommended configuration provides frost protection to satisfy the ASCE criteria for an unheated foundation. For lateral protection, the insulation layer should extend a minimum of 6 feet beyond the edge of the footings.

The bottom of excavation should be proof rolled and then probed by a qualified geotechnical engineer to evaluate the subgrade for locally loose or compressible soils. We recommend a 1 foot subcut below footing grade to prepare the site for foundations if silt is encountered at the footing depth. The excavation should be backfilled with non-frost susceptible (NFS) structural fill and compacted to at least 95 percent of the modified Proctor optimum dry density (ASTM D-1557). We recommend that Selected Material Type A classified material compacted to this criteria is also used to backfill the foundation excavations and develop the permanent slopes needed under the bridge. Under this condition, footings should be designed for an allowable bearing pressure of not more than 2,000 pounds per square foot (psf) for footings embedded at 10 feet below the ground surface (bgs) or 1,500 psf for footings embedded at 5 feet bgs. The minimum width of footings shall be 2 feet for both embedment depths. This bearing pressure may be increased by one third for short-term wind loading.

The above minimum depth provides some frost protection limiting seasonal heaving and gives lateral resistance for bridge imposed lateral loads. It is possible that footing embedments greater than the minimum may be necessary to achieve suitable lateral resistance. Lateral earth pressures for evaluating footing embedment are provided in a subsequent Section 7.6.

7.2 Uplift Resistance

The uplift resistance of a footing foundation can be estimated by summing the dead weight of the footing, the weight of the soil within a zone described by a vertical surface extending upward from the horizontal limits of the footing, and the shearing resistance of the soil across this surface. Assuming Selected Material Type A is used to backfill above the footings using the placement and compaction requirements outlined in Section 7.5, the density of the soil resisting uplift should be at approximately 130 pounds per cubic foot (pcf) for soil above the seasonal high

water table. Lastly, shearing resistance can be calculated using a frictional resistance of about 36 degrees for densely compacted imported fill.

7.3 Static Settlements

The magnitudes of the static settlements that will develop at the bridge site are dependent upon the applied loads, the density of the support material, and the care with which structural fills are placed and compacted. Compaction recommendations and procedures are described in Section 7.5; these recommendations should be strictly adhered to for best results. We estimate that total maximum settlements will be about 1 inch or less with differential settlements being about 1/2 of the total settlements over a distance of 30 feet. The greatest amount of settlement should occur during construction, essentially as fast as the loads are applied, such that long term static settlements should be relatively small and well within tolerable limits. It is estimated that long term static settlements should be about 1/4 inch or less.

7.4 Construction Drainage

Groundwater was encountered in our borings during field activities, so water may be encountered during excavation work. Because the water was found during drilling in the loose sand at the site, it is our opinion that dewatering with sumps and pumping equipment should only be used to draw the water level down one to two feet from the static level. If more drawdown is needed to construct the foundations a dewatering system with well points should be used to reduce the potential for running ground and quick bottom conditions. A dewatering plan prepared by a professional engineer or hydrogeologist should be prepared prior to dewatering more than one or two feet below the static water level.

The ground around open excavations should be contoured to direct surface water around the excavations. The excavation and backfilling work should be closely coordinated such that seepage and surface runoff is not allowed to collect and stand in open trenches for long time periods. Seepage from the excavation walls may cause local running or sloughing of the soil, which may require shoring depending on the excavation slope angles and depth of the excavations. Exposed silty soils should be protected from additional moisture during construction as they are likely moisture sensitive and may lose significant strength if saturated.

7.5 Structural Fill

Backfill will be required in the footing excavation and behind the stem walls. Classified structural fill placed in these areas should be clean, granular soil to provide drainage and frost protection. These soils should contain less than about six percent (by weight, based on the minus

3/4-inch portion) passing the No. 200 sieve. Selected Material Type A material as defined by the Alaska Department of Transportation & Public Facilities (ADOT&PF) meets these requirements. Generally, these soils may be placed using moisture density control in both wet and dry conditions. The on-site silty soils in general do not meet the gradation requirements for classified fill as shown on Figure 8.

Classified structural fills should be placed in lifts not to exceed 10 to 12 inches loose thickness and compacted to 95 percent of the maximum density as determined by the Modified Proctor compaction procedure (ASTM D-1557). During fill placement, we recommend that cobbles or boulders with dimensions in excess of 2/3 of the layer thickness be removed from structural fills. We recommend that our services be retained to inspect the quality of fill compaction during construction.

When backfilling within 18 inches of the stem walls where the wall is not supported on both sides, material should be placed in layers not to exceed six inches loose thickness and densely compacted with hand operated equipment. Heavy equipment should not be used as it could cause increased lateral pressures and damage walls.

7.6 Lateral Earth Pressures

Design of buried shallow footings/stem walls should consider the lateral earth pressures that may be imposed or resisted by the soil. We have calculated the following lateral pressures (expressed as equivalent fluid pressures) which, in our opinion, are suitable for design of these structures. The magnitude of the pressure is dependent on the method of backfill placement, the type of backfill material, drainage provisions, and whether the wall is permitted to deflect after or during placement of backfill. For the earth pressures provided herein, we assume that footing trenches will be backfilled with a free-draining structural fill (such as Selected Material Type A material) and groundwater levels will naturally remain below the footing level.

If the walls are allowed to deflect laterally or rotate an amount equal to about 0.001 times the height of the wall, an active earth pressure condition under static loading would prevail and an equivalent fluid weight of 35 pounds per cubic foot (pcf) is recommended for design of the walls. To simulate seismic loading, at-rest and active earth pressures should be increased with a uniformly distributed, rectangular pressure prism of 14 pounds per square foot per foot of wall length. For rigid walls that are restrained from deflecting at the top, an at-rest earth pressure condition would prevail and an equivalent fluid weight of 55 pcf is recommended.

Lateral forces from wind or seismic loading may be resisted by passive earth pressures against the sides of footings. These resisting pressures can be estimated using an equivalent fluid weight of 250 pcf. This value includes a factor of safety of at least 1.5 on the full passive earth pressure to limit deflections. The ultimate passive earth pressure is reduced during earthquake conditions but will still exceed the 250 pcf allowable pressure so there will be no loss of lateral resistance.

Lateral resistance may also be developed in friction against sliding along the base of foundations. These forces may be computed using a coefficient of 0.4 between concrete and soil.

8.0 CLOSURE/LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The analyses, conclusions and recommendations contained in this report are based on site conditions as they presently exist. It is assumed that the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

If, during construction, subsurface conditions different from those encountered in these and prior explorations are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed and recommendations can be reconsidered where necessary. If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

We recommend that we be retained to review those portions of the plans and specifications pertaining to earthwork and foundations to determine if they are consistent with our recommendations. In addition, we should be retained to observe construction, particularly the compaction of structural fill, preparation of spread footing foundations and installation of shoring and site excavations, and also to make field measurements of ground displacements and such other field observations as may be necessary.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some

contingency fund is recommended to accommodate such potential extra costs. Shannon & Wilson has prepared the attachments in Appendix A *Important Information About Your Geotechnical/Environmental Report* to assist you and others in understanding the use and limitations of the reports. We appreciate this opportunity to be of service. Please feel free to contact the undersigned with questions or comments concerning the contents of this report.

Sincerely,

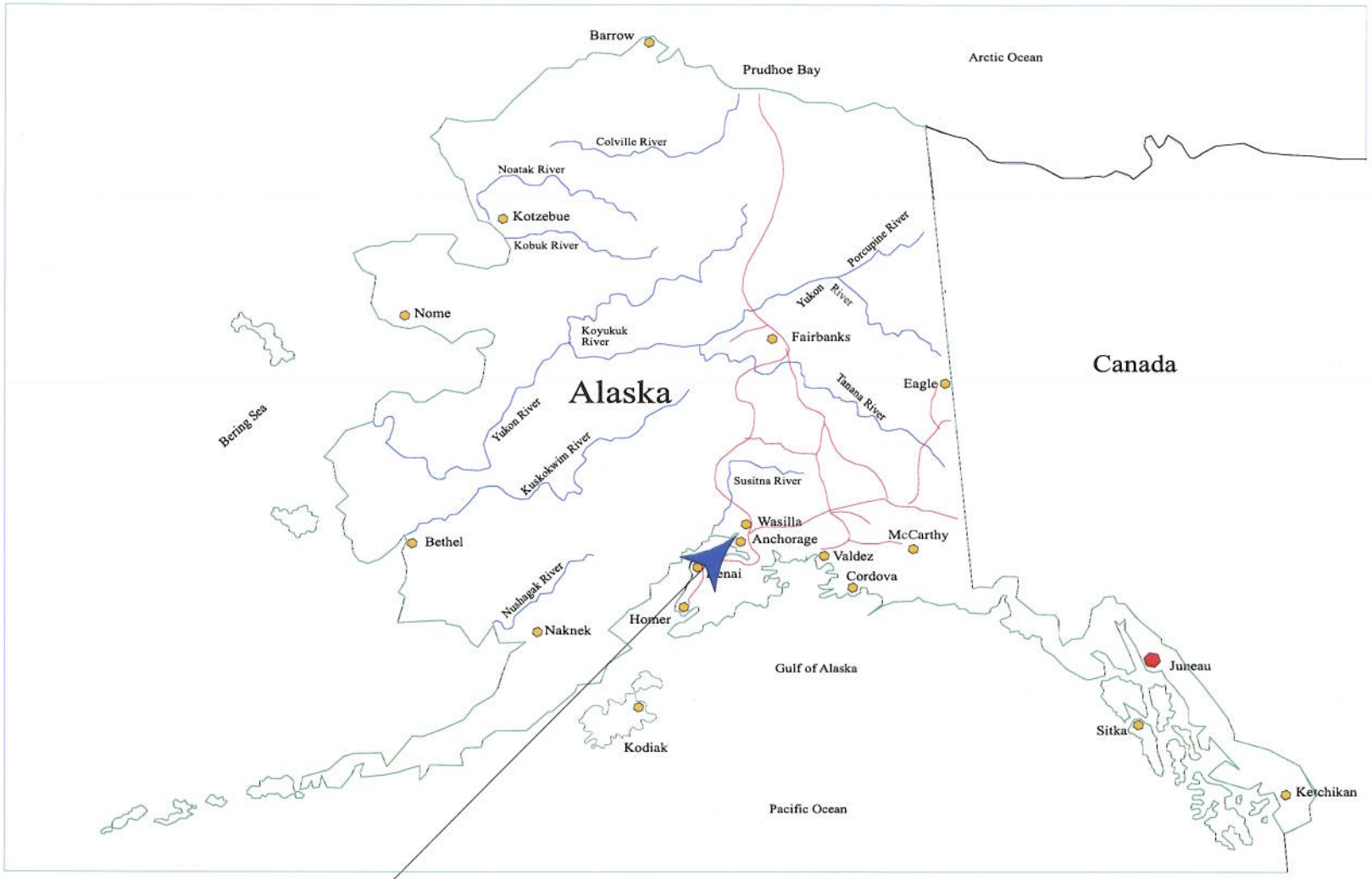
SHANNON & WILSON, INC.

Prepared by:

Katra Wedeking
Geologist III

Approved by:

Kyle Brennan, P. E.
Associate



Reflections Lake Pedestrian Bridge
Wasilla, Alaska

VICINITY MAP

April 2009

32-1-02038

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Fig. 1

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth Mapping Service

LEGEND

B-1 Approximate location of Boring B-1, by Shannon & Wilson, March 2009

N

REFLECTIONS LAKE PEDESTRIAN BRIDGE
WASILLA ALASKA

SITE PLAN

APRIL 2009 32-1-02038

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FIG. 2

Unified Soil Classification System

GROUP NAME Criteria for Assigning Group Names and Group Symbols			Soil Classification Group Symbol with Generalized Group Descriptions	
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	Clean GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded Gravels
		GRAVELS with fines More than 12% fines	GM	Gravel & Silt Mixtures
			GC	Gravel & Clay Mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	Clean SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Poorly-graded Sands
		SANDS with fines More than 12% fines	SM	Sand & Silt Mixtures
			SC	Sand & Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less	INORGANIC	ML	Non-plastic & Low-plasticity Silts
			CL	Low-plasticity Clays
		ORGANIC	OL	Non-plastic and Low-plasticity Organic Clays Non-plastic and Low-plasticity Organic Silts
	SILTS AND CLAYS Liquid limit greater than 50%	INORGANIC	CH	High-plasticity Clays
			MH	High-plasticity Silts
		ORGANIC	OH	High-plasticity Organic Clays High-plasticity Organic Silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat

Organic Content

Adjective	Percent by Volume
Occasional	0-1
Scattered	1-10
Numerous	10-30
Organic	30-50, minor constituent
Peat	50-100, MAJOR constituent

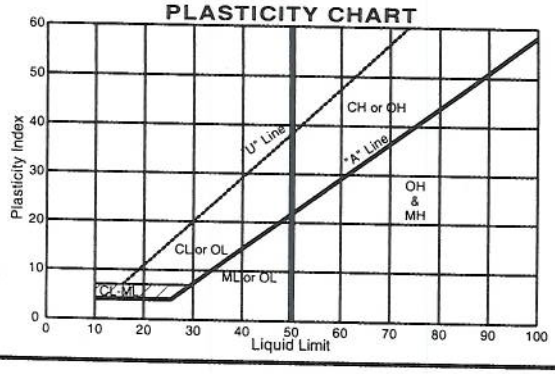
Descriptive Terminology Denoting Component Proportions

Description	Range of Proportion
Add the adjective "slightly"	5 - 12%
Add soil adjective[(a)]	12 - 50%
Major proportion in upper case, (e.g., SAND)	>50%

(a) Use gravelly, sandy, or silty as appropriate

NOTE: The soil descriptions used in the boring logs lists constituents from smallest percentage to largest percentage.

PLASTICITY CHART



Reflections Lake Pedestrian Bridge
Wasilla, Alaska

SOIL CLASSIFICATION LEGEND

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Fig. 3

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FROST CLASSIFICATION

(after Municipality of Anchorage)

GROUP		P-200	USC SYSTEM
NFS	Sandy Soils	0 to 3	SW, SP
	Gravelly Soils	0 to 6	GW, GP, GW-GM, GP-GM
F1	Sandy Soils	3 to 6	SW, SP, SW-SM, SP-SM
	Gravelly Soils	6 to 13	GM, GW-GM, GP-GM
F2	Sandy Soils	6 to 19	SP-SM, SW-SM, SM
	Gravelly Soils	13 to 25	GM
F3	Sands, except very fine silty sands*	Over 19	SM, SC
	Gravelly Soils	Over 25	GM, GC
	Clays, PI>12		CL, CH
F4	All Silts		ML, MH
	Very fine silty sands*	Over 19	SM, SC
	Clays, PI<12		CL, CL-ML
	Varved clays and other fined grained, banded sediments		CL and ML CL, ML, and SM; SL, SH, and ML; CL, CH, ML, and SM

P-200 = Percent passing the number 200 sieve

* Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

Reflections Lake Pedestrian Bridge
Wasilla, Alaska

FROST CLASSIFICATION

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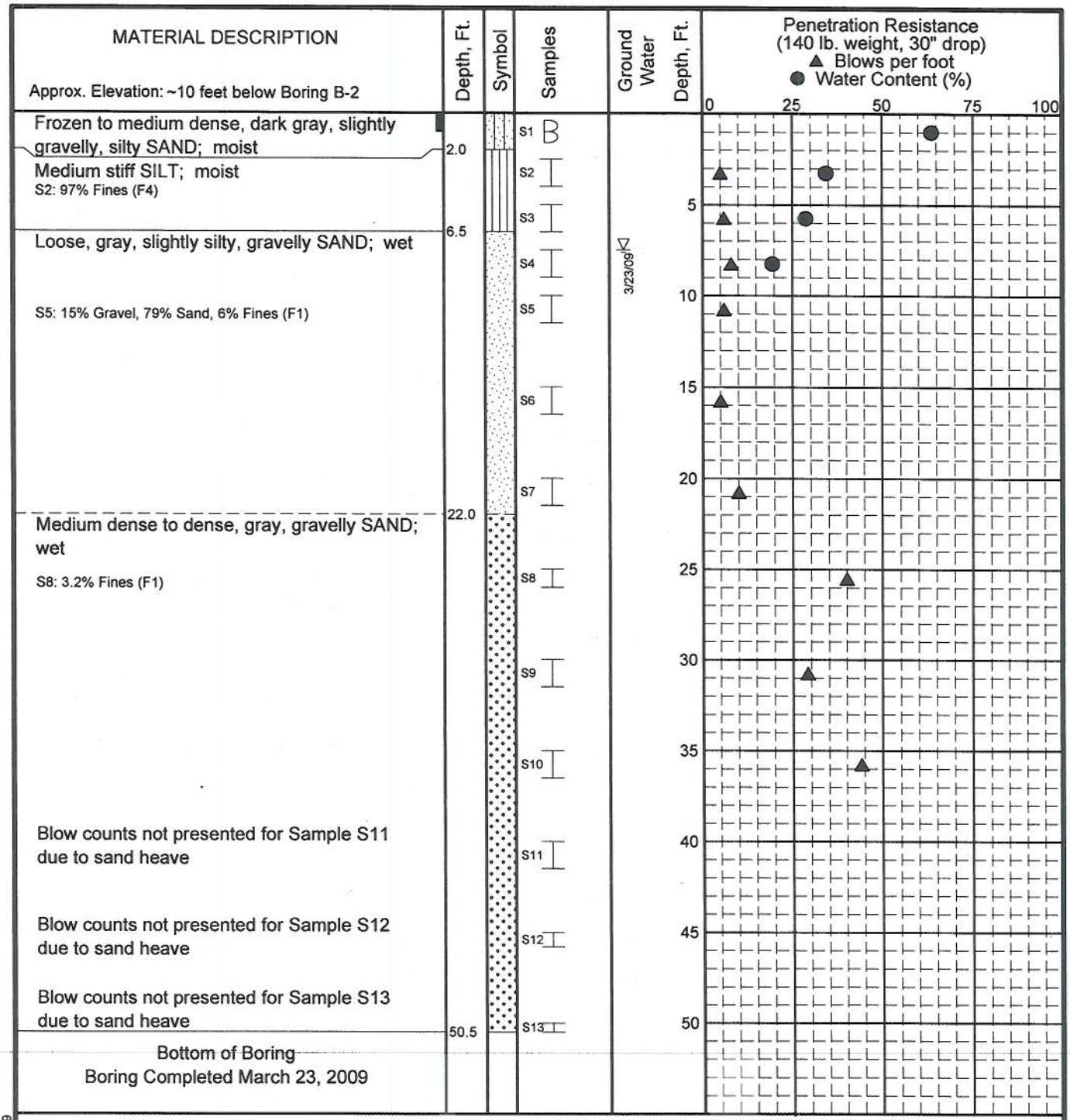
Fig. 4



LEGEND

* Sample Not Recovered
B Auger Cuttings
2" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
● Water Content (%)
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Reflections Lake Pedestrian Bridge
Wasilla, Alaska

LOG OF BORING B-1

April 2009 32-1-02038

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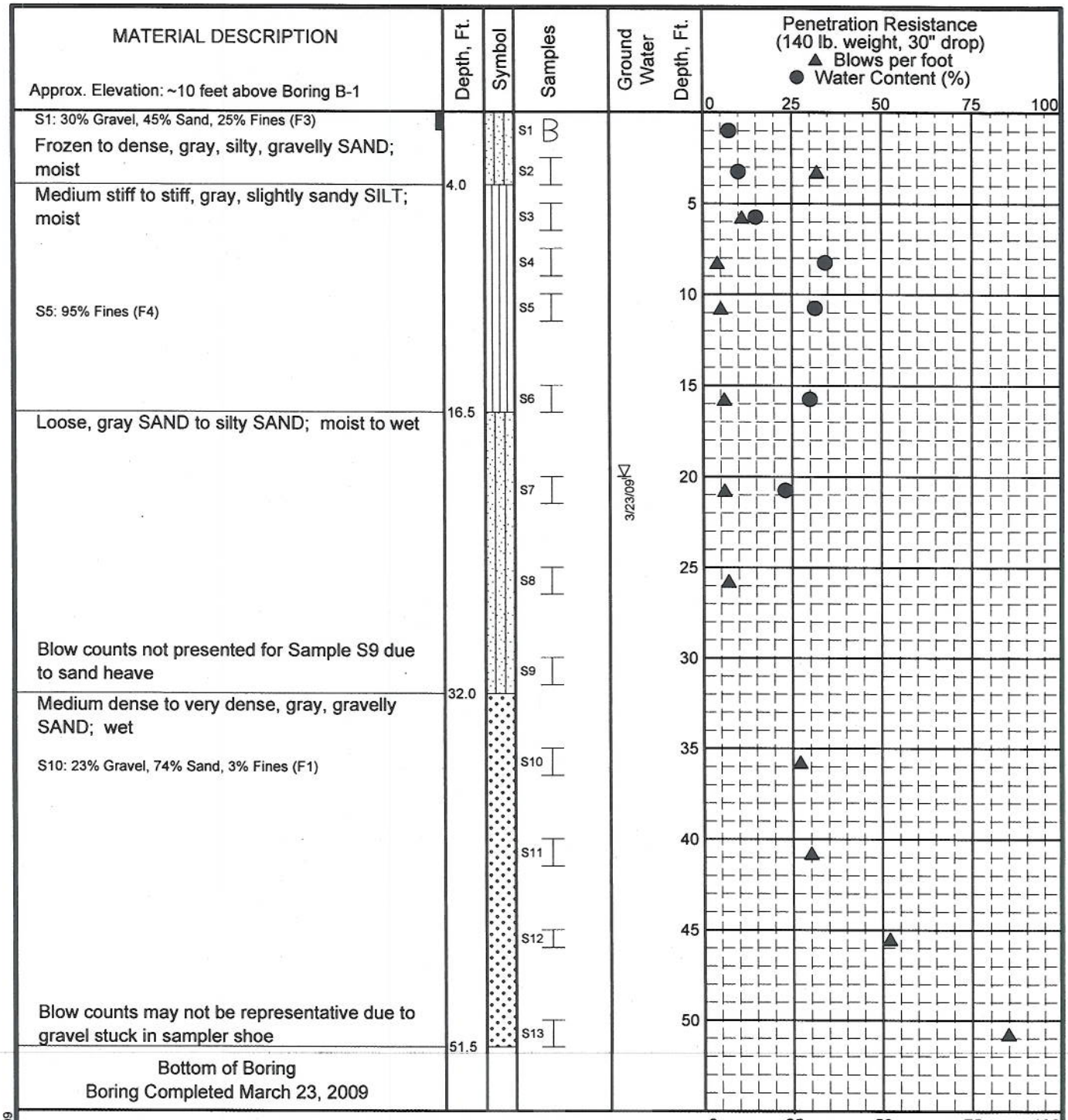
Fig. 5

GEOTECHNICAL LOG 02038 GINT.GPJ S&W GEO1.GDT 4/29/09



LEGEND

* Sample Not Recovered
B Auger Cuttings
2" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
● Water Content (%)
Plastic Limit — Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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Wasilla, Alaska

LOG OF BORING B-2

April 2009 32-1-02038

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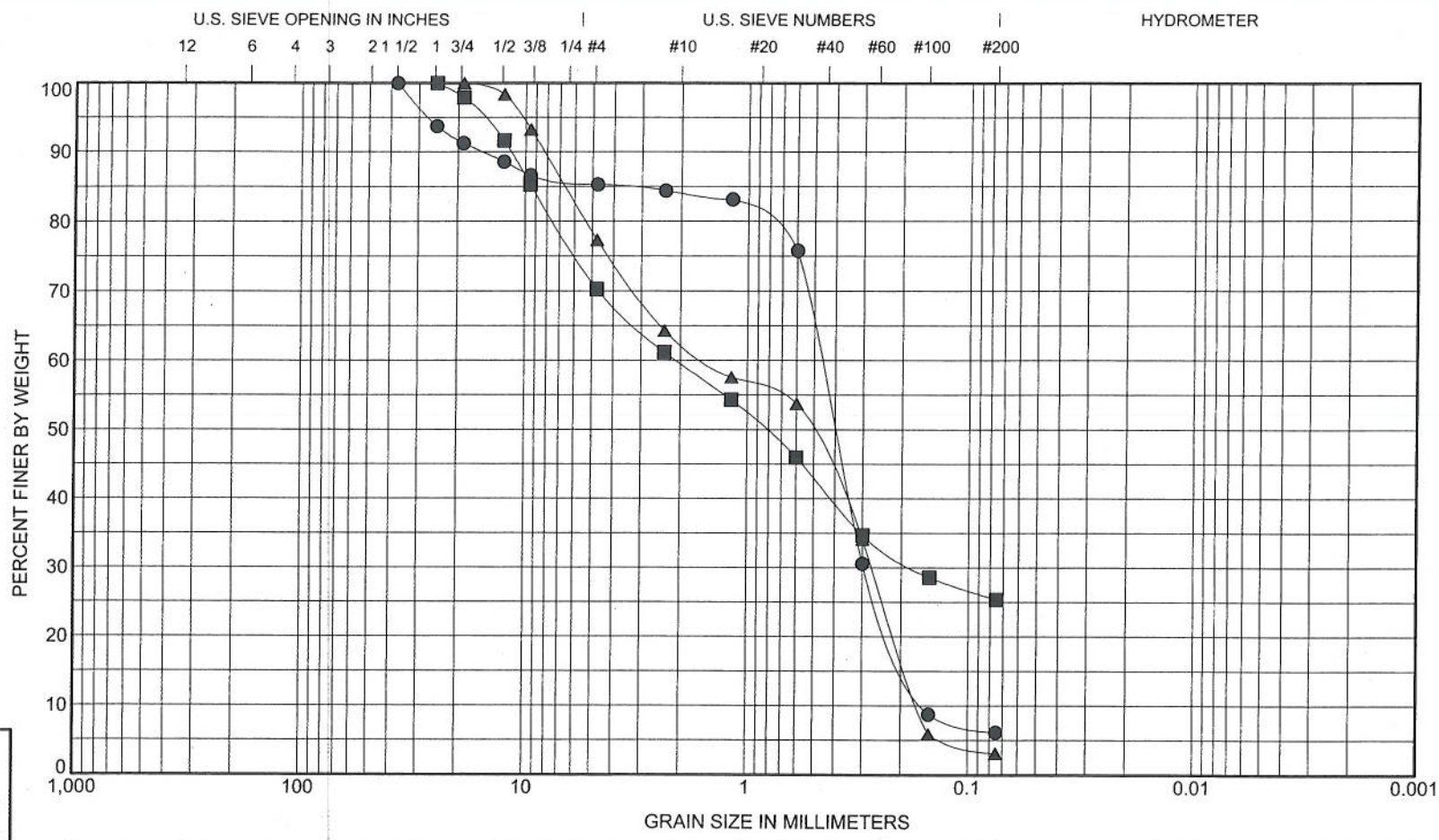
Fig. 6

GEOTECHNICAL LOG 02038 GINT.GPJ S&W GEO1.GDT 4/29/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
● B-1 S5	10.0 - 11.5	Slightly silty, gravelly SAND (SP-SM)				1.2	3.0
■ B-2 S1	0.0 - 2.0	Silty, gravelly SAND (SM)					
▲ B-2 S10	35.0 - 36.5	Gravelly SAND (SP)				0.3	9.1

Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1 S5	10.0 - 11.5	37.5	0.47	0.29	0.16	15	79	6	
■ B-2 S1	0.0 - 2.0	25	2.1	0.18		30	45	25	
▲ B-2 S10	35.0 - 36.5	19	1.52	0.27	0.17	23	74	3	

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GRAIN SIZE CLASSIFICATION

April 2009

32-1-02038

Reflections Lake Pedestrian Bridge
Wasilla, Alaska

Fig. 7
Sheet 1 of 1

GRADATION AND DURABILITY REQUIREMENTS

After: Alaska Department of Transportation
Standard Specifications for Highway Construction

D1

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
1 in.	25 mm	100
3/4 in.	19 mm	70 - 100
3/8 in.	9.5 mm	50 - 80
No. 4	4.75 mm	35 - 65
No. 8	2.36 mm	20 - 50
No. 50	0.300 mm	8 - 30
No. 200	0.075 mm	0 - 6

Select Material Type A

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
No. 4	4.75 mm	20 - 55
No. 200	0.075 mm	6 Max. on minus 3-in. portion

Aggregate containing no muck, frozen material, roots, sod or other deleterious matter and with a plasticity index not greater than 6 as tested by WAQTC FOP for AASHTO T 89/T 90. Meet the gradation as tested by WAQTC FOP for AASHTO T 27/T 11.

Select Material Type B

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
No. 200	0.075 mm	10 Max. on minus 3-in. portion

Aggregate containing no muck, frozen material, roots, sod or other deleterious matter and with a plasticity index not greater than 6 as tested by WAQTC FOP for AASHTO T 89/T 90. Meet the gradation as tested by WAQTC FOP for AASHTO T 27/T 11.

Select Material Type C

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
No. 200	0.075 mm	30 Max. on minus 3-in. portion

Aggregate containing no muck, frozen material, roots, sod or other deleterious matter and with a plasticity index not greater than 6 as tested by WAQTC FOP for AASHTO T 89/T 90. Meet the gradation as tested by WAQTC FOP for AASHTO T 27/T 11.

Coarse Aggregate Durability

Retained on #4 Sieve

Test Type	Percent Loss
L.A. Abrasion	45 - 50 max. *
Sulfate Soundness	9 max.

* Asphalt and Surface Course = 45% max
Base Course = 50% max

Reflections Lake Pedestrian Bridge
Wasilla, Alaska

GRADATION AND DURABILITY REQUIREMENTS

April 2009 32-1-02038

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Fig. 8

APPENDIX A

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Attachment to 32-1-02038

Date: April 2009
To: Alaska Department of Fish and Game
Re: Reflections Lake Pedestrian Bridge
Wasilla, Alaska

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

3/2004

United States Department of Agriculture

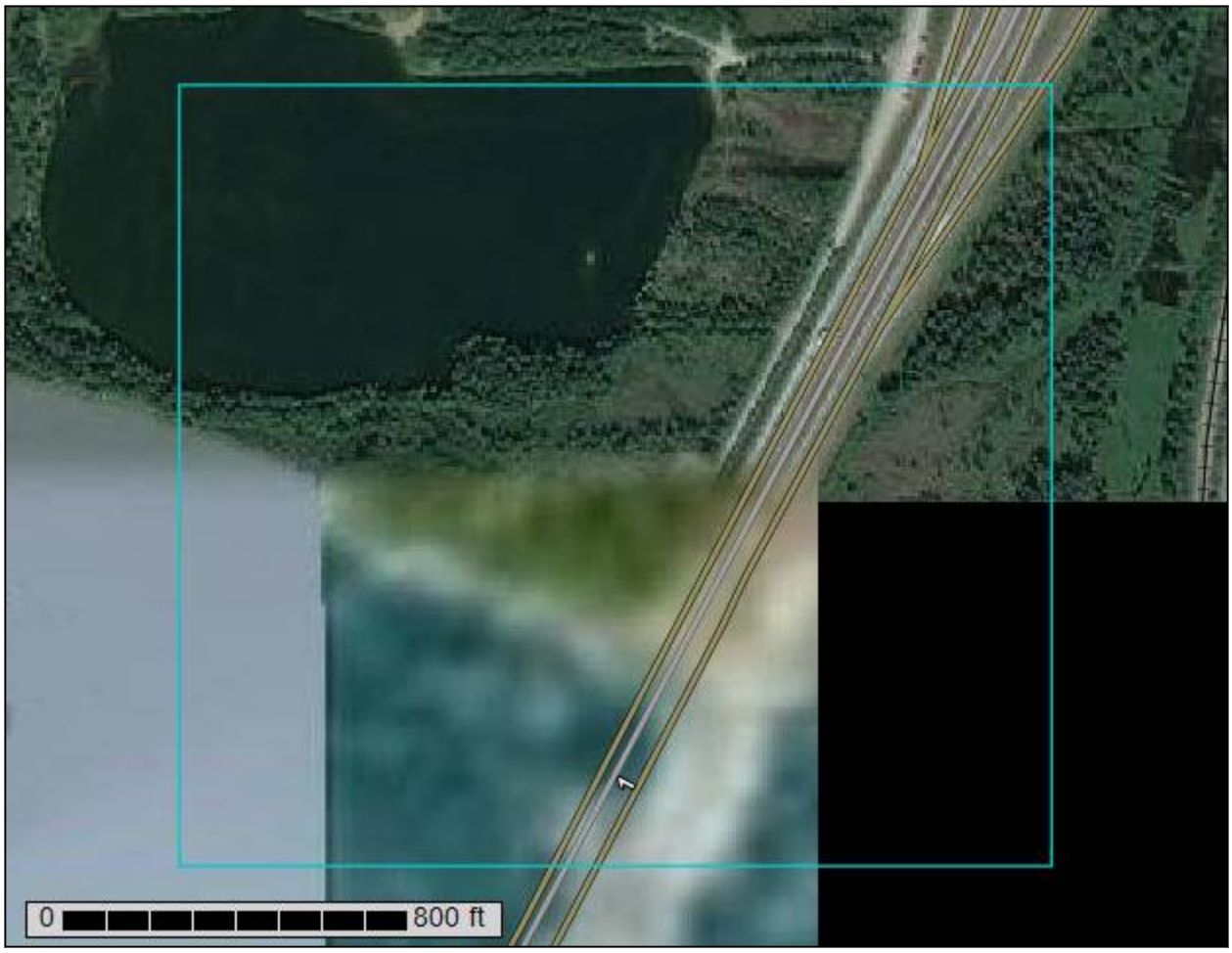
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Anchorage Area, Alaska

Reflections Lake



January 21, 2021

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

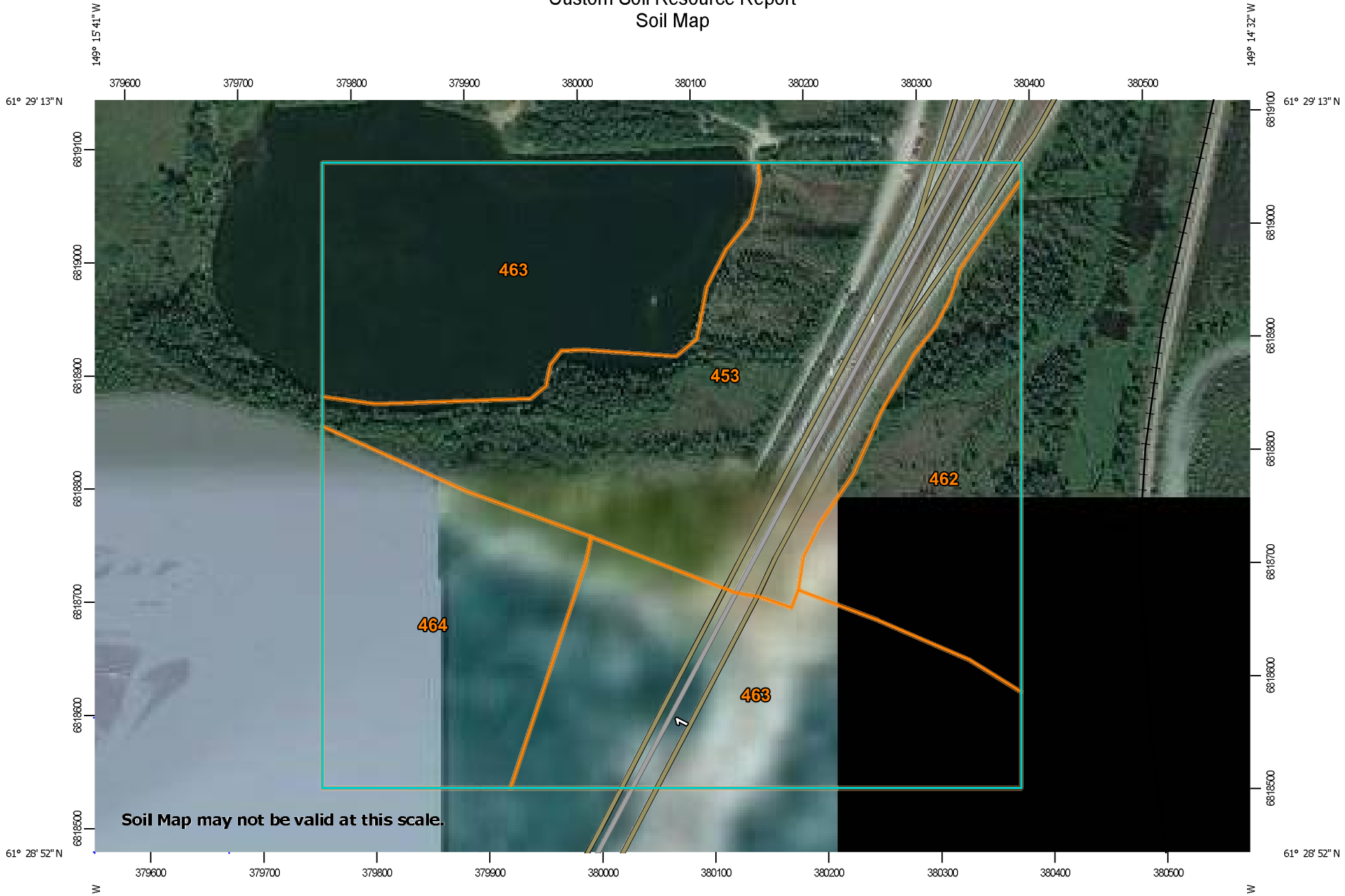
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,670 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 6N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Anchorage Area, Alaska
Survey Area Data: Version 16, May 28, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 10, 2019—Aug 17, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
453	Susivar and Niklavar fine sandy loams	25.2	29.7%
462	Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes	11.6	13.7%
463	Water, fresh	34.1	40.1%
464	Water, saline	14.0	16.5%
Totals for Area of Interest		**84.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate

pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Anchorage Area, Alaska

453—Susivar and Niklavar fine sandy loams

Map Unit Setting

National map unit symbol: n9ps
Elevation: 10 to 70 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 29 to 43 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Susivar and similar soils: 46 percent
Niklavar and similar soils: 44 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Susivar

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium over sandy and gravelly alluvium

Typical profile

A - 0 to 3 inches: fine sandy loam
Cg - 3 to 60 inches: stratified sand to silt

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water capacity: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Niklavar

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium over sandy and gravelly alluvium

Typical profile

A - 0 to 1 inches: loamy fine sand
Cg - 1 to 30 inches: stratified sand to silt
2C - 30 to 60 inches: very gravelly coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water capacity: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Riverwash

Percent of map unit: 4 percent
Landform: Flood plains
Down-slope shape: Linear
Hydric soil rating: Unranked

Niklason

Percent of map unit: 3 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Moose river

Percent of map unit: 3 percent
Landform: Depressions on flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: n9pf
Elevation: 0 to 50 feet

Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 29 to 43 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Typic cryaquents, tidal flats, and similar soils: 70 percent
Typic cryaquepts, beach terrace, and similar soils: 25 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Typic Cryaquents, Tidal Flats

Setting

Landform: Tidal flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty marine deposits

Typical profile

Cg1 - 0 to 16 inches: silt loam
Cg2 - 16 to 21 inches: silt loam
Cg3 - 21 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Available water capacity: Very high (about 13.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Yes

Description of Typic Cryaquepts, Beach Terrace

Setting

Landform: Beach terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty marine deposits

Typical profile

Ag - 0 to 30 inches: silt loam
Bg - 30 to 38 inches: silt loam
Cg - 38 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Very poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water capacity: Very high (about 13.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Water, saline

Percent of map unit: 5 percent
Landform: Lakes, rivers
Hydric soil rating: Unranked

463—Water, fresh

Map Unit Setting

National map unit symbol: n9qb
Elevation: 0 to 3,610 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 29 to 43 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform: Lakes, rivers

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Minor Components

Riverwash
Percent of map unit: 10 percent
Landform: Flood plains
Down-slope shape: Linear
Hydric soil rating: Unranked

464—Water, saline

Map Unit Setting
National map unit symbol: n9qc
Elevation: 0 to 20 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 29 to 43 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition
Water, saline: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water, Saline

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Minor Components

Typic cryaquents, tidal flats
Percent of map unit: 8 percent
Landform: Tidal flats
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Cryosaprists, tidal flats
Percent of map unit: 2 percent
Landform: Salt marshes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Water Features

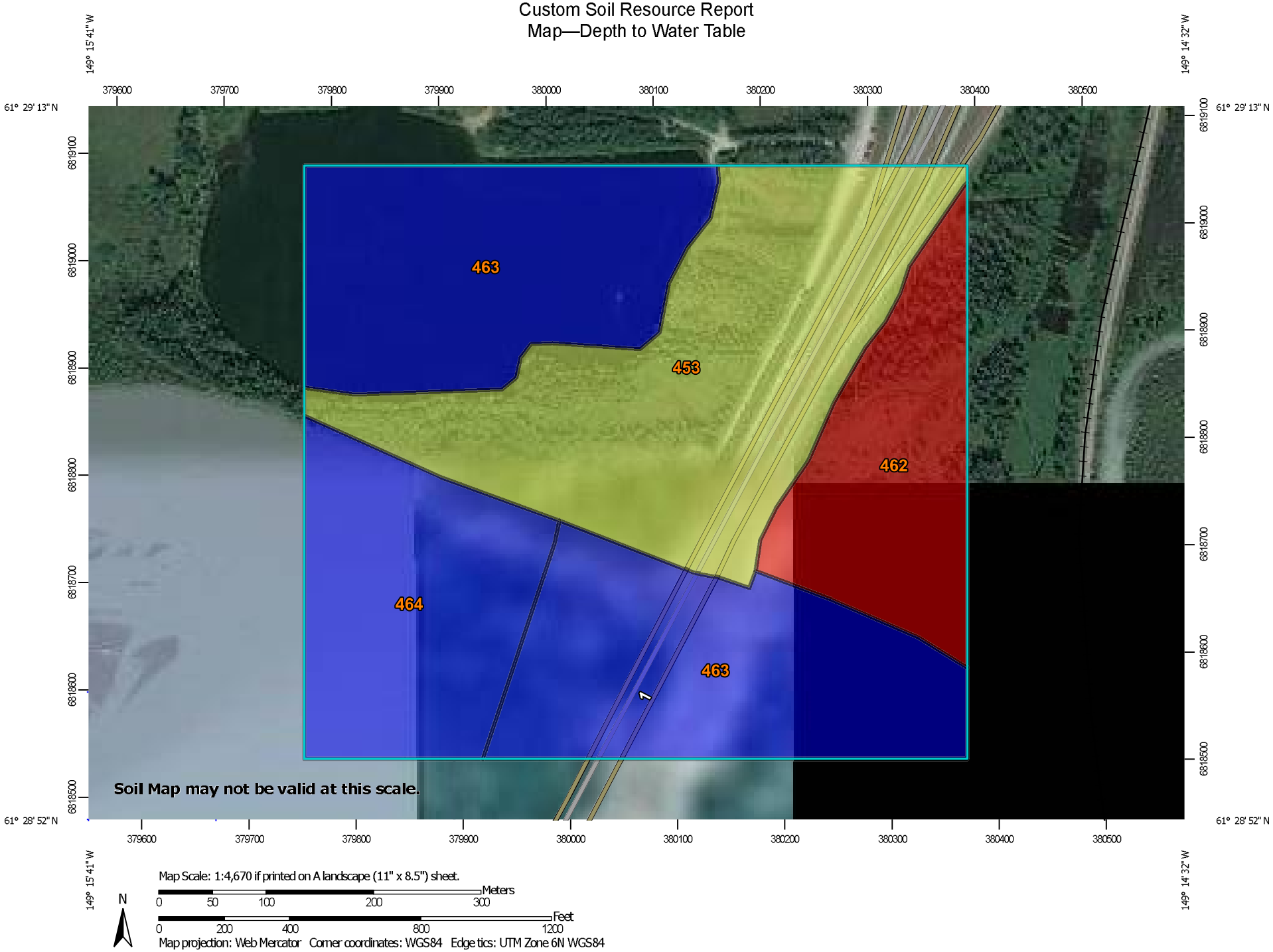
Water Features include ponding frequency, flooding frequency, and depth to water table.

Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Map—Depth to Water Table



Map Scale: 1:4,670 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 6N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Anchorage Area, Alaska
Survey Area Data: Version 16, May 28, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 10, 2019—Aug 17, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
453	Susivar and Niklavar fine sandy loams	61	25.2	29.7%
462	Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes	5	11.6	13.7%
463	Water, fresh	>200	34.1	40.1%
464	Water, saline	>200	14.0	16.5%
Totals for Area of Interest			**84.9**	**100.0%**

Rating Options—Depth to Water Table

Units of Measure: centimeters

Aggregation Method: Dominant Component

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Component" returns the attribute value associated with the component with the highest percent composition in the map unit. If more than one component shares the highest percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher attribute value should be returned in the case of a percent composition tie. The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Beginning Month: January

Ending Month: December

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves,

numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Anchorage Area, Alaska														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
453—Susivar and Niklavar fine sandy loams														
Susivar	46	C	0-3	Fine sandy loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	90-93-95	60-68-75	25-30-35	NP-5-10
			3-60	Stratified sand to silt	SM	A-2, A-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	80-85-90	30-40-50	0-5 -10	NP
Niklavar	44	D	0-1	Loamy fine sand	SM	A-2, A-4	0- 0- 0	0- 0- 0	100-100-100	95-100-100	80-85-90	20-30-40	0-5 -10	NP
			1-30	Stratified sand to silt	SM	A-2, A-4	0- 0- 0	0- 0- 0	100-100-100	95-100-100	80-85-90	30-40-50	0-5 -10	NP
			30-60	Very gravelly coarse sand, extremely gravelly coarse sand, very cobbly sand	GP, SP	A-1	0- 0- 0	0- 0- 15	40-50-80	30-40-75	10-18-25	0- 3- 5	0-0 -0	NP
Moose river	3	D	0-5	Slightly decomposed plant material	PT	A-8	—	—	—	—	—	—	—	—
			5-10	Very fine sandy loam, silt loam, loamy very fine sand	SM, ML	A-4	0- 0- 0	0- 0- 0	95-100-100	90-100-100	75-87-100	40-65-90	25-30-35	NP-5-10
			10-50	Stratified fine sand to silt loam	SM, ML	A-2, A-4	0- 0- 0	0- 0- 0	80-95-100	70-90-100	60-80-100	30-60-90	10-20-30	NP-5-10

Engineering Properties–Anchorage Area, Alaska														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			50-60	Gravelly sandy loam, gravelly sand	SM	A-1, A-2	0- 0- 0	10-15-25	55-70-90	45-60-85	30-40-50	10-20-30	0-5 -15	NP-2 -5
Niklason	3	B	0-1	Moderately decomposed plant material	PT	A-8	—	—	—	—	—	—	—	—
			1-4	Mucky silt loam, silt loam, very fine sandy loam	OL, SM, ML	A-4	0- 0- 0	0- 0- 0	95-98-100	90-95-100	80-90-100	45-75-85	25-30 -35	NP-3 -5
			4-28	Stratified loamy sand to silt loam	ML, SM	A-4	0- 0- 0	0- 0- 0	95-98-100	90-95-100	80-90-100	45-75-85	25-30 -35	NP-3 -5
			28-60	Extremely gravelly coarse sand, very gravelly loamy coarse sand, very gravelly loamy sand	GW, GM	A-1	0- 0- 5	10-15-25	35-45-55	30-40-50	15-30-45	0-10- 20	0-0 -15	NP
462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes														
Typic cryaquents, tidal flats	70	D	0-16	Silt loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30 -35	NP-5 -10
			16-21	Silt loam, sandy loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30 -35	NP-5 -10
			21-60	Silt loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30 -35	NP-5 -10
Typic cryaquepts, beach terrace	25	D	0-30	Silt loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30 -35	NP-5 -10
			30-38	Silty clay loam, silt loam	CL	A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30 -35	10-12-15
			38-60	Silty clay loam, silt loam	CL	A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30 -35	10-12-15

Engineering Properties–Anchorage Area, Alaska														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
464—Water, saline														
Typic cryaquents, tidal flats	8	D	0-16	Silt loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30-35	NP-5-10
			16-21	Silt loam, sandy loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30-35	NP-5-10
			21-60	Silt loam	ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-90-100	70-80-90	25-30-35	NP-5-10
Cryosaprists, tidal flats	2	D	0-9	Peat, mucky peat	PT	A-8	—	—	—	—	—	—	—	—
			9-60	Mucky peat, peat	PT	A-8	—	—	—	—	—	—	—	—

Particle Size and Coarse Fragments

This table shows estimates of particle size distribution and coarse fragment content of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Total fragments is the content of fragments of rock and other materials larger than 2 millimeters in diameter on volumetric basis of the whole soil.

Fragments 2-74 mm refers to the content of coarse fragments in the 2 to 74 millimeter size fraction.

Fragments 75-249 mm refers to the content of coarse fragments in teh 75 to 249 millimeter size fraction.

Fragments 250-599 mm refers to the content of coarse fragments in the 250 to 599 millimeter size fraction.

Fragments >=600 mm refers to the content of coarse fragments in the greater than or equal to 600 millimeter size fraction.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov)

Particle Size and Coarse Fragments–Anchorage Area, Alaska										
Map symbol and soil name	**Horizon**	**Depth**	**Sand**	**Silt**	**Clay**	**Total fragments**	**Fragments 2-74 mm**	**Fragments 75-249 mm**	**Fragments 250-599 mm**	**Fragments >=600 mm**
		In	*L-RV-H Pct*	*L-RV-H Pct*	*L-RV-H Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*
453—Susivar and Niklavar fine sandy loams										
Susivar	A	0-3	35-65- 75	25-30- 35	0- 5- 10	2	2	—	—	—
	Cg	3-60	10-90- 95	5- 5- 85	0- 5- 10	2	2	—	—	—
Niklavar	A	0-1	75-85- 95	0-10- 15	0- 5- 10	0	0	—	—	—
	Cg	1-30	10-90- 95	5- 5- 85	0- 5- 10	0	0	—	—	—
	2C	30-60	90-95-10 0	0- 3- 5	0- 3- 5	45	45	0	—	—
Riverwash	—	—	—	—	—	—	—	—	—	—
Moose River	Oi	0-5	—	—	—	0	—	—	—	—
	A	5-10	10-20- 75	25-75- 90	0- 5- 10	0	0	—	—	—
	Cg1	10-50	10-90- 95	5- 5- 90	0- 5- 10	6	6	—	—	—
	2Cg2	50-60	80-90-10 0	0- 8- 15	0- 3- 5	34	24	10	—	—
Niklason	Oe	0-1	—	—	—	0	—	—	—	—
	A	1-4	20-45- 50	40-50- 70	0- 5- 10	4	4	—	—	—
	C1	4-28	25-55- 80	20-40- 65	0- 5- 10	4	4	—	—	—
	2C2	28-60	80-90-10 0	0- 8- 15	0- 2- 5	67	50	15	—	2

Particle Size and Coarse Fragments–Anchorage Area, Alaska										
Map symbol and soil name	**Horizon**	**Depth**	**Sand**	**Silt**	**Clay**	**Total fragments**	**Fragments 2-74 mm**	**Fragments 75-249 mm**	**Fragments 250-599 mm**	**Fragments >=600 mm**
		In	*L-RV-H Pct*	*L-RV-H Pct*	*L-RV-H Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*
462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes										
Typic Cryaquents, tidal flats	Cg1	0-16	20-30- 40	50-65- 70	1- 5- 10	—	—	—	—	—
	Cg2	16-21	30-40- 60	40-55- 60	1- 5- 10	—	—	—	—	—
	Cg3	21-60	20-30- 40	50-65- 70	1- 5- 10	—	—	—	—	—
Typic Cryaquepts, beach terrace	Ag	0-30	30-40- 50	40-50- 65	5-10- 20	—	—	—	—	—
	Bg	30-38	20-25- 50	40-55- 65	15-20- 30	—	—	—	—	—
	Cg	38-60	20-25- 50	40-55- 65	15-20- 30	—	—	—	—	—
Water, saline	—	—	—	—	—	—	—	—	—	—
463—Water, fresh										
Water	—	—	—	—	—	—	—	—	—	—
Riverwash	—	—	—	—	—	—	—	—	—	—
464—Water, saline										
Water, saline	—	—	—	—	—	—	—	—	—	—
Typic Cryaquents, tidal flats	Cg1	0-16	20-30- 40	50-65- 70	1- 5- 10	—	—	—	—	—
	Cg2	16-21	30-40- 60	40-55- 60	1- 5- 10	—	—	—	—	—
	Cg3	21-60	20-30- 40	50-65- 70	1- 5- 10	—	—	—	—	—
Cryosaprists, tidal flats	Oi	0-9	—	—	—	0	—	—	—	—
	Oe	9-60	—	—	—	0	—	—	—	—

Fragments on the Soil Surface

This table provides information about fragments on the soil surface. Surface fragments are unattached, cemented pieces of bedrock, bedrock-like material, durinodes, concretions, nodules, or pedogenic horizons (e.g., petrocalcic fragments) 2 mm or larger in diameter and woody material 20 mm or larger in diameter that are exposed at the surface of the soil. Surface fragments can be rock fragments, pararock fragments, or wood fragments. Vegetal material other than wood fragments, whether live or dead, is not included.

Pct. of map unit is the percent of the map unit comprised by the component.

Surface fragment cover percent is the percent of the soil surface covered by fragments 2 mm or larger in diameter (20 mm or larger in diameter for wood fragments).

Distance between fragments is the average distance between surface fragments, measured between edges.

Fragment size is the size based on the multiaxial dimensions of the surface fragment.

Flat fragment class	*Length of fragment (mm)*
Channers	2 - 150
Flagstones	150 - 380
Stones	380 - 600
Boulders	>= 600

Nonflat fragment class	*Diameter (mm)*
Gravel	2 - 75
Cobbles	75 - 250
Stones	250 - 600
Boulders	>= 600

Fragment kind is the lithology or composition of the surface fragments 2 mm or larger (20 mm or larger for wood fragments).

Fragment shape is a description of the overall shape of the surface fragment.

Fragment roundness is an expression of the sharpness of edges and corners of surface fragments.

Fragment hardness is the hardness of the fragment. It is equivalent to the rupture resistance cemented of a surface fragment that has been air-dried and then submerged in water.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. https://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/)

Three values are provided to identify the expected Low (L), Representative Value (RV), and High (H).

Fragments on the Soil Surface–Anchorage Area, Alaska								
Map symbol and soil name	**Pct. of map unit**	**Surface fragment cover percent**	**Distance between fragments**	**Fragment size**	**Fragment kind**	**Fragment shape**	**Fragment roundness**	**Fragment hardness**
		L-RV-H	*Meters (L-RV-H)*	*Millimeters (L-RV-H)*				
453—Susivar and Niklavar fine sandy loams								
Susivar	46	- 0-	—	—	—	—	—	—
Niklavar	44	- 0-	—	—	—	—	—	—
Riverwash	4	-55- -30- - 3- - 1-	— — — —	2- 40- 75 75- 175- 250 250- 425- 600 600-1000-1500	— — — —	— — — —	— — — —	— — — —
Moose River	3	- 0-	—	—	—	—	—	—
Niklason	3	- 0-	—	—	—	—	—	—
462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes								
Typic Cryaquents, tidal flats	70	- 0-	—	—	—	—	—	—
Typic Cryaquepts, beach terrace	25	- 0-	—	—	—	—	—	—
Water, saline	5	—	—	—	—	—	—	—
463—Water, fresh								
Water	90	—	—	—	—	—	—	—
Riverwash	10	-55- -30- - 3- - 1-	— — — —	2- 40- 75 75- 175- 250 250- 425- 600 600-1000-1500	— — — —	— — — —	— — — —	— — — —
464—Water, saline								
Water, saline	90	—	—	—	—	—	—	—
Typic Cryaquents, tidal flats	8	- 0-	—	—	—	—	—	—
Cryosaprists, tidal flats	2	- 0-	—	—	—	—	—	—

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov)

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Anchorage Area, Alaska														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
453—Susivar and Niklavar fine sandy loams														
Susivar	0-3	35-65- 75	25-30- 35	0- 5- 10	1.10-1.18-1.25	4.23-9.17-14.11	0.26-0.28-0.30	0.0- 1.5- 2.9	2.0- 3.5- 5.0	.37	.37	5	2	134
	3-60	10-90- 95	5- 5- 85	0- 5- 10	1.10-1.18-1.25	4.23-9.17-14.11	0.10-0.13-0.15	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.24	.24			
Niklavar	0-1	75-85- 95	0-10- 15	0- 5- 10	1.10-1.18-1.25	4.23-9.17-14.11	0.10-0.13-0.15	0.0- 1.5- 2.9	2.0- 3.5- 5.0	.24	.24	2	2	134
	1-30	10-90- 95	5- 5- 85	0- 5- 10	1.10-1.18-1.25	4.23-9.17-14.11	0.10-0.13-0.15	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.24	.24			
	30-60	90-95-100	0- 3- 5	0- 3- 5	1.50-1.55-1.60	42.34-91.74-141.14	0.02-0.03-0.04	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.02	.15			
Riverwash	—	—	—	—	—	—	—	—	—					
Moose river	0-5	—	—	—	0.07-0.12-0.18	14.00-28.00-42.00	0.32-0.33-0.35	—	60.0-70.0-80.0			3	8	0
	5-10	10-20- 75	25-75- 90	0- 5- 10	0.85-0.90-0.95	4.00-9.00-14.00	0.15-0.19-0.22	0.0- 1.5- 2.9	4.0- 6.0- 8.0	.37	.37			
	10-50	10-90- 95	5- 5- 90	0- 5- 10	0.85-0.90-1.00	4.00-9.00-14.00	0.15-0.19-0.22	0.0- 1.5- 2.9	1.0- 2.0- 5.0	.37	.37			
	50-60	80-90-100	0- 8- 15	0- 3- 5	1.40-1.45-1.50	14.00-77.00-141.00	0.04-0.06-0.07	0.0- 1.5- 2.9	1.0- 2.0- 5.0	.15	.32			
Niklason	0-1	—	—	—	0.07-0.12-0.18	14.00-28.00-42.00	0.32-0.33-0.35	—	60.0-70.0-80.0			2	2	134
	1-4	20-45- 50	40-50- 70	0- 5- 10	0.80-0.90-1.00	4.00-9.00-14.00	0.19-0.22-0.25	0.0- 1.5- 2.9	10.0-15.0-20.0	.32	.37			
	4-28	25-55- 80	20-40- 65	0- 5- 10	0.80-0.90-1.00	4.00-9.00-14.00	0.19-0.22-0.25	0.0- 1.5- 2.9	3.0- 6.0- 9.0	.32	.37			
	28-60	80-90-100	0- 8- 15	0- 2- 5	1.50-1.55-1.60	42.00-92.00-141.00	0.02-0.03-0.04	0.0- 1.5- 2.9	0.5- 1.0- 2.0	.02	.05			

Physical Soil Properties–Anchorage Area, Alaska														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes														
Typic cryaquents, tidal flats	0-16	20-30- 40	50-65- 70	1- 5- 10	1.00-1.15- 1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0- 2.0	.37	.37	5	1	160
	16-21	30-40- 60	40-55- 60	1- 5- 10	1.00-1.15- 1.30	4.00-9.00-14.00	0.15-0.20-0.24	0.0- 1.5- 2.9	0.0- 1.0- 2.0	.37	.37			
	21-60	20-30- 40	50-65- 70	1- 5- 10	1.00-1.15- 1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0- 2.0	.37	.37			
Typic cryaquepts, beach terrace	0-30	30-40- 50	40-50- 65	5-10- 20	1.00-1.15- 1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0- 2.0	.37	.37	5	1	160
	30-38	20-25- 50	40-55- 65	15-20- 30	1.00-1.15- 1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0- 2.0	.37	.37			
	38-60	20-25- 50	40-55- 65	15-20- 30	1.00-1.15- 1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0- 2.0	.37	.37			
Water, saline	—	—	—	—	—	—	—	—	—					
463—Water, fresh														
Water	—	—	—	—	—	—	—	—	—					
Riverwash	—	—	—	—	—	—	—	—	—					

Physical Soil Properties–Anchorage Area, Alaska														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
464—Water, saline														
Water, saline	—	—	—	—	—	—	—	—	—					
Typic cryaquents, tidal flats	0-16	20-30- 40	50-65- 70	1- 5- 10	1.00-1.15-1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0-2.0	.37	.37	5	1	160
	16-21	30-40- 60	40-55- 60	1- 5- 10	1.00-1.15-1.30	4.00-9.00-14.00	0.15-0.20-0.24	0.0- 1.5- 2.9	0.0- 1.0-2.0	.37	.37			
	21-60	20-30- 40	50-65- 70	1- 5- 10	1.00-1.15-1.30	4.00-9.00-14.00	0.20-0.22-0.24	0.0- 1.5- 2.9	0.0- 1.0-2.0	.37	.37			
Cryosaprists, tidal flats	0-9	—	—	—	0.05-0.08-0.10	42.00-91.00-141.00	0.32-0.33-0.35	—	50.0-60.0-70.0			5	8	0
	9-60	—	—	—	0.07-0.12-0.18	14.00-28.00-42.00	0.32-0.33-0.35	—	60.0-70.0-80.0					

Water Features

This folder contains tabular reports that present soil hydrology information. The reports (tables) include all selected map units and components for each map unit. Water Features include ponding frequency, flooding frequency, and depth to water table.

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Hydrologic Soil Group and Surface Runoff–Anchorage Area, Alaska			
Map symbol and soil name	Pct. of map unit	Surface Runoff	Hydrologic Soil Group
453—Susivar and Niklavar fine sandy loams			
Susivar	46	Low	C
Niklavar	44	Very high	D
Riverwash	4	—	—
Moose river	3	Very high	D
Niklason	3	Low	B
462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes			
Typic cryaquents, tidal flats	70	Very high	D
Typic cryaquepts, beach terrace	25	Very high	D
Water, saline	5	—	—
463—Water, fresh			
Water	90	—	—
Riverwash	10	—	—
464—Water, saline			
Water, saline	90	—	—
Typic cryaquents, tidal flats	8	Very high	D
Cryosaprists, tidal flats	2	Very high	D

Water Features

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell

potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

Water table refers to a saturated zone in the soil. The water features table indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table. The kind of water table, apparent or perched, is given if a seasonal high water table exists in the soil. A water table is perched if free water is restricted from moving downward in the soil by a restrictive feature, in most cases a hardpan; there is a dry layer of soil underneath a wet layer. A water table is apparent if free water is present in all horizons from its upper boundary to below 2 meters or to the depth of observation. The water table kind listed is for the first major component in the map unit.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance

of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Map unit symbol and soil name	Hydrologic group	Surface runoff	Most likely months	Water table			Ponding			Flooding	
				Upper limit	Lower limit	Kind	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*		*Ft*				
453—Susivar and Niklavar fine sandy loams											
Susivar	C	Low	Jan	1.5-3.0	5.0	Apparent	—	—	None	—	
			Feb-Mar	2.0-3.5	5.0	Apparent	—	—	None	—	
			Apr-May	1.5-2.5	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Jun	2.5-3.5	5.0	Apparent	—	—	None	—	
			Jul	4.0-5.0	5.0	Apparent	—	—	None	—	
			Aug	4.0-5.0	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Sep	2.5-3.5	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Oct	2.0-3.0	5.0	Apparent	—	—	None	—	
			Nov-Dec	1.5-3.0	5.0	Apparent	—	—	None	—	
Niklavar	D	Very high	Jan	1.0-2.0	5.0	Apparent	—	—	None	—	
			Feb-Mar	1.5-2.5	5.0	Apparent	—	—	None	—	
			Apr-May	1.0-1.5	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Jun	1.0-1.5	5.0	Apparent	—	—	None	—	
			Jul	3.0-4.0	5.0	Apparent	—	—	None	—	
			Aug	3.0-4.0	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Sep	2.0-3.0	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Oct	1.5-2.5	5.0	Apparent	—	—	None	—	
			Nov-Dec	1.0-2.0	5.0	Apparent	—	—	None	—	

Map unit symbol and soil name	Hydrologic group	Surface runoff	Most likely months	Water table			Ponding			Flooding	
				Upper limit	Lower limit	Kind	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*		*Ft*				
Riverwash			Jan-Dec	—	—	—	—	—	None	Long (7 to 30 days)	Frequent
Moose river	D	Very high	Jan	0.5-1.5	5.0	Apparent	—	—	None	—	
			Feb-Mar	1.0-2.0	5.0	Apparent	—	—	None	—	
			Apr-May	0.0-1.0	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Jun	1.0-2.0	5.0	Apparent	—	—	None	—	
			Jul	2.5-4.0	5.0	Apparent	—	—	None	—	
			Aug	2.5-4.0	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Sep	1.5-2.5	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Oct	1.0-2.0	5.0	Apparent	—	—	None	—	
			Nov-Dec	0.5-1.5	5.0	Apparent	—	—	None	—	
Niklason	B	Low	Jan	1.5-2.5	5.0	Apparent	—	—	None	—	
			Feb-Mar	2.0-3.5	5.0	Apparent	—	—	None	—	
			Apr-May	1.5-2.5	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Jun	2.0-4.0	5.0	Apparent	—	—	None	—	
			Jul	4.0-5.0	5.0	Apparent	—	—	None	—	
			Aug	4.0-5.0	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Sep	2.5-3.5	5.0	Apparent	—	—	None	Brief (2 to 7 days)	Occasional
			Oct	2.0-3.0	5.0	Apparent	—	—	None	—	
			Nov-Dec	1.5-2.5	5.0	Apparent	—	—	None	—	

Map unit symbol and soil name	Hydrologic group	Surface runoff	Most likely months	Water table			Ponding			Flooding	
				Upper limit	Lower limit	Kind	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*		*Ft*				
462—Typic Cryaquent and Typic Cryaquept soils, 0 to 2 percent slopes											
Typic cryaquents, tidal flats	D	Very high	Jan-Dec	0.0-0.3	5.0	Apparent	—	—	None	Very brief (4 to 48 hours)	Very frequent
Typic cryaquepts, beach terrace	D	Very high	Jan-Dec	0.0-1.0	5.0	Apparent	—	—	None	—	Rare
Water, saline				—	—	—	—	—	—	—	
463—Water, fresh											
Water				—	—	—	—	—	—	—	
Riverwash			Jan-Dec	—	—	—	—	—	None	Long (7 to 30 days)	Frequent
464—Water, saline											
Water, saline				—	—	—	—	—	—	—	
Typic cryaquents, tidal flats	D	Very high	Jan-Dec	0.0-0.3	5.0	Apparent	—	—	None	Very brief (4 to 48 hours)	Very frequent
Cryosaprists, tidal flats	D	Very high	Jan-Dec	0.0-0.2	5.0	Apparent	—	—	None	Very brief (4 to 48 hours)	Very frequent

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX C

Environmental Permits

Emily Amato
FAAME Engineering
2900 Spirit Way
Anchorage, AK 99508
(907) 354-1997

March 28, 2021

US Army Corps of Engineers
Post Office Box 6898
Elmendorf, AK 99506-0898

RE: PRELIMINARY JURISDICTIONAL DETERMINATION AND USACE SECTION 404/10 PERMIT APPLICATION, CED 2021.04 KNIK RIVER ACCESS RECREATIONAL SITE PROJECT, PALMER, ALASKA

To Whom it May Concern,

FAAME Engineering is requesting a U.S. Army Corps of Engineers Preliminary Jurisdictional Determination (PJD) due to the potential for construction within wetlands located on our project site. If it is determined that wetlands are located within the project site FAAME Engineering will submit a Section 404 Individual Permit for the Knik River Recreational Site Access Project. The proposed project is located within Township 016N, Range 001E, Section 15, Latitude 61.48333˚, and Longitude -149.266667˚.

Project Description:
This project includes the design of infrastructure to improve access and provide recreational opportunities in the Palmer Hay Flats State Game Refuge, as well as the design of the Gold Star Families Memorial Monument, which will increase awareness and improve stewardship of the site.

Improvements of Infrastructure:

- Construction of improved paved parking facilities
  - 15 12’x46’ Trailer Spots
  - 15 12’x18’ Passenger Vehicle Spots
    - 2 ADA Access Spots
- Construction of new amenities
  - Kids Don’t Float Kiosk
  - Orientation Kiosk
  - Picnic Shelter
  - Vaulted Toilet
- Installation of Bio-Swale Along Parking Facilities to minimize potential wetland impacts
  - Trapezoidal Cross-Section
    - 4:1 (H:V) Side Slopes, 2ft Flat Bottom
    - 578 ft Length with Longitudinal Slopes of 0.25%-0.40%

- Construction of Elevated Boardwalk within potential wetlands
  - 8’ Wide Boardwalk, with Helical Piles
  - Will meet minimum ADA Requirements

Gold Star Memorial Monument:
- Strip Footing Foundation
- Reseeding of disturbed areas to match surrounding vegetation

Purpose and Need:
There are three main purposes for this project, the first is to improve the existing facilities due to the lack of infrastructure for the current demand. The second is to create stewardship for the Palmer Hay Flats State Game Refuge. The final is to provide Gold Star Families a Memorial in the vicinity of Gold Star Peak.

Clean Water Act Section 404 Involvement:
The project area is located within potential wetlands located within the Palmer Hay Flats State Game Refuge located at Reflections Lake. The proposed project would include the permanent placement of a boardwalk and a Gold Star Monument located within potential wetlands as well as drainage of stormwater from the parking lot through a bio-swale into the wetlands.

Avoidance, Minimization, and Mitigation:
The proposed alternative will avoid wetland delineation wherever possible. Impacts to the State Game Refuge will be minimized by preparing an Environmental Sediment Control Plan (ESCP) and Storm Water Pollution Prevention Plan (SWPP) in accordance with all Environmental Agencies as well as the Construction General Permit (CGP). These will implement Best Management Practices (BMPs) to minimize the overall impact.

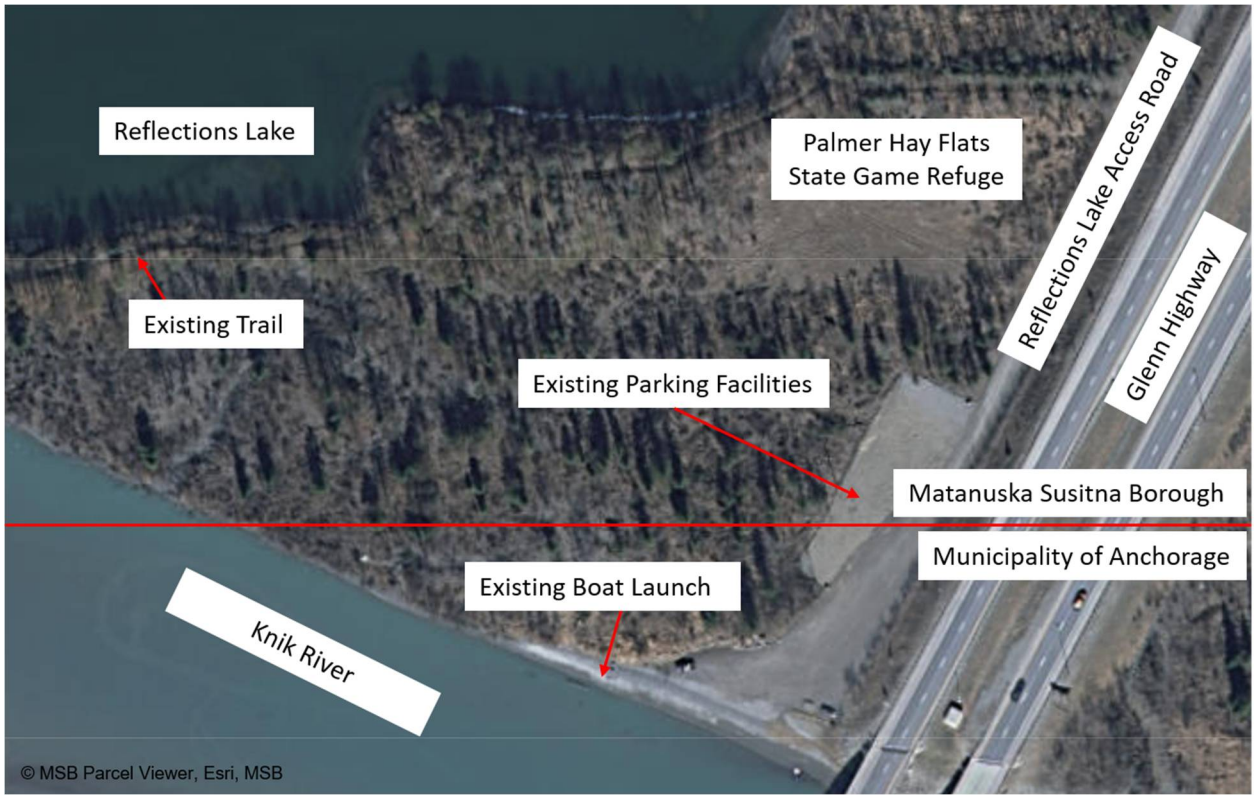
Sincerely,

Emily Amato

Emily Amato, Environmental Technical Lead

Enclosures:
Figure 1: Location and Vicinity Map
Figure 2: Project Overview and Existing Facilities
Figure 3: 65% Proposed Design
Figure 4: National Wetland Inventory Screenshot
Application for USACE Section 404 Permit

Figure 1: Project Location and Vicinity Map



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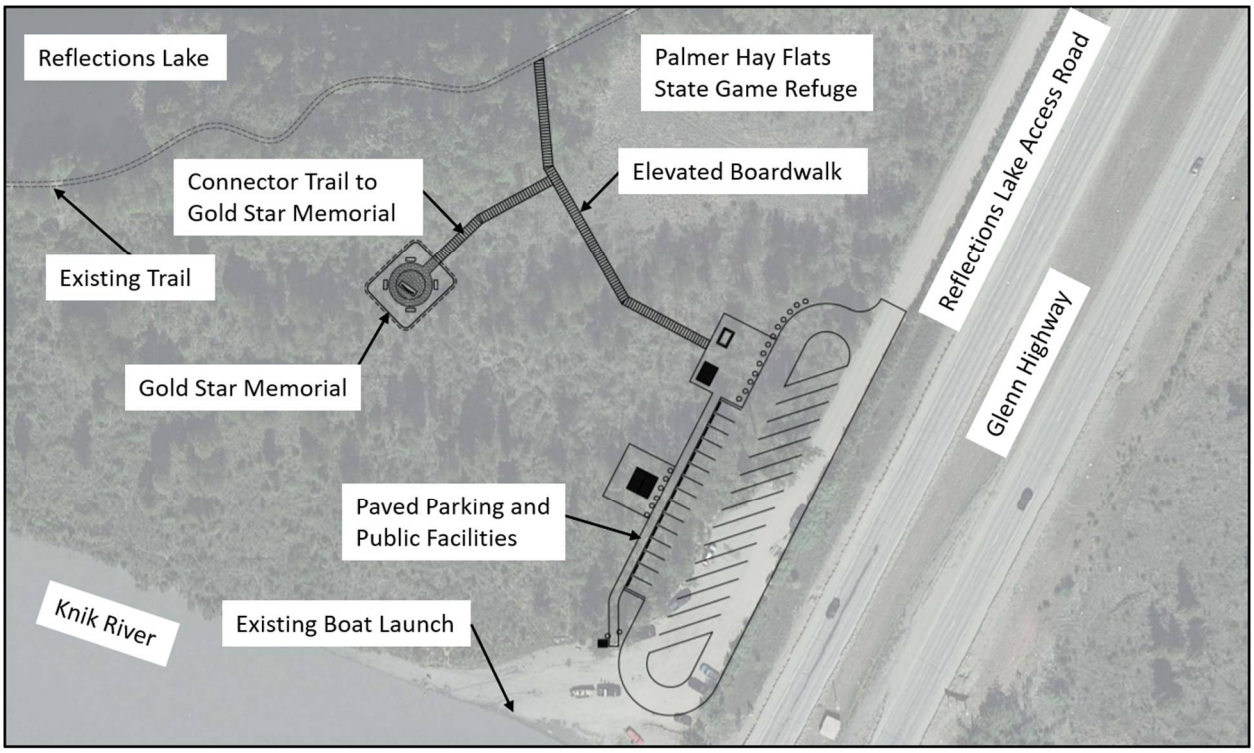

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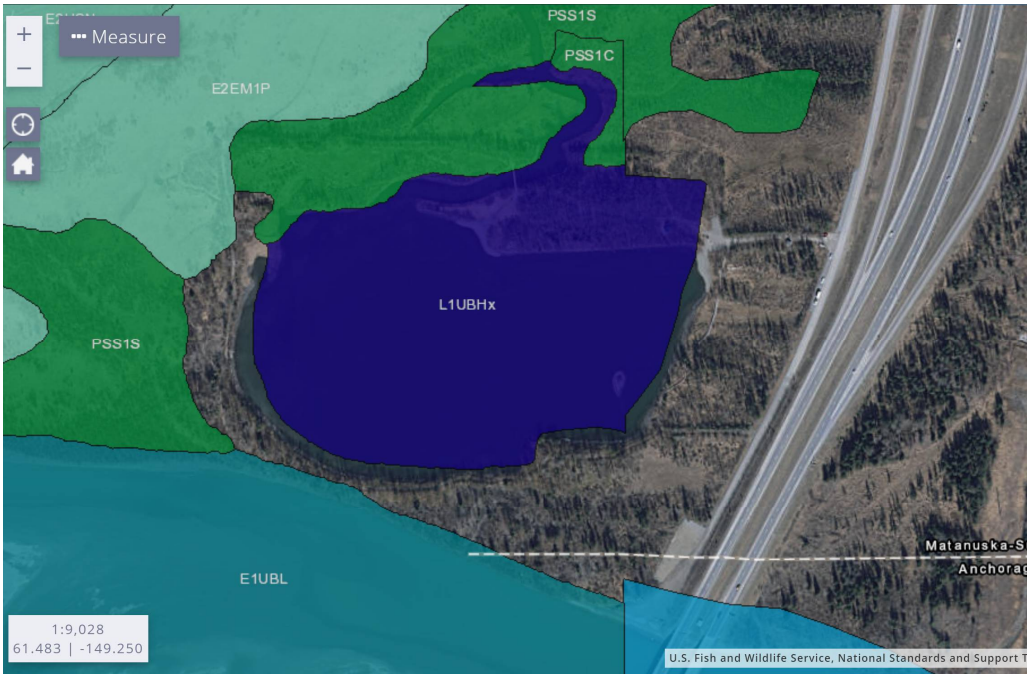

Figure 4: National Wetland Inventory Screenshot

U.S. Army Corps of Engineers (USACE)

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

Form Approved - OMB No. 0710-0003 Expires: 01-08-2018

The public reporting burden for this collection of information, OMB Control Number 0710-0003, is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or burden reduction suggestions to the Department of Defense, Washington Headquarters Services, at whs.mc-alex.esd.mbx.dd-dod-information-collections@mail.mil. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR APPLICATION TO THE ABOVE EMAIL.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned. System of Record Notice (SORN). The information received is entered into our permit tracking database and a SORN has been completed (SORN #A1145b) and may be accessed at the following website: http://dpcld.defense.gov/Privacy/SORNsIndex/DOD-wide-SORN-Article-View/Article/570115/a1145b-ce.aspx

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - Emily Middle - Rose Last - Amato	First - Middle - Last -
Company - FAAME Engineering	Company -
E-mail Address - eramato@alaska.edu	E-mail Address -
6. APPLICANT'S ADDRESS:	**9. AGENT'S ADDRESS:**
Address- 2900 Spirit Way	Address-
City - Anchorage State - AK Zip - 99504 Country - USA	City - State - Zip - Country -
7. APPLICANT'S PHONE NOs. w/AREA CODE	**10. AGENTS PHONE NOs. w/AREA CODE**
a. Residence b. Business c. Fax	a. Residence b. Business c. Fax
907-354-1997	

STATEMENT OF AUTHORIZATION

11. I hereby authorize, _____ to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

_____ _____

SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

CED 2021.04 Knik River Recreational Site Access

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
	Address
15. LOCATION OF PROJECT	City - State- Zip-
Latitude: ◦N 61.483333 Longitude: ◦W -149.266667	

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality MSB/MOA

Section - 15 Township - 016N Range - 001E

17. DIRECTIONS TO THE SITE

Mile 30.8 Glenn Highway at Knik River Access exit. Reflections Lake and parking are located on the west side of the frontage road.

18. Nature of Activity (Description of project, include all features)

Project Delineation
Use Best Management Practices (BMPs) for temporary and permanent erosion and sediment control
Earthwork to improve existing facilities and install Gold Star Monument
Parking Lot Paving
Install Upgraded Amenities: vaulted toilet, picnic shelter, picnic tables, Kid's Don't Float Kiosk, and Orientation Kiosk.
Reseed disturbed areas to match surrounding vegetation
Install Boardwalk within Project Location and tie into existing trail head

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

FAAME Engineering has identified a need to improve the facilities located at the Palmer Hay Flats State Game Refuge, Reflections Lake. The current infrastructure does not meet the current demand required. As a result of this the purpose of this project is to meet these three major objectives:
Improve Existing Facilities due to Lack of Infrastructure for Current Demand
Create Stewardship for the Palmer Hay Flats State Game Refuge
Provide Gold Star Families a Memorial within the Vicinity of Gold Star Peak

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

The discharge of material into the potential wetlands surrounding the project location is necessary in order to fulfill the project's purpose and need. Discharges would be associated with the construction of the boardwalk, and the memorial, as well as storm water from the parking lot's permanent facilities. To minimize impacts from storm water from the parking lot a Bio-Swale will be installed.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres

or

Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Impacts to the wetlands will be avoided whenever practicable. The proposed alternative will avoid wetland delineation wherever possible. These impacts will be minimized by preparing an Environmental Sediment Control Plan (ESCP) and Storm Water Pollution Prevention Plan (SWPP) in accordance with all Environmental Agencies as well as the Construction General Permit (CGP). These will implement BMPs to minimize the overall impact.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address-

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT | DATE | SIGNATURE OF AGENT | DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

Emily Amato
FAAME Engineering
2900 Spirit Way
Anchorage, AK 99508
(907) 354-1997

March 28, 2021

Alaska Department of Environmental Conservation
Post Office Box 111800
Juneau, AK 99811

RE: REQUEST FOR CERTIFICATE OF REASONABLE ASSURANCE, CED 2021.04 KNIK RIVER ACCESS RECREATIONAL SITE PROJECT, PALMER, ALASKA

To Whom it May Concern,

FAAME Engineering is requesting a Certificate of Reasonable Assurance from the Alaska Department of Environmental Conservation for our project's proposed Bio-Swale, and the Vaulted Toilet temporary and permanent facilities. The proposed project is located within Township 016N, Range 001E, Section 15, Latitude 61.48333˚, and Longitude -149.266667˚.

Project Description:
This project includes the design of infrastructure to improve access and provide recreational opportunities in the Palmer Hay Flats State Game Refuge, as well as the design of the Gold Star Families Memorial Monument, which will increase awareness and improve stewardship of the site.

Improvements of Infrastructure:

- Construction of improved paved parking facilities
  - 15 12'x46' Trailer Spots
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    - 2 ADA Access Spots
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  - Orientation Kiosk
  - Picnic Shelter
  - Vaulted Toilet
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  - Trapezoidal Cross-Section
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    - 578 ft Length with Longitudinal Slopes of 0.25%-0.40%
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- Reseeding of disturbed areas to match surrounding vegetation

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There are three main purposes for this project, the first is to improve the existing facilities due to the lack of infrastructure for the current demand. The second is to create stewardship for the Palmer Hay Flats State Game Refuge. The final is to provide Gold Star Families a Memorial in the vicinity of Gold Star Peak.

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Sincerely,

Emily Amato

Emily Amato, Environmental Technical Lead

Enclosures:
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Figure 2: Project Overview and Existing Facilities
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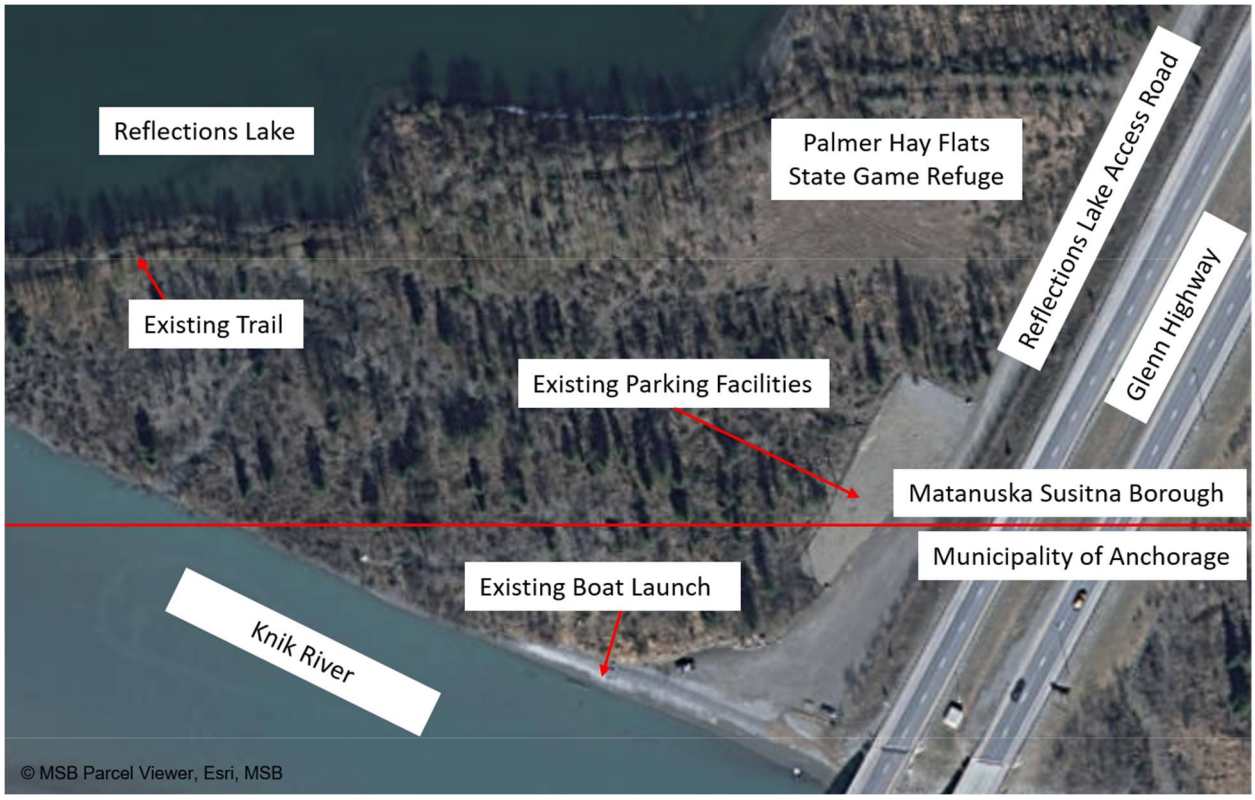
Figure 4: Bioswale Plan View
Figure 5: Standard Drawing Vaulted Toilet

Figure 1: Project Location and Vicinity Map



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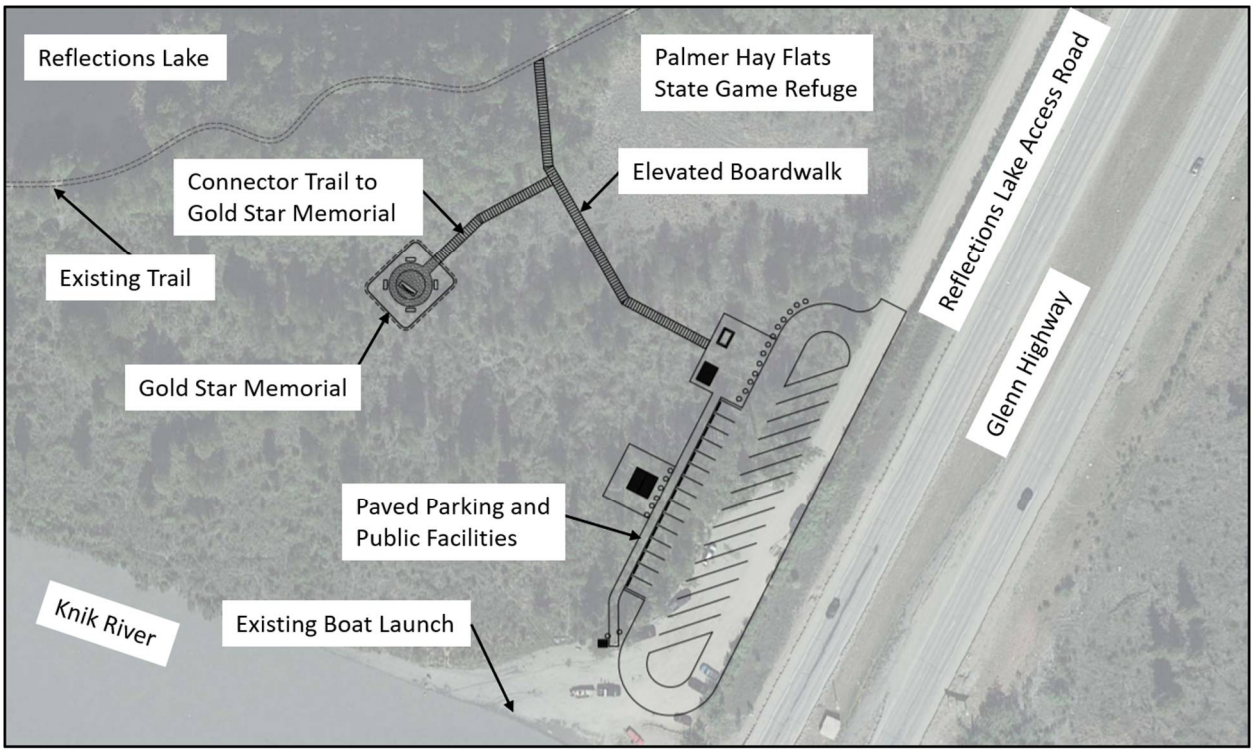

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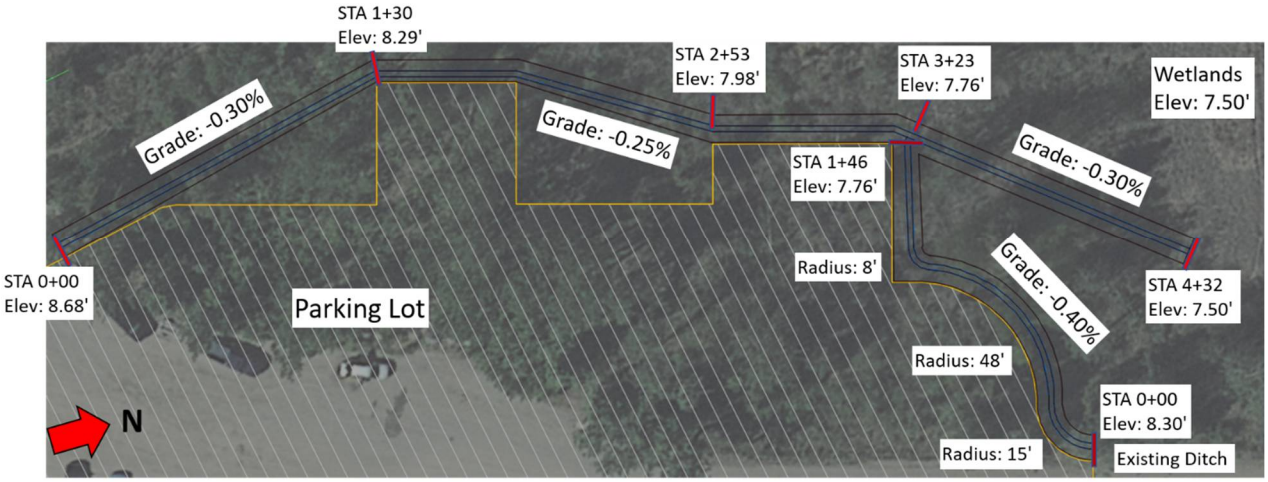

Figure 4: Bioswale Plan View

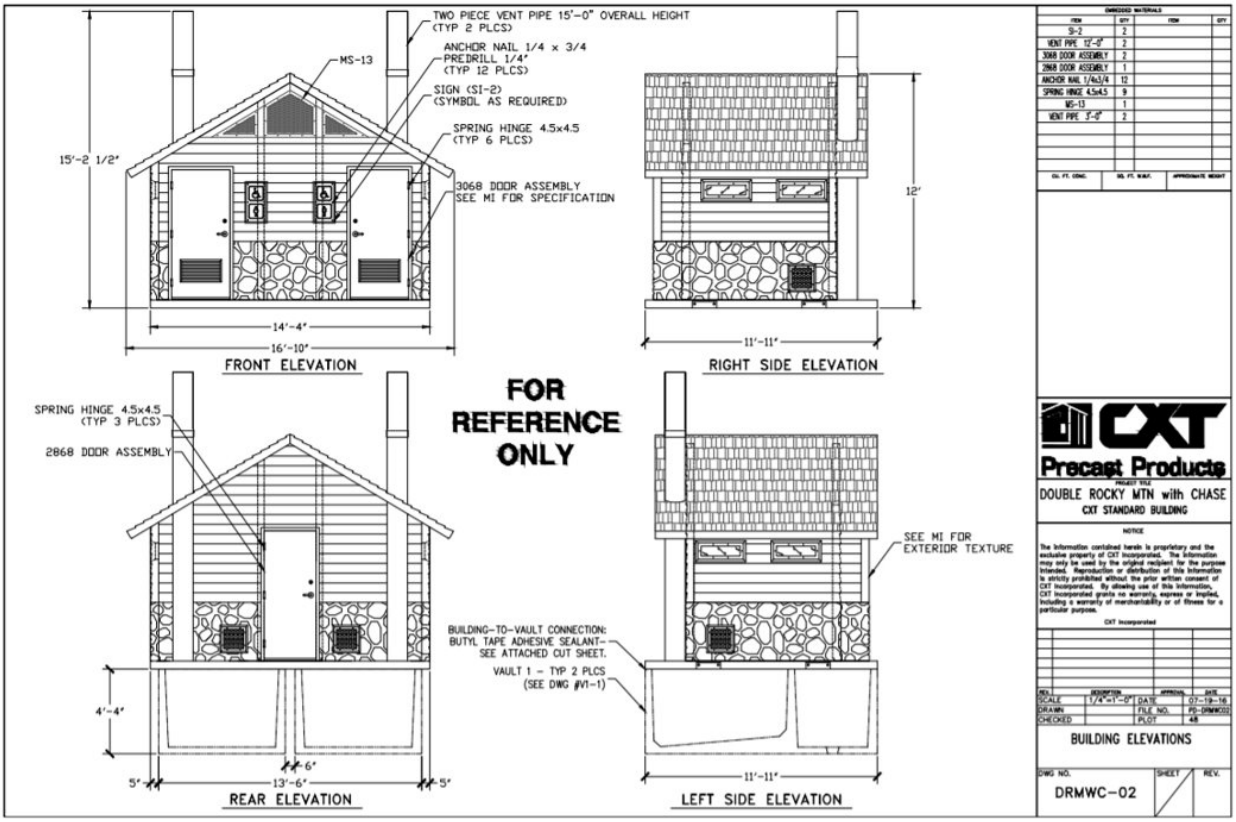

Figure 5: Standard Drawing CXT Double Rocky with Chase Toilet

FH #_____
(Office Use Only)

ALASKA DEPARTMENT OF FISH AND GAME
SPECIAL AREA PERMIT APPLICATION

(For approval of a project or activity within a State game refuge, game sanctuary, or critical habitat area)
Pursuant to 5 AAC 95

A. APPLICANT

Name: Emily Amato

Company: FAAME Engineering

Address: 2900 Spirit Way

City/State/ZIP: Anchorage, AK 99508

E-Mail: eramato@alaska.edu

Telephone: 907-354-1997 Fax: _____

Name of Responsible Party in the Field: Forrester Cook

B. LOCATION OF PROJECT SITE:

Name of Special Area: Palmer Hay Flats SGR

Specific Project Location: Knik River Access

Township 016N	Range 001E	Meridian	Section(s)
USGS Map			
Latitude 61.48333		Longitude -149.266667	(NAD 83)

Is the project on: **State Land** Private Land Federal Land
Municipal Land Ownership Unknown Other _____

Water bodies crossed or otherwise affected: N/A

C. DESCRIPTION OF THE PROJECT OR ACTIVITY

On separate, attached sheets provide complete plans and specifications and all other details necessary to fully describe the scope of the proposed project or activity. Include, at a minimum, the following information:

- The purpose of the project or activity.
- The timeframe for the project or activity, including the specific time periods for any inwater work or other activities which may disturb fish or wildlife.

- A description of construction methods, types, and quantities of equipment and number of people involved.
- A description of water use including methods of withdrawal, rate of withdrawal, and the total quantity of water required.
- A list of fill and excavation quantities, including the types of material and the source.
- A map and description showing how access will be gained to the project area (use USGS 1:63,360 scale maps where available).
- A detailed map or plan view, drawn to scale, and any cross-sectional views necessary to show project features and local topography including the location of all facilities and project dimensions.
- A current aerial photograph of the project location (if available).

D. OTHER PERMITS

Identify other state or federal permits or authorizations obtained or for which you have applied:

See attached letter.

MITIGATION: As a condition of project approval, applications will be required to compensate fully for damage to fish and wildlife and their habitat by employing the most appropriate techniques. Where determined necessary by the department, a mitigation plan pursuant to 5 AAC 95 will be required.

I HEREBY CERTIFY THAT ALL INFORMATION PROVIDED ON OR IN CONNECTION WITH THIS APPLICATION IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Signature of Applicant

Date

Name of Applicant (please print)

SUBMIT APPLICATION BY MAIL OR IN PERSON TO THE NEAREST DEPARTMENT OF FISH AND GAME, DIVISION OF HABITAT OFFICE.

ANCHORAGE
333 Raspberry Rd, Ste 2068
Anchorage, AK 99518

CRAIG
PO Box 668
Craig, AK 99921

DOUGLAS (JUNEAU)
PO Box 110024
Juneau, AK 99811-0024

FAIRBANKS
1300 College Rd
Fairbanks, AK 99701

SOLDOTNA (KENAI)
514 Funny River Rd
Soldotna, AK 99669

MAT-SU/PALMER
1800 Glenn Highway, Ste 4
Palmer, AK 99645

Emily Amato
FAAME Engineering
2900 Spirit Way
Anchorage, AK 99508
(907) 354-1997

March 28, 2021

Alaska Department of Fish & Game
333 Raspberry Rd, Ste 2068
Anchorage, AK 99518

RE: ADF&G SPECIAL AREA PERMIT APPLICATION CED 2021.04 KNIK RIVER ACCESS: PALMER HAY FLATS SGR, PALMER, ALASKA

To Whom it May Concern,

FAAME Engineering is requesting a Special Area Permit from the Alaska Department of Fish and Game for construction within the Palmer Hay Flats State Game Refuge. The proposed project is located within Township 016N, Range 001E, Section 15, Latitude 61.48333˚, and Longitude -149.266667˚.

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Sincerely,

Emily Amato

Emily Amato, Environmental Technical Lead

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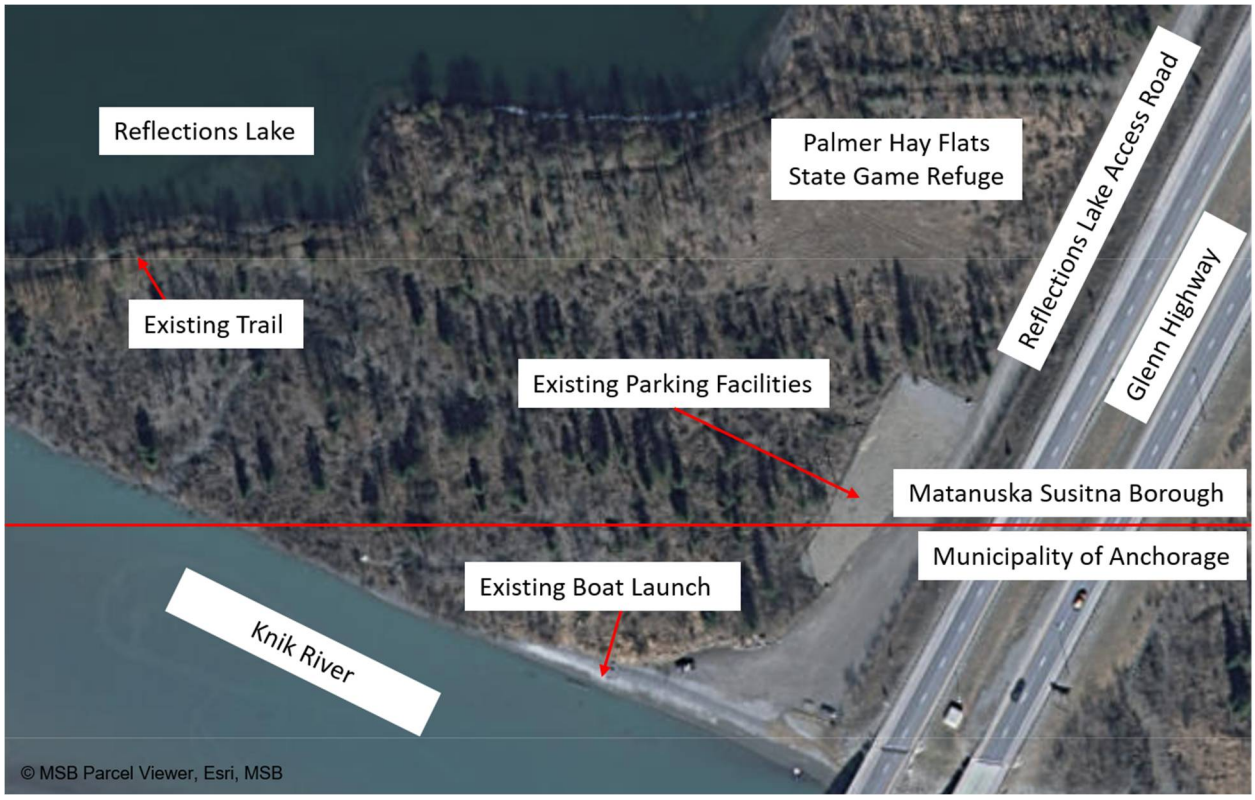

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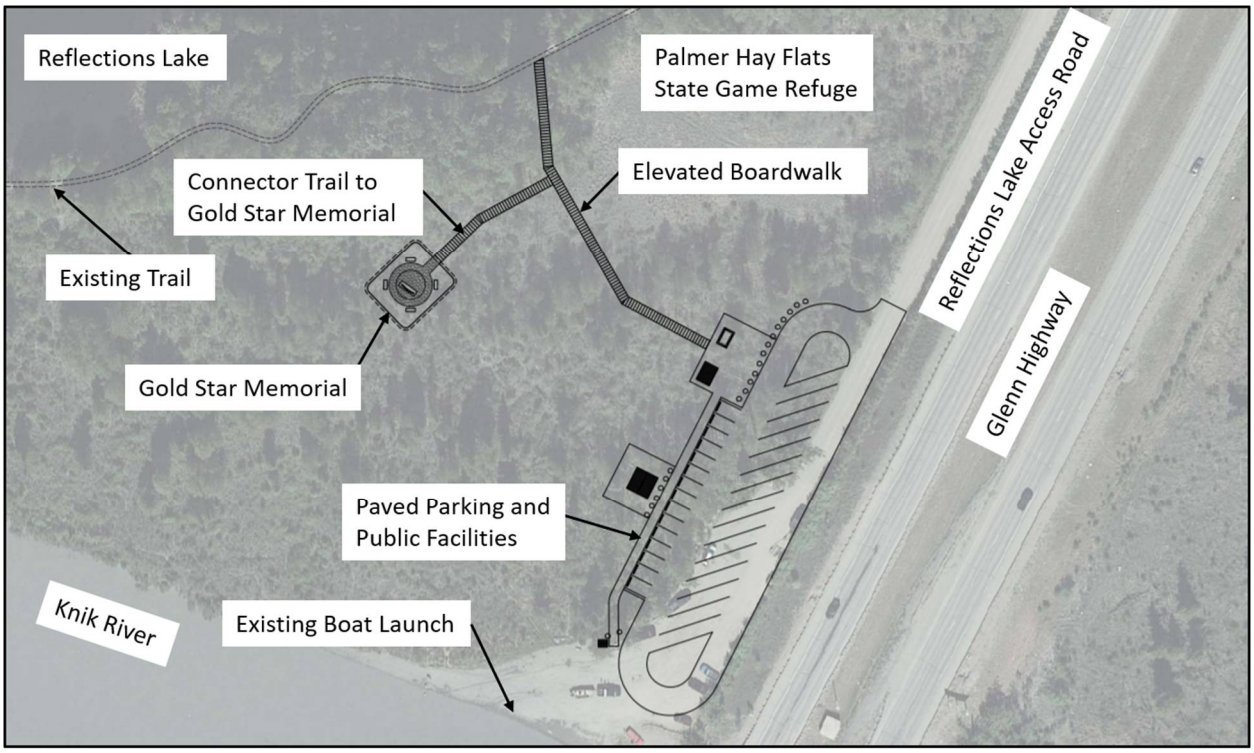

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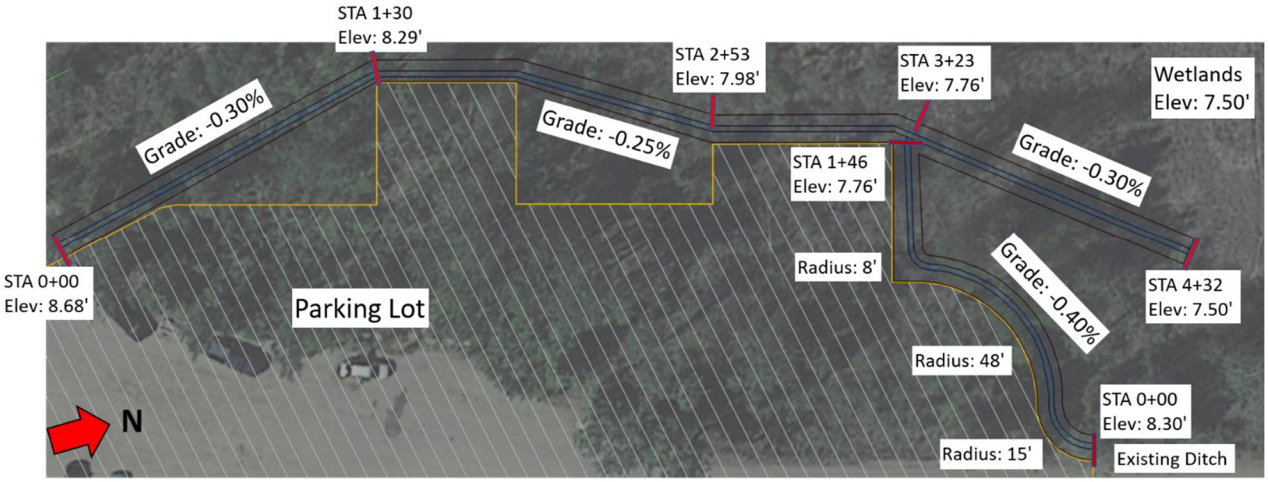

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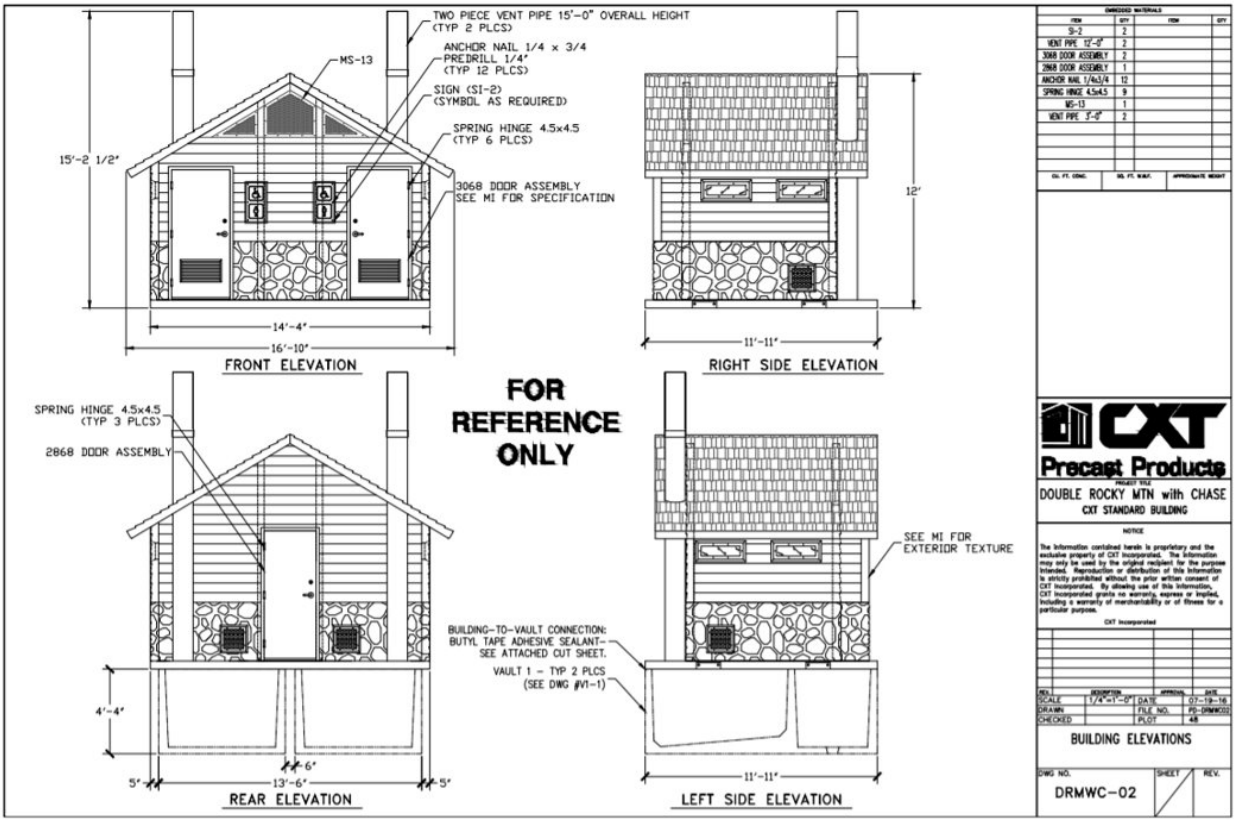


Figure 5: Standard Drawing CXT Double Rocky with Chase Toilet

Date Received:_____ Received By:_____

Project/Permit Number:_____

Fee:_____

(To be Completed by MOA)

Municipality of Anchorage
Project Management & Engineering Department
Mail: P.O. Box 196650, Anchorage, AK 99519-6650
4700 Elmore Road, Anchorage, AK 99507
Phone (907) 343-8135 Fax (907) 343-8088
www.muni.org

FLOOD HAZARD PERMIT APPLICATION

(Please fill out application completely; Indicate NA if necessary. Property information can be found at http://neighborhood.muni.org/ or http://redirect.muni.org/propappraisal/public.html)

PART I – APPLICANT INFORMATION

APPLICANT: Emily Amato

MAILING ADDRESS: 2900 Spirit Way

CITY: Anchorage STATE: AK ZIP: 99508

PHONE: 907-354-1997 FAX: _____ EMAIL: eramato@alaska.edu

OWNER (If Different): Alaska Department of Fish & Game, ADF&G

MAILING ADDRESS: 333 Raspberry Rd

CITY: Anchorage STATE: AK ZIP: 99518

PHONE: 907-267-2342 FAX: _____ EMAIL: _____

PART II - LOCATION OF PROPOSED PROJECT

TAX PARCEL ID(s): _____

SUDIVISION: _____

LOT(s): _____ BLOCK: _____

ADDRESS/OTHER LOCATION INFORMATION: Mile 30.8 Glenn Highway at Knik River Access exit. Reflections Lake and parking area are located on the west side of frontage road.

PART III – PROJECT DESCRIPTION:

PROPOSED WORK – CHECK ALL THAT APPLY

- ☑ STRUCTURE
  - ☐ RESIDENTIAL
  - ☐ COMMERCIAL
  - ☑ NEW CONSTRUCTION
  - ☐ ALTERATION
  - ☐ ADDITION
- ☐ MOBILE HOME
  - ☐ PRIVATE LOT
  - ☐ MOBILE HOME PARK
- ☑ GRADE/EXCAVATION/FILL
- ☐ ROAD CONSTRUCTION
- ☐ NEW SUBDIVISION
- ☐ WATERCOURSE ALTERATION
- ☐ BRIDGE/CULVERT (Please Circle)
- ☐ UTILITY
  - ☐ MAINLINE
  - ☐ SERVICE CONNECT
- ☐ OTHER _____

EXISTING STRUCTURES

1) FAIR MARKET VALUE OF STRUCTURE(s) BEFORE IMPROVEMENT: _____

2) COST OF IMPROVEMENTS: _____

ADDITIONAL IMPERVIOUS AREA TO BE ADDED TO THE FLOODPLAIN (ROOF, PAVEMENT, ETC) _____SQ. FT.

DETAILED PROJECT NARRATIVE (*Attach additional documentation if necessary*)

This project includes the design of infrastructure to improve access and provide recreational opportunities in the Palmer Hay Flats State Game Refuge, as well as the design of the Gold Star Families Memorial Monument, which will increase awareness and provide stewardship of the project site. The project will include the construction of improved paved parking facilities, construction of new amenities, the installation of a bio-swale along the parking facilities to minimize potential wetland impacts, and the construction of an elevated boardwalk within the wetlands that will meet ADA requirements.

PART IV – SUBMITTAL REQUIREMENTS

Check box to indicate information has been provided. ***All applications require the submittal of a site plan****.*

☒ SITE PLAN SHOWING THE NATURE, LOCATION, DIMENSIONS, AND ELEVATION (NGS 1972) OF THE PROPERTY LOCATED WITHIN THE FLOODPLAIN, EXISTING OR PROPOSED STRUCTURES, LOCATION OF PROPOSED FILL, LOCATION OF STORAGE OF MATERIALS INCLUDING FUEL, AND LOCATION OF DRAINAGE FACILITIES. (*Refer to Appendix A for clarification)*

☐ PROPOSED ELEVATION (NGS 1972) OF THE LOWEST FLOOR, INCLUDING BASEMENTS/CRAWLSPACES OF ALL STRUCTURES.

☐ PROPOSED ELEVATION (NGS 1972) OF ALL MACHINERY SERVING THE STRUCTURE INCLUDING FURNACES, HOTWATER HEATERS, AIR CONDITIONING, DUCTWORK, AND UTILITY METERS

☐ FOR NON-RESIDENTIAL CONSTRUCTION ONLY, ELEVATION AND CERTIFICATION BY A REGISTERED ENGINEER OR ARCHITECT THAT FLOOD-PROOFING METHODS FOR ANY NON-RESIDENTIAL STRUCTURES MEET THE FLOOD-PROOFING CRITERIA OF THE MUNICIPAL FLOOD ORDINANCE.

☐ BASE FLOOD ELEVATIONS FOR NEW SUBDIVISONS OR DEVELOPMENT

☐ WRITTEN DESCRIPTION, IF APPLICABLE, DESCRIBING THE EXTENT WHICH A WATERCOURSE WILL BE ALTERED OR RELOCATED AS A RESULT OF THE PROPOSED DEVELOPMENT

☐ NO-RISE CERTIFICATION PREPARED BY A REGISTERED PROFESSIONAL ENGINEER FOR ALL PROJECTS LOCATED IN THE FLOODWAY, AND FOR ALL HYDRAULIC STRUCTURES, DRAINAGE FACILITIES, AND FILL IN FLOOD AREAS WITH BASE FLOOD ELEVATIONS WHERE NO FLOODWAYS HAVE BEEN IDENTIFIED. (Refer to Appendix C)

ASSOCIATED PERMITS

MUNICIPAL PERMITS	PERMIT/CASE NUMBER
☐ RESIDENTIAL/COMMERCIAL BUILDING OR LAND USE PERMIT	
☐ FILL AND GRADE	
☐ STORM WATER POLLUTION PREVENTION PLAN (SWPPP)	NA
☐ PLANNING PLAT OR SITE PLAN REVIEW	

STATE AND FEDERAL PERMITS (Attach Documentation)	STATUS
☑ ARMY CORPS OF ENGINEERS 404 WETLAND PERMIT	Drafting
☐ FISH HABITAT PERMIT	
☐ COASTAL PROJECT REVIEW	
☐ OTHER _____	

ADDITIONAL REQUIREMENTS

IF A PERMIT CAN BE ISSUED FOR A PROPOSED STRUCTURE, IT WILL BE THE RESPONSIBILITY OF THE APPLICANT TO PROVIDE AN FINAL AS-BUILT DRAWING AND ELEVATION CERTIFICATE PREPARED BY A REGISTERED PROFESSIONAL LAND SURVEYOR. A FINAL CERTIFICATE OF OCCUPANCY WILL NOT BE ISSUED UNTIL THESE DOCUMENTS HAVE BEEN SUBMITTED.

Pending Final Design

In signing this application, the landowner(s) or agent hereby grants the Municipality of Anchorage the right to enter the above described location to inspect the work proposed, in progress, or work completed.

I hereby affirm and certify that I am one of the owners or am under contract with the owners, and I believe that the above information and/or statements are true in all respects to the best of my knowledge.

_____ _____

SIGNATURE (*Check One)* ☐ *Owner* ☐ *Applicant* *Date Signed*

FLOOD HAZARD PERMIT FEES

NOTICE: All fees are payable at time of application.

If issuance of a permit for one of these types of developments is, after review, refused by the Municipality of Anchorage, one half of the permit fee deposited will be returned to the applicant.

PROJECT TYPE		FEE
Structure		
	Addition	$ 50.00
	Alteration	50.00
	New residential	200.00
	New commercial	200.00
Watercourse Alteration or Obstruction		600.00
Utility mainline		200.00
Utility service connect		50.00
New subdivision (Plus $200.00 per lot within the floodplain)		600.00
Mobile Home		
	Private Lot	100.00
	Mobile home park (Plus $50.00 per mobile home space within the floodplain)	200.00
Street/Road Construction		400.00
Bank/Slope Restoration (No in-channel work)		50.00
Other		50.00

FOR MOA USE ONLY

FEE CALCULATION	FEE
Structure	_____
Watercourse Alteration	_____
Utility	_____
Subdivision	_____
Mobile Home	_____
Street/Road Construction	_____
Bank/Slope Restoration	_____
Other:_____	_____
TOTAL	_____

APPENDIX A – SITE PLAN REQUIREMENTS

A SITE PLAN IS AN ACCURATE AND DETAILED MAP OF YOUR PROPERTY:

It shows the size, shape, and special features of your property; and the size and location of any buildings or other improvements to the property. Site plans show what currently exists on your property, and any changes or improvements you are proposing to make.

A SITE PLAN MUST CONTAIN THE FOLLOWING INFORMATION:

1. Legal description of parcel, north arrow, and scale
2. All property lines, easements and their dimensions.
3. Names of adjacent roads, location of driveways.
4. Location of streams, or lakes with setbacks indicated
5. Location, size, and shape of all buildings, existing and proposed, with elevation of lowest floor indicated
6. Location and dimensions of existing or proposed sewage systems.
7. Location of all propane tanks, fuel tanks, and generators
8. Dimensions and depth of any fill on site. .
9. A survey showing the existing ground elevations at 4 corners of the building
10. Proposed ground elevations at 4 corners of the building, it applicable
11. Location of any proposed temporary construction fencing, buildings, fuel storage, and erosion control structures.

ELEVATION NOTE: The Municipality of Anchorage requires all VERTICAL datum to be based on 1972 NGS datum. Assumed datum will not be accepted unless the property is located in areas where 1972 NGS datum has not been established.

For structures proposed in the flood plain, the lowest floor elevation must be one foot above the base flood elevation. **Crawlspace grade is also considered "floor elevation" for the purpose of this requirement.**

For those areas where 1972 NGS datum does not exist, a plot plan with contours, lot corner elevations using assumed datum, high-water mark and existing water levels of creeks, lakes, or streams, and proposed lowest living floor elevations, is required.

APPENDIX B- FLOODPLAIN CONSTRUCTION STANDARDS

USE OF FLOOD RESISTANT MATERIALS

The Federal Emergency Management Agency (FEMA) guidelines for flood resistant materials are contained in Technical Bulletin 2-93. This publication is available for review or reproduction upon request. This publication is also available on the Web.

Portions of buildings below the base flood elevation (BFE) are often constructed entirely out of concrete, which is considered a flood resistant material. It is also a common building practice to frame up from a concrete stem wall with wood construction to create a garage/storage space below the elevated first floor. Since garage spaces typically utilize sheetrock to achieve the necessary fire separation, construction of this type results in the use of materials subject to flood damage.

In order to comply with FEMA's guidelines for flood resistant materials as listed in Technical Bulletin 2-93, the use of untreated wood and sheetrock to cover wall members below the BFE is prohibited. The preferred design alternative (other than concrete walls) will be the use of pressure treated heavy timber construction (6"x10" horizontal, 8"x8" vertical) and pressure treated frame members. The ceiling can be protected with sheetrock if the first floor above the protected ceiling is one foot above the BFE and the sheetrock is less than one foot below that elevation. Cement board may be used as a substitute for sheetrock. Siding below the BFE shall utilize the acceptable materials listed in Technical Bulletin 2-93.

The area of a building below the BFE may only used for building access, parking and storage. No living space is permitted below the BFE.

REQUIRED ELEVATION

All construction below the BFE is susceptible to flooding and must consist of flood-resistant materials. The BFE will be established by this department and conveyed to the applicant for incorporation into the building plans. In order to adequately determine if flood-resistant materials are required, applicants proposing construction in flood prone areas shall provide a survey of existing ground elevations of the four corners of the proposed development and the proposed ground elevations of the proposed development.

The BFE shall be shown on the elevation drawings for the proposed structure. The BFE will be established by this department and conveyed to the applicant for incorporation into the building plans.

BASEMENTS

The Municipal Flood Ordinance requires that the lowest floor, including basement, be elevated one foot above the BFE. The National Flood Insurance Program defines a basement as "any area of the building having its floor subgrade (below ground level) on all sides."

Applicants proposing construction in flood prone areas will need to be aware of final interior and exterior grade levels of the proposed structure. Subgrade basements and crawlspaces can incur significant flood insurance penalties.

OPENINGS TO EQUALIZE HYDROSTATIC FLOOD FORCES

The Municipal Flood Ordinance requires that all fully enclosed areas below the lowest floor that are usable solely for parking, building access, or storage in an area other than a basement or crawl space shall have a minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area according to FEMA specifications. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

The vents should be placed on opposing walls to allow the entry and exit of floodwaters. Detailed information about FEMA's flood venting requirement may be found in Technical Bulletin 1. This publication is available for review or reproduction upon request. This publication is also available on the Web.

ELECTRICAL GEAR AND EQUIPMENT

All electrical, heating, ventilation, plumbing and air conditioning equipment that is permanently affixed to a structure and which may be subject to floodwater damage shall be elevated a minimum of one foot above the BFE or higher unless otherwise constructed to prohibit the entry of flood waters. FEMA has published a document titled *Protecting Building Utilities from Flood Damage* that gives specific guidance on proper construction technique. This publication is available for review or reproduction upon request. This publication is also available on the Web.

FILL/ENCROACHMENT GUIDELINES

Proposed developments cumulatively may not increase base flood heights more that one-foot anywhere in the identified floodplain. (Applies only to floodplains with BFEs but without identified floodways.)

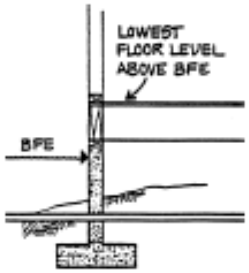
All watercourse alterations or modifications must not reduce the carrying capacity of the stream or increase BFEs. Watercourse alterations or modifications must not reduce the carrying capacity of the stream or increase BFEs. The applicant must submit an analysis that compares existing channel capacity with proposed capacity. Alteration or modification must maintain carrying capacity of the watercourse. Floodway regulations apply for alterations within a designated floodway (Appendix C).

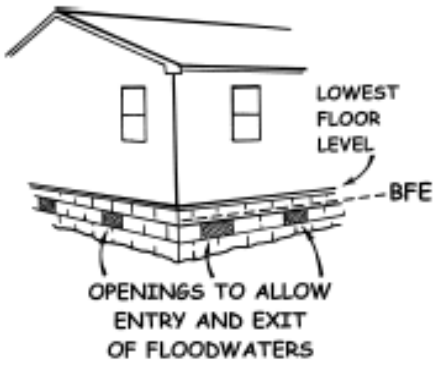
If fill is to be placed within the floodplain areas the applicant must include with the application the volume, height, and sideslope of the fill perimeter within the floodplain. The applicant must also indicate the method used to protect the fill from erosion. The placement must not interfere with any existing utilities or easements. Fill must not unreasonably obstruct or divert the flow of surface water to the detriment of adjacent or hydraulically affected property owners.

SPECIFIC FLOODPLAIN CONSTRUCTION STANDARDS

Residential Structures:

Residential structures must have the lowest floor including basement elevated at least to or above the BFE. This elevation requirement can be accomplished by any of the following three (3) methods:





1. Foundation Stem Walls:
The crawlspace must not be below grade. It must have as a minimum two permanent openings no more than one foot above grade. The total area of the openings must be no less than 1 square inch for every square foot of enclosed space. This helps to relieve hydrostatic pressure on the foundation during a flood. Any covers placed over the openings must be able to open automatically during flood flows without human intervention. Screens are acceptable if they permit entry and exit of floodwater.

2. Fill:
A poured slab placed over compacted fill can also be used to elevate the lowest floor of a structure to one foot above the BFE. Please note that when a building site is filled, it is still in the floodplain and no basements are permitted.

3. Piers, Piles and Posts:
This method is commonly used to avoid large fills and when flood heights are extreme. The supporting members must be designed to resist hydrostatic and hydrodynamic forces. Fully enclosed areas below the BFE can only be used for parking, access and limited storage. In addition, the following conditions must be met for any enclosed area below the BFE:

a) Service equipment (e.g., furnaces, water heaters, washers/dryers, etc.) are NOT

permitted below the BFE.

b) All walls, floors, and ceiling materials located below the BFE must be unfinished and constructed of materials resistant to flood damage.

c) The walls of any enclosed area below the BFE must be designed by a registered professional engineer or architect in a manner to prevent lateral movement, collapse or flotation of the structure. There must be at least two openings on each wall and the bottom of all openings must be no higher than one foot above grade.

Non-residential Structures

Must have the lowest floor including basement elevated to or above the BFE, or floodproofed at least one foot above BFE. If floodproofed, structures must be dry-floodproofed, which means keeping the water out. Non-residential (commercial) structures, together with attendant utility and sanitary facilities, are designed so that the structure is watertight below the base flood level. The walls are impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. Additionally, the structure must be designed to:

- prevent seepage, collapse or cracking of basement walls
- prevent buckling of basement floors
- prevent back-up of water from sewer lines
- have all openings located one foot above BFE
- all protective features must operate automatically without human intervention

Note: Dry floodproofing measures must be certified by a licensed engineer and only apply to non-residential structures.

APPENDIX C – "NO-RISE" ANAYLSIS PROCEDURES

Section 60.3(d)(3) of the National Flood Insurance Program (NFIP) requires that the Municipality to prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the city during the occurrence of the base (100-year) flood discharge.

In most cases, the "No-Rise Certificate" must be supported by technical data based upon the standard step-backwater computer model utilized to develop the 100-year floodway shown on the Anchorage's effective Flood Insurance Rate Map (FIRM) or Flood Boundary and Floodway Map (FBFM) and the results tabulated on the Flood Insurance Study (FIS) for Anchorage.

The analysis procedure is outlined in the attached document from the Federal Emergency Management Agency. While the attached guidelines specifically address floodway development the same procedure can be used to determine the impact of projects in flood zones without BFEs has that have the potential to increase flood elevations.

U.S. Department of Homeland Security
Region X
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

Procedures for "No-Rise" Certification
For Proposed Developments in the Regulatory Floodway

Section 60.3 (d) (3) of the National Flood Insurance Program (NFIP) regulations states that a community shall "prohibit encroachments, including fill, new construction, substantial improvements and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base (100-year) flood discharge."

Prior to issuing any building, grading or development permits involving activities in a regulatory floodway the community must obtain a certification stating the proposed development will not impact the pre-project base flood elevations, floodway elevations, or floodway data widths. The certification should be obtained from the applicant and be signed and sealed by a professional engineer.

The engineering or "no-rise" certification must be supported by technical data.

The supporting technical data should be based upon hydraulic analyses that utilize the same model used to prepare the effective Flood Insurance Study (FIS) report and Flood Insurance Rate Map (FIRM) unless it is demonstrated that the 'effective' hydraulic model is unavailable or its use is inappropriate. If an alternative hydraulic model is used, the new model must be calibrated to reproduce the FIS profiles within 0.5 feet. Hydraulic model used in the analysis must be on FEMA's accepted models list, or documentation must be provided showing the model meets the requirements of NFIP regulation 65.6(a)(6).

Although communities are required to review and approve the "no-rise" submittals, they may request, in writing, technical assistance and review from the FEMA regional office. However, if this alternative is chosen, the community must review the technical submittal package and verify that all supporting data, listed in the following paragraphs, are included in the package before forwarding to FEMA.

To support a "no-rise" certification for proposed developments encroaching into the regulatory floodway, a community will require that the following procedures be followed:

1. Current Effective Model: Submit a written request for the effective model for the specified stream and community, identifying the limits of the requested data. A fee will be assessed for providing the data. Send data requests to:

   Michael Baker Jr., Inc.
   3601 Eisenhower Avenue
   Alexandria, Virginia 22304
   (703) 960-8800

2. Duplicate Effective Model: Upon receipt of the effective computer model, the engineer should run the original model to duplicate the output in the effective (FIS).

3. Corrected Effective Model: The model that corrects any errors that occur in the Duplicate Effective model, adds any additional cross sections, or incorporates more detailed topographic information than that used in the current effective model. Floodway limits should be manually set at the new cross-section locations by measuring from the effective FIRM or FBFM. The cumulative reach lengths of the stream should also remain unchanged. The Corrected Effective model must not reflect any man-made physical changes since the date of the effective model.

4. Existing, or Pre-Project Conditions Model: Revise the Duplicate Effective or the Corrected Effective model to reflect any modifications that have occurred within the floodplain since the date of the Effective model but prior to the construction of the project. If no modifications have occurred since the date of the effective model, then the model would be identical to the Duplicate Effective or Corrected Effective model. The results of this Existing Conditions analysis will indicate the 100-yr elevations at the project site.

5. Proposed, or Post-Project Conditions Model: Modify the Existing Condition or Pre-Project Conditions Model (or Duplicate Effective model or Corrected Effective model, as appropriate) to reflect revised or post-project conditions. The overbank roughness coefficients should remain the same unless a reasonable explanation of how the proposed development will impact Manning's "n" values is included with the supporting data. The results of this analysis will indicate the 100-year elevation for proposed conditions at the project site. These results must indicate NO impact on the 100-year floodway elevations when compared to the Existing Conditions or Pre-Project Conditions model. If an increase results the project will require the submittal of a CLOMR prior to the start of the project.

The "no-rise" supporting data and a copy of the engineering certification must be submitted to and reviewed by the appropriate community official prior to issuing a permit.

The "no-rise" supporting data should include, but may not be limited to:

1) Copy of the Duplicate Effective model;

2) Copy of the Corrected Effective model;

3) Existing conditions, or Pre-Project conditions model

4) Proposed conditions or Post-Project conditions model.

5) FIRM and topographic map, showing floodplain and floodway, the additional cross-sections, the site location with the proposed topographic modification superimposed onto the maps, and a copy of the effective FIRM or FBFM showing the current regulatory floodway.

6) Documentation clearly stating analysis procedures. All modifications made to the original FIS model to represent revised existing conditions, as well as those made to the revised existing conditions model to represent proposed conditions, should be well documented and submitted with all supporting data.

7) Copy of effective Floodway Data Table copied from the (FIS) report.

8) Statement defining source of additional cross-section topographic data and supporting information.

9) Cross-section plots, of the added cross sections, for revised existing and proposed conditions.

10) Certified planimetric (boundary survey) information indicating the location of structures on the property.

11) Copy of the source from which input for original FIS model was taken.

12) CD with all input and output files.

13) Printout of output files from EDIT runs for all three floodway models.

The engineering "no-rise" certification and-supporting technical data must stipulate NO impact on the 100-year flood or floodway elevations at the new cross-sections and at all existing cross-sections anywhere in the model. Therefore, the revised computer model should be run for a sufficient distance (usually one mile, depending on hydraulic slope of

the stream) upstream and downstream of the development site to insure proper "no-rise" certification.

Attached is a sample "no-rise" certification form that can be completed by a registered professional engineer and supplied to the community along with the supporting technical data when applying for a development permit.

ENGINEERING "NO-RISE" CERTIFICATION

This is to certify that I am a duly qualified engineer licensed to practice in the State of _____.

It is to further certify that the attached technical data supports the fact that proposed _____ will
(Name of Development)
not impact the 100-year flood elevations, floodway elevations and floodway widths on _____ at published sections
(Name of Stream)
in the Flood Insurance Study for _____,
(Name of Community)
dated _____ and will not impact the 100-year flood elevations, floodway elevations, and floodway widths at unpublished cross-sections in the vicinity of the proposed development.

Attached are the following documents that support my findings:

_____
_____
_____

_____ _____
(Date) (Signature)

_____
(Title)

seal:

_____
(Address)

MATANUSKA-SUSITNA BOROUGH

350 East Dahlia Avenue, Palmer, Alaska 99645-6488
Planning and Land Use Department
Development Services Division (907) 861-7822
FAX (907) 861-8158 - E-Mail PermitCenter@matsugov.us

FLOODPLAIN DEVELOPMENT ACKNOWLEDGEMENT NOTICE

Matanuska-Susitna Borough Code 17.29.100

"A development permit shall be obtained before construction or development begins within any area of special flood hazard established in MSB 17.29.060. The permit shall be for all structures, including manufactured homes, as set forth in the definitions, and for all development including fill and other activities, also as set forth in the definitions."

I Emily Amato hereby acknowledge that I have read, understand and will
(Print Applicants Name)
comply with MSB 17.29.100. Failure to do so may result in enforcement actions in accordance with MSB 1.45.

Development Site Address: Mile 30.8 Glenn Highway at Knik River Access exit

Applicants Mailing Address: 2900 Spirit Way, Anchorage, AK 99508

Applicants e-mail Address: eramato@alaska.edu

Applicants Phone number: 907-354-1997

_____ _____
Applicants Signature Date

Received by and copy given to applicant

_____ _____
Permit Center Date

MATANUSKA-SUSITNA BOROUGH
Planning and Land Use Department
Permit Center
350 East Dahlia Ave, Palmer, Alaska 99645
(907)861-7822 fax (907)861-8158
permitcenter@matsugov.us

APPLICATION FOR FLOODPLAIN DEVELOPMENT PERMIT MSB 17.29

Application Fee is: $100 for proposed development. *The application must be complete with all attachments. Please carefully read MSB 17.29 and these instructions. Fill out forms completely. Use N/A if a question is not applicable. Address all development. Attach additional sheets as needed. Additional information and permits may be required. For more information go to www.matsugov.us and click on Flood Info.*

REQUIRED ATTACHMENTS ***(All drawings must be to scale and show all required dimensions)***
☑ **A site plan showing horizontal dimensions and location of all existing and proposed development on the site.**
☑ **Drawings or photos depicting what the development will look like showing vertical dimensions.**
☐ **A completed Elevation Certificate.**

PROJECT LOCATION: TRS 016N, 001E, 15, Meridian Seward

SUBDIVISION: _____ BLOCK:_____, LOT:_____

STREET ADDRESS: Mile 30.8 Glenn Highway at Knik River Access exit

MSB TAX ACCOUNT ID#: _____

FLOODING SOURCE: _____

Is site in a Special Use District (SPUD) or City? ☐ Yes ☑ No

If yes, which SPUD or City? _____

Development and use must also comply with the rules for the SPUD and city.

Ownership: If the applicant is not the property owner of record, a letter of authorization signed by the owner must be attached to this application.

Is written owner's authorization attached? ☑ N/A ☐ Yes ☐ No

Name of Property Owner
Alaska Department of Fish & Game, ADF&G
Address: 333 Raspberry Rd, Anchorage, AK 99518
Phone: Hm: 907-267-2342
Wk: _____
Email: _____

Name of Property Owner
_____
Address: _____
_____
Phone: Hm: _____
Wk: _____
Email: _____

Type of Use:

❑ Residential, Number of dwelling units _____
❑ Commercial
❑ Industrial
☑ Public/Institutional

Describe the use:

One-mile trail around Reflections Lake that offers easy walking year-round to the public, as well as access to fishing, and boating.

Type of Project:

☑ New Structure
❑ Relocation
☑ Existing
❑ Crawl Space
❑ Addition
❑ Mobile/Manufactured home placement
❑ Private Storage/Garage
❑ Dock
❑ Road/Bridge construction
❑ Other type of structure(s) (Tank, Tower, etc.) Describe:

☑ Excavation TBD total cubic yards.
☑ Fill TBD total cubic yards
☑ Grading TBD square feet.
❑ Dredging _____total cubic yards.
❑ Drilling
❑ Watercourse/shoreline alteration
❑ Paving _____ square feet
❑ Mining (gravel, soil, etc.) _____ total cu yds.
❑ Utilities, type _____

Substantial Improvement means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of a structure either before the improvement or repair is started or if the structure has been damaged and is being restored, before the damage occurred.

Is this project a Substantial Improvement? ☑ Yes ❑ No
If Yes: When was the existing structure originally built? 1963

Value of existing structure prior to proposed addition/alteration repair $TBD

Estimated cost of addition/alteration addressed by this application $TBD
*A detailed estimate must be submitted with application

Project Description: *{Example: Warehouse – 20,000 sq. ft.; Office – 5,000 sq. ft., etc. or living space 1,000 sq. ft.; Garage 400 sq. ft., 20,000 sq. ft. paved parking area, 98 ft. tall tower or, 1,000 cubic yards of fill.} Include all structures and development.*

This project includes the desgn of infrastructure to improve access and provide recreational opportunities in the Palmer Hay Flats State Game Refuge, as well as the design of the Gold Star Families Memorial Monument which will increase awareness and provide stewardship of the project site. The project will include the construction of improved paved parking facilities, construction of new amenities, and the installation of a bio-swale.

Maximum height of structure above avg. grade: _____ ft.
Number of stories above avg. grade: _____
Total exterior gross area of Building: _____ sq. ft.
Type of foundation: _____
How is the structure anchored?
_____
_____

Type of Sewage Disposal: ❑ None ❑ Existing ❑ Proposed ❑ Pit Privy ❑ Holding Tank ❑ Septic Tank ❑ Public/Community ❑ Other (Specify)_____

No part of a subsurface sewage disposal system shall be closer than 100 ft from any body of water or water course (MSB Title 17.55.020)

Type of Water Supply: ❑ None ❑ Existing ❑ Proposed ❑ Private well/Cistern ❑ Public/Community

Provide additional details on flood proofing and anchoring for sewage disposal systems pursuant to the National Flood insurance Program (NFIP).

_____

_____

_____

APPLICANT'S SIGNATURE

I understand that for each building located in numbered A Zones, which is constructed or substantially improved under this permit, the owner must provide to the Borough the actual "As Built" elevation (in relation to mean sea level) of the lowest floor within 90 days of completion of the structure.

I am the owner of this property, or the owner's authorized agent, and I attest that the information in this application is true and agree to conform to all applicable laws of this jurisdiction.

_____	_____	_____
Applicant Printed Name	**Applicant Signature**	**Date**

WARNING AND DISCLAIMER OF LIABILITY.

The degree of flood protection required by this permit is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by manmade or natural causes. This permit does not imply the property or structures will be free from flooding or flood damages. This permit does not create any duty or liability on the part of the borough, any officer or employee thereof, or the Federal Insurance Administration for any flood damages that result from reliance on this permit or any administrative decision made hereunder

FLOODPLAIN DETERMINATION*(To be completed by the Administrator)*

1. MSB FLOOD HAZARD AREA DEVELOPMENT PERMIT - ALL NEW STRUCTURES INCLUDING MANUFACTURED HOMES, SUBSTANTIAL IMPROVEMENTS, AND OTHER DEVELOPMENT.
   - a. Is elevation certification attached? ❑ Yes ❑ No
   - b. Is proposed Site Plan attached? ❑ Yes ❑ No
   - c. Is site in a designated Flood Hazard Area? ❑ Not Mapped ❑ Yes ❑ No
     FIRM Panel # _____FIRM Zone _____
     BFE _____ Source _____LAG _____ Lowest Floor _____
   - d. Is site in a designated Floodway? ❑ Not Mapped ❑ Yes ❑ No
   - e. Does structure have an enclosed crawl space? ❑ Yes ❑ No
   - f. Will structure/improvement(s) be anchored to prevent floatation, collapse, and lateral movement? ❑ Yes ❑ No
   - g. Will all materials and utility equipment used be resistant to flood damage? ❑ Yes ❑ No
   - h. Will all construction methods and practices, minimize flood damage? ❑ Yes ❑ No

2. NON-RESIDENTIAL STRUCTURE ❑ N/A
   - a. Is first floor flood-proofed to base flood elevation? ❑ Yes ❑ No
   - b. Is structure capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy? ❑ Yes ❑ No

3. MANUFACTURED HOME ❑ N/A
   - a. Will manufactured home be placed on a permanent foundation? ❑ Yes ❑ No
   - b. Will manufactured home be anchored with over-the-top and frame ties to ground anchors in accordance with MSB 17.29.160? ❑ Yes ❑ No

4. UTILITIES AND OTHER DEVELOPMENT ❑ N/A
   - a. Are new and replacement water and sewer systems designated to minimize and eliminate infiltration of flood waters? ❑ Yes ❑ No
   - b. Is new or replacement sanitary sewage system designed to minimize or eliminate discharge from system to flood waters? ❑ Yes ❑ No
   - c. Is on-site waste disposal system located to avoid impairment and contamination during flooding? ❑ Yes ❑ No
   - d. Are all tanks, containment areas, pipeline, dikes, diversion areas, ditches, fill, etc. located or designed to avoid impairment and contamination during flooding? ❑ Yes ❑ No
   - e. Are all electrical, heating, ventilation, plumbing and air conditioning equipment and other service designed, elevated or located to prevent flood waters from entering and accumulating in components? ❑ Yes ❑ No

5. EXCAVATION OR FILL/ROAD CONSTRUCTION ❑ N/A
   a. Will fill encroach upon a mapped floodway? ❑ Yes ❑ No
   b. Are culverts or drainage provided to maintain existing drainage patterns? ❑ Yes ❑ No

6. ALTERATION, RELOCATION OR, ENCROACHMENT IN, WATER COURSE ❑ N/A
   a. Will watercourse be altered or relocated? ❑ Yes ❑ No
   b. Will proposed development encroach into any watercourse? ❑ Yes ❑ No
   c. Describe the type, and extent of any encroachment into, alteration or relocation of a water course resulting from the proposed development. _____
   _____
   _____
   d. Will encroachment, relocation, or alternation of the water course result in diminished flood carrying capacity during occurrence of the base flood discharge? ❑ Yes ❑ No

REVIEWED BY:

_____ _____

Certified Floodplain Manager **Date**

Emily Amato
FAAME Engineering
2900 Spirit Way
Anchorage, AK 99508
(907) 354-1997

March 28, 2021

State Historic Preservation Office
550 West 7th Avenue, Suite 1310
Anchorage, AK 99501

RE: REQUEST FOR SHPO SECTION 106 REVIEW, CED 2021.04 KNIK RIVER ACCESS RECREATIONAL SITE PROJECT, PALMER, ALASKA

To Whom it May Concern,

FAAME Engineering is requesting a State Historic Preservation Office Review, SHPO Section 106 for construction within the Palmer Hay Flats State Game Refuge.

General Information:

- CED 2021.04 Knik River Recreation Site Access
- Alaska Department of Fish & Game, ADF&G
- The project is located at Mile 30.8 on the Glenn Highway at the Knik River Access exit.
- The proposed project is located within Township 016N, Range 001E, Section 15, Latitude 61.48333˚, and Longitude -149.266667˚.

Required Agency Information

Application Contact Info:

FAAME Engineering
2900 Spirit Way
Anchorage, AK 99508
(907) 354-1997

Other Parties Involved:

Alaska Department of Fish & Game, ADF&G
333 Raspberry Road
Anchorage, AK 99518
907-267-2342

Alaska Department of Natural Resources, DNR
550 W 7th Avenue, Suite 1360
Anchorage, AK 99501
907-269-8400

Project Description:
This project includes the design of infrastructure to improve access and provide recreational opportunities in the Palmer Hay Flats State Game Refuge, as well as the design of the Gold Star Families Memorial Monument, which will increase awareness and improve stewardship of the site.

Improvements of Infrastructure:

- Construction of improved paved parking facilities
  - 15 12'x46' Trailer Spots
  - 15 12'x18' Passenger Vehicle Spots
    - 2 ADA Access Spots
- Construction of new amenities
  - Kids Don't Float Kiosk
  - Orientation Kiosk
  - Picnic Shelter
  - Vaulted Toilet
- Installation of Bio-Swale Along Parking Facilities to minimize potential wetland impacts
  - Trapezoidal Cross-Section
    - 4:1 (H:V) Side Slopes, 2ft Flat Bottom
    - 578 ft Length with Longitudinal Slopes of 0.25%-0.40%

- Construction of Elevated Boardwalk within potential wetlands
  - 8' Wide Boardwalk, with Helical Piles
  - Will meet minimum ADA Requirements

Gold Star Memorial Monument:

- Strip Footing Foundation
- Reseeding of disturbed areas to match surrounding vegetation

Sincerely,

Emily Amato

Emily Amato, Environmental Technical Lead

Enclosures:
Figure 1: Location and Vicinity Map
Figure 2: Project Overview and Existing Facilities
Figure 3: 65% Proposed Design
Request for SHPO Section 106 Review

Figure 1: Project Location and Vicinity Map

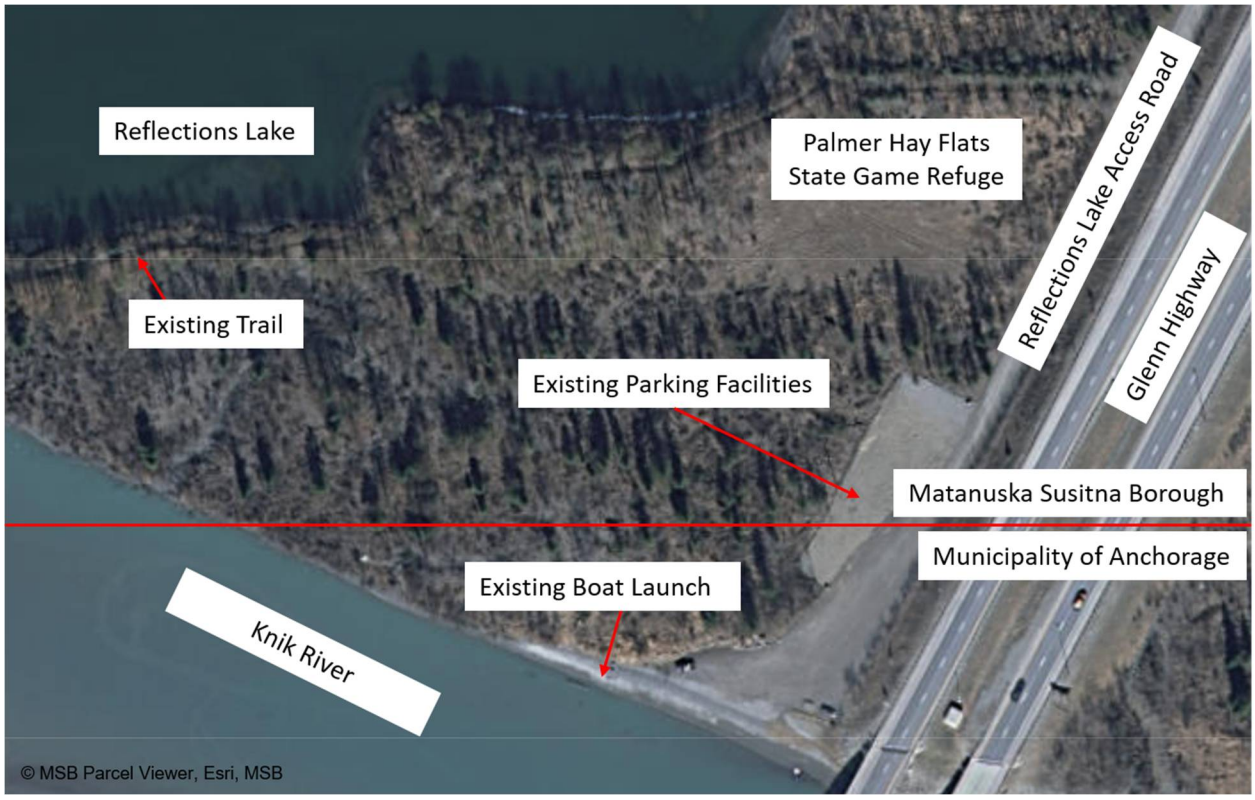


Figure 2: Project Overview and Existing Facilities

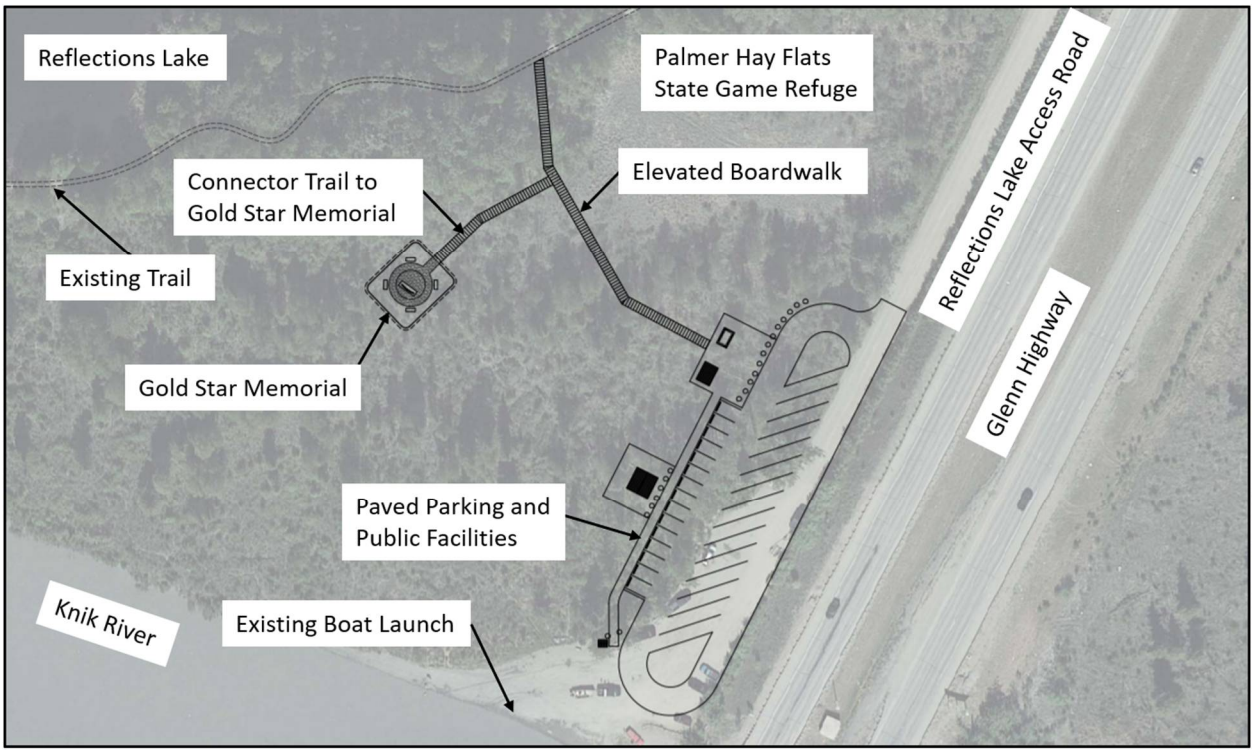


Figure 3: 65% Proposed Design

Request for SHPO Section 106 Review (36 CFR 800)

May also be used for review pursuant to Alaska Statute [A.S.] 41.35.070

Please use this form as a checklist and provide responses as an Appendix to this application. ***Incomplete forms may be returned. Please print, complete, and mail this form and accompanying material (typed) to:***

STATE HISTORIC PRESERVATION OFFICE | OFFICE OF HISTORY AND ARCHAEOLOGY | DEPARTMENT OF NATURAL RESOURCES
550 West 7th Avenue, Suite 1310, Anchorage, AK 99501

If this is a small project with few accompanying attachments, you may email the request to oha.revcomp@alaska.gov

Please note that as stipulated in 36 CFR 800.2(c), other consulting parties such as the local government and Tribes are required to be notified of the undertaking. Information provided by other consulting parties may cause us to re-evaluate our comments and recommendations. Please note that our comment does not end the 30-day review period provided to other consulting parties.

REQUIRED AGENCY INFORMATION

It is the statutory obligation of the Federal agency to fulfill the requirements of section 106 (36 CFR 800.2[a]). The agency official remains legally responsible for all required findings and determinations (36 CFR 800.2[a][3]).

☑ **Contact Information for Party Requesting Review** (provide your name, title, and applicable contact info)

☑ **Other Parties Involved** (check all that apply)**: Federal** ☐ **State** ☑ **Local** ☐ **N/A / Private** ☐

Describe the nature of involvement (funding, jurisdiction, permit, license, approval)

☐ **Federal, State, Local Agency contact information** (name, title, contact info for agency official)

I. GENERAL INFORMATION

☑ **Project Name**

☑ **Landowner**

☑ **Project Address / Location**

☐ **USGS Quad Map Name**

☑ **Meridian: Township: Range: Section:**

☐ **NAD 83 Latitude/Longitude:** (Decimal Latitude) (Decimal Longitude)

II. GROUND DISTURBING ACTIVITY

Examples include, but are not limited to excavation, trenching, grading, tree removal, hydroaxing, utility installation, new construction, access roads, borrow areas, and staging/storage areas.

DOES THIS PROJECT INVOLVE GROUND DISTURBANCE? ☑ YES ☐ NO Pending Final Design

☐ **Description of length, width, and depth of proposed ground disturbance**

☐ **Previous and current land use, condition, and disturbances**

☐ **Are there archaeological resources on the property?** ☐ YES ☐ NO **How was this determined?**

III. DESCRIPTION OF THE PROJECT (UNDERTAKING)

☑ **Detailed written description of the project**

☑ **Attach localized project map**

☑ **Attach photographs of the project area** (Current, historic, and aerial photos are helpful)

IV. AREA OF POTENTIAL EFFECTS (APE)

The APE is the geographic area or areas within which an undertaking or project may cause direct or indirect changes in the character or use of historic properties. **Every undertaking has an APE.**

☑ **Identify the APE on the USGS map and localized project map**

☑ **Explain how the APE was developed and how it encompasses potential direct and indirect effects**

Pending Final Design

V. IDENTIFICATION OF HISTORIC PROPERTIES

Defined as prehistoric or historic sites, buildings, structures, objects, districts, landscapes, or properties of traditional religious and cultural importance to Tribes included in, *or eligible for,* the National Register of Historic Places (NRHP).

Record each cultural resource within the APE using the AHRS Data Form (http://dnr.alaska.gov/parks/oha/ahrs/ahrsform.pdf) and/or the AHRS Building Form (http://dnr.alaska.gov/parks/oha/ahrs/buildinventory.pdf).

☐ **Describe the steps taken (methodology) to identify cultural resources in the APE**

☐ **Describe, date, map, and photograph all cultural resources located in the APE.**

Please select one or more of the following:

☐ Previously-unknown cultural resources present in the APE. Proceed to Section VI.

☐ Known or previously-reported cultural resources present in the APE. Proceed to Section VI.

Using professional judgment, determine if a site reevaluation and updated DOE is necessary. Provide basis for decision.

☐ No cultural resources present in the APE. Proceed to Section VII. Note: finding of effect will be "No historic properties affected."

Alaska Heritage Resources Survey (AHRS) REQUIREMENTS

AHRS numbers are **required** for all cultural resources in the APE. Shape files should be submitted for each AHRS site location as well as for surveyed areas. Alternatively, you may include a table containing survey and AHRS site boundary metadata in the report. To obtain AHRS numbers or for questions regarding AHRS requirements and shapefile schema, contact our office at 907.269.8721 or visit: http://dnr.alaska.gov/parks/oha/ahrs/ahrs.htm.

VI. DETERMINATION OF ELIGIBILITY

A determination of eligibility (DOE) should be provided for each cultural resource in the APE. Only a qualified professional in an appropriate field of study should make these determinations. Please see "How to Apply the National Register Criteria for Evaluation" available at: http://www.cr.nps.gov/nr/publications/bulletins/nrb15/. Provide the basis for each NRHP eligibility assessment using the following.

- Category of Historic Property (district, site, building, structure, object, other)
- Historic Context specific to the property type(s)
- Area/s of Significance
- NRHP Criteria for Evaluation (A, B, C or D and criteria considerations A-G)
- Level of Significance: local, state or national
- Seven Aspects of Integrity (location, design, setting, materials, workmanship, feeling and association)

☐ **Cultural resources present within the APE but none is eligible for inclusion in the NRHP.** Note: finding of effect will be "No historic properties affected."

☐ **Historic properties (36 CFR 800.16[d]) present within the APE.** Note: the next step is to determine if the effect will be adverse. Apply Criteria of Adverse Effect at 36 CFR 800.5.

VII. FINDING OF EFFECT

Please provide the basis for your finding.

☐ No historic properties affected [36 CFR 800.4(d)(1)].

☐ No Adverse Effect [36 CFR 800.5(b)]. See examples of adverse effects at 36 CFR 800.5(a)(2).

☐ Adverse Effect [36 CFR 800.5(d)(2)]. If an undertaking results in an adverse effect, further consultation must occur to resolve the adverse effect.

☐ **Consulting parties:** Has this material been provided to other consulting parties (36 CFR 800.2[c]) such as the local government and Tribes? Please explain / describe the nature of this consultation. We request being involved in the consultation process with other consulting parties, as appropriate, if additional information is provided that is relevant to the consideration of historic properties.

APPENDIX D

Engineer's Estimate

ENGINEER'S ESTIMATE State of Alaska Department of Natural Resources	Knik River Access: Palmer Hay Flats State Game Refuge

Basic Bid

Item Number	*Description*	*Unit*	*Quantity*	*Unit Price*	*Amount*
201(1B)	CLEARING	Lump Sum	All Required	5,000.00	5,000.00
201(2B)	GRUBBING	Lump Sum	All Required	5,000.00	5,000.00
201(7)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	Lump Sum	All Required	7,500.00	7,500.00
203(3)	UNCLASSIFIED EXCAVATION	Cubic Yard	4,390	12.00	52,680.00
203(6A)	BORROW, TYPE A	Ton	5,500	25.00	137,500.00
203(27)	BIOSWALE GRADING	Linear Foot	575	40.00	23,000.00
205(6)	STRUCTURAL FILL	Cubic Yard	1200	25.00	30,000.00
301(1)	AGGREGATE BASE COURSE, GRADING D-1	Ton	1,150	45.00	51,750.00
401(1B)	HMA, TYPE II; CLASS B	Ton	575	115.00	66,125.00
401(4)	ASPHALT BINDER, GRADE PG 58-28	Ton	35	1,000.00	34,500.00
401(8B)	HMA PRICE ADJUSTMENT, TYPE II; CLASS B	Contingent Sum	All Required	2,800.00	2,800.00
501(1)	CLASS A CONCRETE	Lump Sum	All Required	15,000.00	15,000.00
505(12)	FURNISH AND DRILL ABOVE-GRADE BOARDWALK ANCHORS	Each	124	500.00	62,000.00
506(5)	BOARDWALK, ELEVATED (TYPE A)	Linear Foot	492	550.00	270,600.00
506(10)	END OF BOARDWALK TRANSITION	Each	2	2,000.00	4,000.00
608(1A)	CONCRETE SIDEWALK, 4 INCHES THICK	Square Yard	274	80.00	21,920.00
607(3)	CHAIN LINK FENCE (8' TALL)	Linear Foot	430	40.00	17,200.00
615(1)	STANDARD SIGN	Square Foot	12	110.00	1,320.00
618(2)	SEEDING	MSF	28	900.00	25,200.00
620(2)	TOPSOIL	Square Yard	3,100	10.00	31,000.00
630(1)	GEOTEXTILE, SEPARATION, CLASS 3	Square Yard	10,670	3.00	32,010.00
640(1)	MOBILIZATION AND DEMOBILIZATION	Lump Sum	All Required	30,000.00	30,000.00
641(1)	EROSION, SEDIMENT AND POLLUTION CONTROL ADMINISTRATION	Lump Sum	All Required	10,000.00	10,000.00
641(5)	TEMPORARY EROSION, SEDIMENT AND POLLUTION CONTROL	Contingent Sum	All Required	15,000.00	15,000.00
641(6)	WITHHOLDING	Contingent Sum	All Required	0.00	0.00
642(1)	CONSTRUCTION SURVEYING	Lump Sum	All Required	25,000.00	25,000.00
642(3)	THREE PERSON SURVEY PARTY	Lump Sum	All Required	15,000.00	15,000.00
643(15)	FLAGGING	Contingent Sum	All Required	5,000.00	5,000.00

ENGINEER'S ESTIMATE **State of Alaska** **Department of Natural Resources**	Knik River Access: Palmer Hay Flats State Game Refuge

Basic Bid

Item Number	*Description*	*Unit*	*Quantity*	*Unit Price*	*Amount*
643(25)	TRAFFIC CONTROL	Contingent Sum	All Required	5,000.00	5,000.00
647(5)	BACKHOE, 4WD, 1 CY BUCKET, 75 HP MIN	Contingent Sum	All Required	5,000.00	5,000.00
650(1)	PICNIC TABLE	EACH	2	1,500.00	3,000.00
650(3B)	PARK BENCH, TYPE B	EACH	4	2,500.00	10,000.00
650(17)	CONCRETE PARKING BUMPER	EACH	15	200.00	3,000.00
650(21)	BARRIER ROCK	EACH	7	500.00	3,500.00
650(26)	PICNIC SHELTER	EACH	1	20,000.00	20,000.00
650(39B)	ORIENTATION KIOSK	EACH	1	30,000.00	30,000.00
650(51A)	KIDS DON'T FLOAT KIOSK, TYPE A	EACH	1	8,000.00	8,000.00
654(2)	DOUBLE CONCRETE VAULTED TOILET	EACH	1	85,000.00	85,000.00
670(1)	PAINTED TRAFFIC MARKINGS	Lump Sum	All Required	20,000.00	20,000.00
680(1)	GOLD STAR MEMORIAL	Lump Sum	All Required	75,000.00	75,000.00
682(1)	VAC-TRUCK POTHOLE	Contingent Sum	All Required	5,000.00	5,000.00

PROJECT SUMMARY		
	BASIC BID (BB) TOTAL	**$1,269,000.00**
	PROJECT CONTINGENCY (PC, 20% of BB)	**254,000.00**
	DESIGN SERVICES (DS, 5% of BB)	**64,000.00**
	CONSTRUCTION ADMIN. (CA, 10% of BB)	**127,000.00**
	PROJECT TOTAL (BB + PC + DS + CA)	**$1,714,000.00**