Noatak River Gravel Mine

Material Site Reclamation Plan

Drake Construction, Inc
April, 2025

mlp & associates

2025 Material Site Reclamation Plan for Noatak River Gravel Mine

Kotzebue, Alaska

April 2025

Prepared For:

Drake Construction, Inc.
PO Box 338
Kotzebue, Alaska 99752

Prepared By:

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721 Depot Drive
Anchorage, Alaska 99501

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Appendix A: Drawings
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1. Introduction

1.1. Purpose and Scope

Drake Construction, Inc. (DCI) is proposing to continue development of an aggregate material source in western Alaska, about 560 miles northwest of Anchorage and about 19 miles north of Kotzebue along the northeastern bank of the Noatak River (see Sheet 1). This document was prepared in accordance with state regulations governing the reclamation of mined lands and describes reclamation goals and techniques for the mine site and ancillary facilities.

The purpose of this Reclamation Plan (Plan) is to provide guidelines for implementing stabilization and reclamation procedures for the material source. These guidelines are based on the best available reclamation technologies. As DCI is committed to concurrent reclamation of portions of the site during operations, these guidelines may be modified as actual reclamation data is gathered during field reclamation of individual facilities or reclamation test plots. Revisions to this Plan would be made to address changes in the design, construction, operations, and concurrent stabilization and reclamation of the facility.

This approach will:

- Allow the incorporation of new design information as subsequent phases of the project are developed
- reflect changes in the operating plans and mining schedule
- account for the stabilization and reclamation of previous phases or specific components of the facility
- incorporate information and actual operating experience developed during the initial phases of the project
- allow for the utilization of new, reasonable and practical reclamation techniques as they are developed.

The following table provides a record of changes to this Plan.

Record of changes and amendments.

Date	Section(s) Revised or Amended

The document is submitted in accordance with Alaska Statute 27.19, reclamation is required of all mining operations, including sand and gravel extraction.

Gravel mining operations were initially permitted on March 10, 2009 and placed into use on August 1, 2011. The total aggregate mined since 2011 is approximately 150,000 cubic yards. The current excavation site is approximately 21.5 acres.

2. Applicant Information [11 AAC 97.310(b)(1)]

2.1. Corporate Officer Completing Application

Name:	Toby Drake
Title:	President
Address:	P.O. Box 338 Kotzebue, Alaska 99752
Telephone:	(907) 442-3512

2.2. Designated Contact Person (Agent)

Name:	Kirstie Gray
Title:	Permit Compliance Officer
Address:	3340 Arctic Blvd Unit 203 Anchorage, Alaska 99503
Telephone:	(907) 947-7395

2.3. Corporate Information

Business Name:	Drake Construction, Inc.
Address:	P.O. Box 338 Kotzebue, Alaska 99752
Telephone:	(907) 258-2777
General Manager:	TBD

3. Project Description

The current phase of aggregate mining at this site is projected to last approximately five years. The mine operates seasonally during the summer months, employing a conventional "truck and shovel" operation that utilizes both bulk and selective mining methods. Currently, there is no road or rail access to the site, and all personnel and supplies are transported by tug and barge. The project remains completely isolated from existing power and other services infrastructure.

The project site encompasses a total of 21.5 acres of extractable material along with additional portions of the property managed by DCI. Currently, about 14 acres of the site are under excavation, while 7.5 acres will involve new excavation across two separate cells. Cell 1 covers approximately 2.5 acres, and Cell 2 spans about 5 acres.

3.1. Properties and Legal Description [11 AAC 97.310(b)(2)]

The legal description of the above property is Native Allotment F-15983, surveyed USS 10965, 50-96-0179, Township 20 North, Range 17 West of the Kateel River Meridian. The allotment is located approximately 19 miles north of Kotzebue, on the northeastern bank of the Noatak River.

Access to the material site is by river barge along the Noatak River below the highwater mark, ADL 418490.

3.2. Vicinity Map [11 AAC 97.310(b)(3)]

A Vicinity Map is included as Sheet 1.

3.3. Map of the Subject Property Including Boundaries and Topographic Details of the Land [11 AAC 97.310(b)(4)]

A United States Geological Survey topographic map is included as Sheet 3. The map shows the general vicinity of the mining operation and the specific property to be worked.

The map also shows the general description and diagram of the mining operation and shows and states the number of acres to be mined.

Diagrams of the mined area and the mining operation are included as Sheets 5 and 6.

4. Environmental Setting

4.1. Vegetation Types and Condition

The Kotzebue Sound Lowlands consist primarily of flat poorly drained coastal plains dominated by terraces, low hills, stabilized and active dune fields. There are many lakes and sinks which are connected by a maze of waterways.

Lakes and ponds make up 15 to 20 percent of the area. Soils underlain by permafrost are nearly always saturated in the summer. Permafrost is deep or absent and soils are well drained in natural levees and sand dunes. Spring flooding along rivers and tidal inundation along the coasts are common. (USDA, 2001)

Since standing water is almost always present, wet tundra communities consisting of sedge mats predominate. In areas of better drainage, woody plants such as white spruce, willows, alder, and paper birch occur. Black spruce forests are present along area rivers, whereas grasses grow along the coast's dunes (USDA, 2001).

4.2. Soil Types and Condition

The surface of the site is wooded with no silty overburden observed. In addition, no permafrost was present at the site and the depth of frost penetration was less than two feet. Underlying the forest surface, the soils consist of well graded and poorly graded gravels with silt and sand (GW-GM, GP-GM), poorly graded and well graded sands with silt and gravel (SW-SM, SP-SM), silty gravels with sands (GM), and silty sands with gravels (SM). (NANA Geotechnical Report, 1999)

4.3. Groundwater Elevation

Groundwater levels are relatively deep, averaging approximately 70 meters below ground surface. (NANA Geotechnical Report, 1999)

4.4. Surface Water Characteristics

The Noatak River, located along the project site's western boundary, is the area's predominant surface water feature. Two unnamed streams are also on the allotment (see Sheet 9), but they do not fall within the proposed excavation area. No modifications to the river or streams are planned.

4.5. Sensitive Species

The U.S. Fish and Wildlife Service (USFWS) IPAC resource list, not for consultation, was accessed on December 9, 2024, to determine if this project potentially impacts resources managed or regulated by the USFWS.

There are two threatened species, Spectacled Eider, (*Somateria fischeri*) and Steller’s Eider (*Polysticta stelleri*)

There are no birds of particular conservation concern that are protected by the Migratory Bird Treaty Act in the project area.

5. Implementation Plan [11 AAC 97.310(b)(6)]

The following includes a description of the reclamation measures to comply with AS 27.19.020 and 11 AAC 97.200 - 11 AAC 97.250. Reclamation goals are to recontour, revegetate, or otherwise stabilize all areas impacted by exploration activities so lands are left in a stable condition that supports the reestablishment of vegetation and creation of wetland resources. Rehabilitation measures include: placement and shaping of overburden, slope stabilization, creation of shallow littoral zones, seeding, and fertilizing. These activities will provide wildlife habitat values; improve aesthetics, stability, and function at the site. This section describes the reclamation activities that will be completed. In this section, reclamation is divided into four phases:

- Initial Reclamation: Begin initial reclamation by reclaiming areas where mining is complete.
- Intermediate Reclamation: Extract and reclaim the project area.
- Final Reclamation: Remove temporary facilities, equipment, and refuse and reclaim the remaining main pit processing areas.
- Monitoring reclaimed areas.

5.1. Initial Reclamation

Summer 2025:

The wall on the east side of the project area will be reclaimed by grading the area 3 horizontal to 1 vertical (3:1). Topsoil and overburden will be placed on the slope with an excavator and bulldozer. The area will then be revegetated with willows and other native plants and seeded. This process will provide even coverage, facilitate vegetation growth, and minimize erosion until vegetation is established.

Slope stabilization with native plants is critical to effective site reclamation. Woody shrubs on the slopes will be helpful in protecting the soil from erosion. Table 5-1 highlights several species that are ideal for slope stabilization. Depending on availability, feltleaf willow *Salix alaxensis* and shrub birch *Betula gladulosa* are native species ideal for planting along all sloped areas, especially the top. Alder *Alnus spp.* are often found in poorer soils on the lower edges of slopes near water. These may be planted along the bottom of the slope (ADFG 2015).

Table 5-1. Woody Shrubs for slope stabilization

Scientific Name	Common Name
Salix alaxensis	Feltleaf willow
Betula gladulosa	Shrub birch
Alnus spp	Alder

The areas of the slope not planted in woody shrubs can be hydroseeded with a simple mix of several species. Table 5-2 identifies the ideal species to include in a hydroseed mix for the Noatak area. These species are valuable for pollinators and will readily reseed.

Table 5-2. Non-woody vegetation for slope stabilization (Wright 2008)

Scientific Name	Common Name
Deschampsia beringensis 'Norcoast'	Bering hairgrass
Deschampsia caeptiosa 'Nortran'	Tufted hairgrass
Festuca rubra	Red fescue
Arctagrostis latifolia 'Alyeska' or 'Kenai'	Polargrass
Chamerion latifolium	Dwarf fireweed
Achillea millefolium var borealis	Boreal yarrow
Heysarum alpinum	Alpine sweetvetch

The plantings' success depends on regular watering and monitoring for the first two years while the plants establish root systems, particularly woody vegetation. Hydroseeded plants likely will not need care after application. Once established, the plantings will reseed and regenerate on their own.

The species listed in this recommendation may or may not be commercially available. Native substitutions may be made that meet the habitat requirements.

5.2. Intermediate Reclamation

The remaining extraction of Cell 1 and 2 will be mined one cell at a time. When the borrow source in a cell has been exhausted, that cell will be reclaimed by grading and revegetation as per section 5.2.1.

5.2.1. Measures for Topsoil Removal, Storage, Protection, and Replacement

Topsoil and overburden removed from areas to be excavated will be stockpiled separately onsite for reuse. If possible, stockpiles will be located away from areas of concentrated runoff flow and a minimum of 100-feet from any wetland or waters of the U.S. in accordance with Best Management Practice (BMP) 44 Stockpile Management and BMP 40.00 Cold Weather Stabilization (Appendix B).

When the borrow source has been exhausted, the slopes will be graded and stockpiled topsoil and overburden placed on the slopes. Topsoil and overburden will be placed on the slopes with an excavator and bulldozer. This process will provide even coverage, facilitate vegetation growth, and minimize erosion until vegetation is established.

Natural vegetation and seed will be placed on the reclaimed slopes using the shrubs and seed mixes outlined in Table 5-1 and Table 5-2. If seed is used, careful consideration will be taken not to introduce non-native seed to the area. Refer to *A Revegetation Manual for Alaska* in Appendix C.

During clearing and grubbing operations, stockpiled organic-rich soil will be managed by use of BMP 44 Stockpile Management. During reclamation and/or post-mining stockpiled organic-rich soil will be placed and graded per the plan. BMP 52.00 & 53.00 Permanent Seeding and Soil Amendments and/or BMP 57.00.

5.3. Final Reclamation

Final reclamation will commence when all material is exhausted of usable material within the footprint of the Allotment 15983. Reclamation will include constructing two pond/wetlands, a bioswale, and vegetated swale spillways. The mined area will be revegetated. The airstrip, the access roads, and the barge landing area will remain as is.

The full width of the pit floor will be covered with a 2- to 4-inch-thick layer of organic-rich soil material to maximize natural revegetation. The area will be revegetated with the seed mix described in Table 5-2.

Two ponds will be created: The upper pond/wetland is approximately 10,000 sf x 3.5 ft deep lined with silt/clay. The lower pond/wetland is approximately 3,500 sf x 3.5 ft deep. Each pond will include two benches, 10 feet wide at 1 ft and 2 ft below the design water level for vegetation. The ponds will fill primarily with snow melt. Due to low annual precipitation around 9 inches, the ponds are unlikely to fill with runoff. The ponds were designed to maximize capture and retention of snowmelt and precipitation runoff. See Sheet 7 and pond design cross section, Sheet 8.

The upper pond/wetland area will capture runoff from the hillside via a bioswale at the toe of the gravel pit cut slope. A vegetated swale spillway will be constructed to collect overflow and convey it to the lower pond/wetland. The lower pond will be used to collect runoff from the reclaimed gravel pit site and the upper pond/wetland. Overflow from the lower pond to the river will pass through a vegetated swale spillway.

Each of the two ponds will include two benches 10 feet wide at 1 ft and 2 ft below the design water level for vegetation. Shallow littoral areas will be formed by shaping the surface of the overburden material. The edge of the littoral shelf will be contoured irregularly and sloped at a 10 horizontal to 1 vertical (10:1) slope. Terraces and slopes will provide varying habitats.

The ponds will be allowed to recharge naturally. Natural recharge allows the perimeter mine site features to come to thermal equilibrium each year as the water rises. The water catchment areas should be planted with species that can thrive in both wet and dry conditions. Table 5-3 shows plantings for each bench and the bowl of the catchment area.

Table 5-3. Plantings for benches and bowls of ponds (Wright 2008).

Scientific Name	Common Name	Location
Alnus spp	Alder	Top bench
Beckmannia syzigachne	American sloughgrass	Top bench, Low bench

Elymus villosus	Downy wildrye	Low bench
Carex macrochaeta	Longawn sedge	bowl

A bioswale will be added at the toe of the wall slope. See Sheet 7. Bioswales are grass lined ditches that remove sediment through filtration and reduction of runoff velocities. The bioswale BMP is appropriate for project sites where concentrated runoff needs to be handled to prevent erosion or encourage infiltration. A healthy grass cover and moderate ditch slopes are needed.

5.4. Monitoring Reclaimed Areas

Monitoring at the site will take place for three years. Seeded areas will be watered as needed to ensure vegetation is established and growing well.

Vegetation growth around the ponds and the wall will be watered and monitored to ensure the establishment of the plantings.

The bioswale and vegetated swale spillways will be repaired and grass re-established as necessary. The bioswale should be checked for scour and repairs should be made immediately. All flow impediments should be removed to maintain the ditch hydraulics.

Project area will also be monitored for invasive species for three years.

5.5. Measures for Stream Placement and Reclamation

Not Applicable – No excavation work will occur in or near streams. In addition, all work will occur above the high water mark and annual flood range.

5.6. Reclamation or Post-Mining Conversion of Access Roads

The gravel access roads will not be reclaimed and will remain for the property owner to access the property and river access.

5.7. Reclamation Activities and Schedule for Completion

A typical reclamation cross section is included as Sheet 8.

Reclamation activities and scheduling are depicted in the table below. Reclamation facilitates consistent, efficient and effective management of the revegetation and habitat restoration effort.

Table 5-4. Schedule of Reclamation Activities

Date	Activity
Summer 2025	

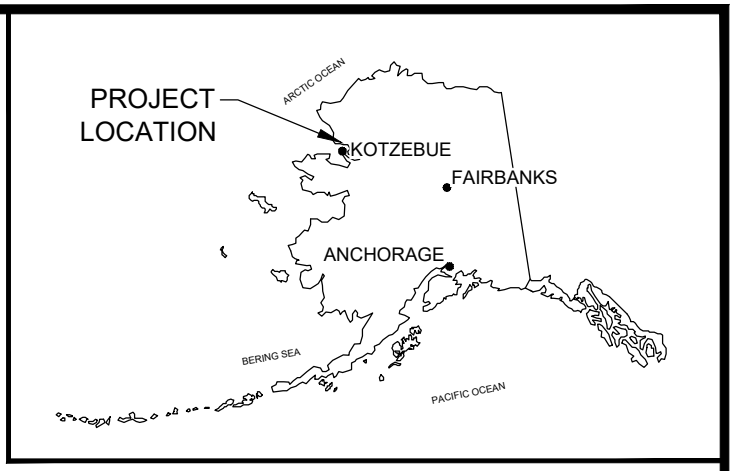
Date	Activity
	Topsoil and organic overburden will be moved from the current location to east wall to be used for grading and topsoil placement. The wall on the east side of the project area will be reclaimed with grading the wall area 3:1 and vegetating it with willows and hydroseeding with other native plants. The remainder of the area will be vegetated with native plants.
Summer 2026 and on ongoing	Reclamation of Cells 1 and 2 will occur after extraction of those areas is complete. All slopes of the worked section will be stabilized and maintained at a 3:1 slope.
Final	Two ponds will be created: The upper pond/wetland is approximately 10,000 sf x 3.5 ft deep lined with silt/clay. The lower pond/wetland is approximately 3,500 sf x 3.5 ft deep. Each pond will include two benches 10 feet wide at 1 ft and 2 ft below the design water level for vegetation. The upper pond/wetland area will capture runoff from the hillside via a flat bottom ditch at the toe of the gravel pit cut slope. A vegetated swale spillway will be constructed to collect overflow and convey it to the lower pond/wetland. The lower pond will be used to collect runoff from the reclaimed gravel pit site and the upper pond/wetland. Overflow from the lower pond to the river will pass through a vegetated swale spillway. The entire mined area will re-contoured and/or terraced for reclamation. Final reclamation will be completed after entire Allotment 15983 has been exhausted of material.
Monitoring	For three years after final extraction or until the vegetation is 70% established. Vegetated areas will be watered, and invasive species will be monitored.

5.8. Equipment List

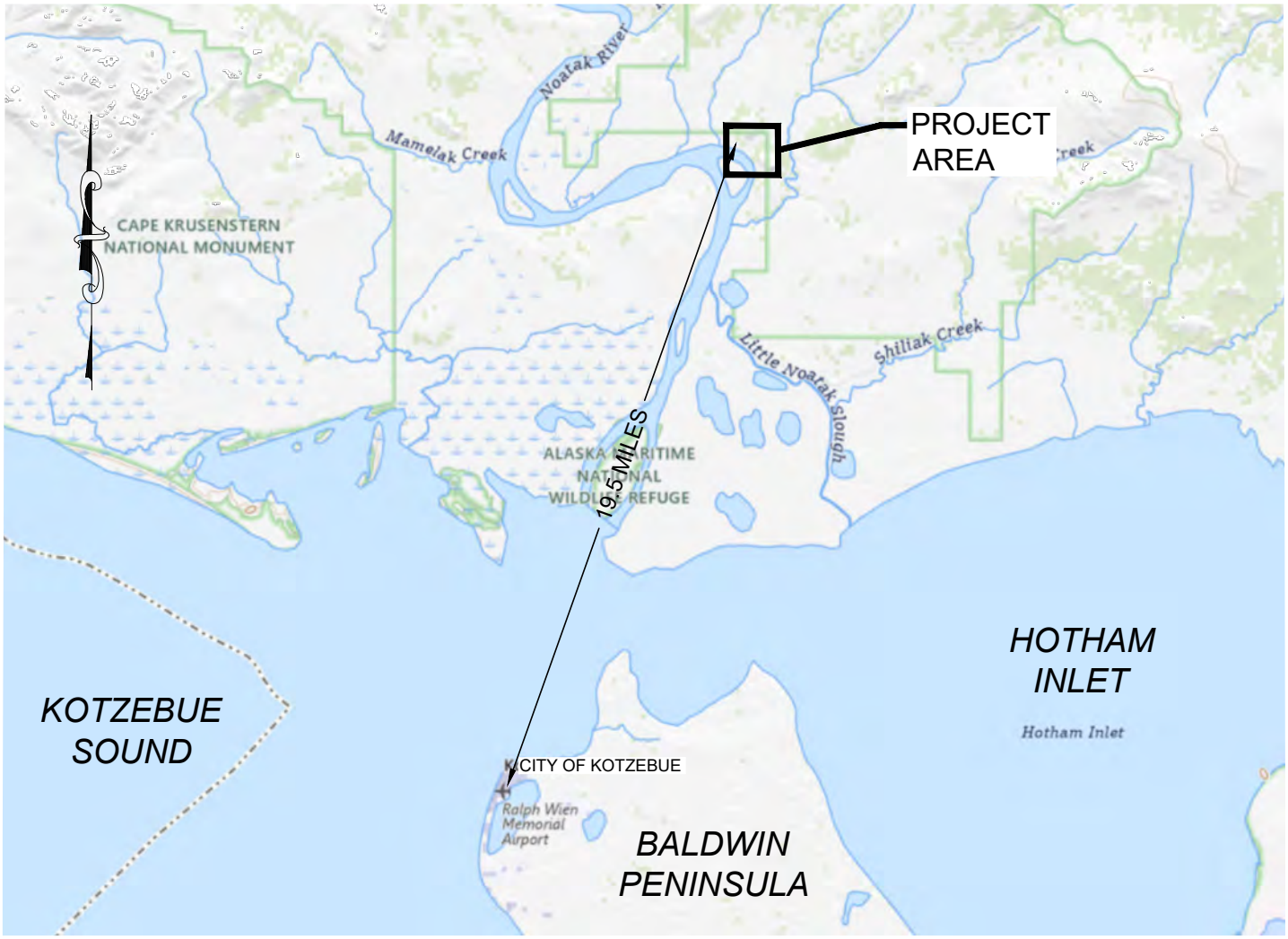
- Excavators
- Grader
- Loaders
- Haul Trucks, Screening Plant
- Articulated Dump Truck
- Fuel trucks
- Service Truck
- Other vehicles

Appendix A

Drawings



LOCATION

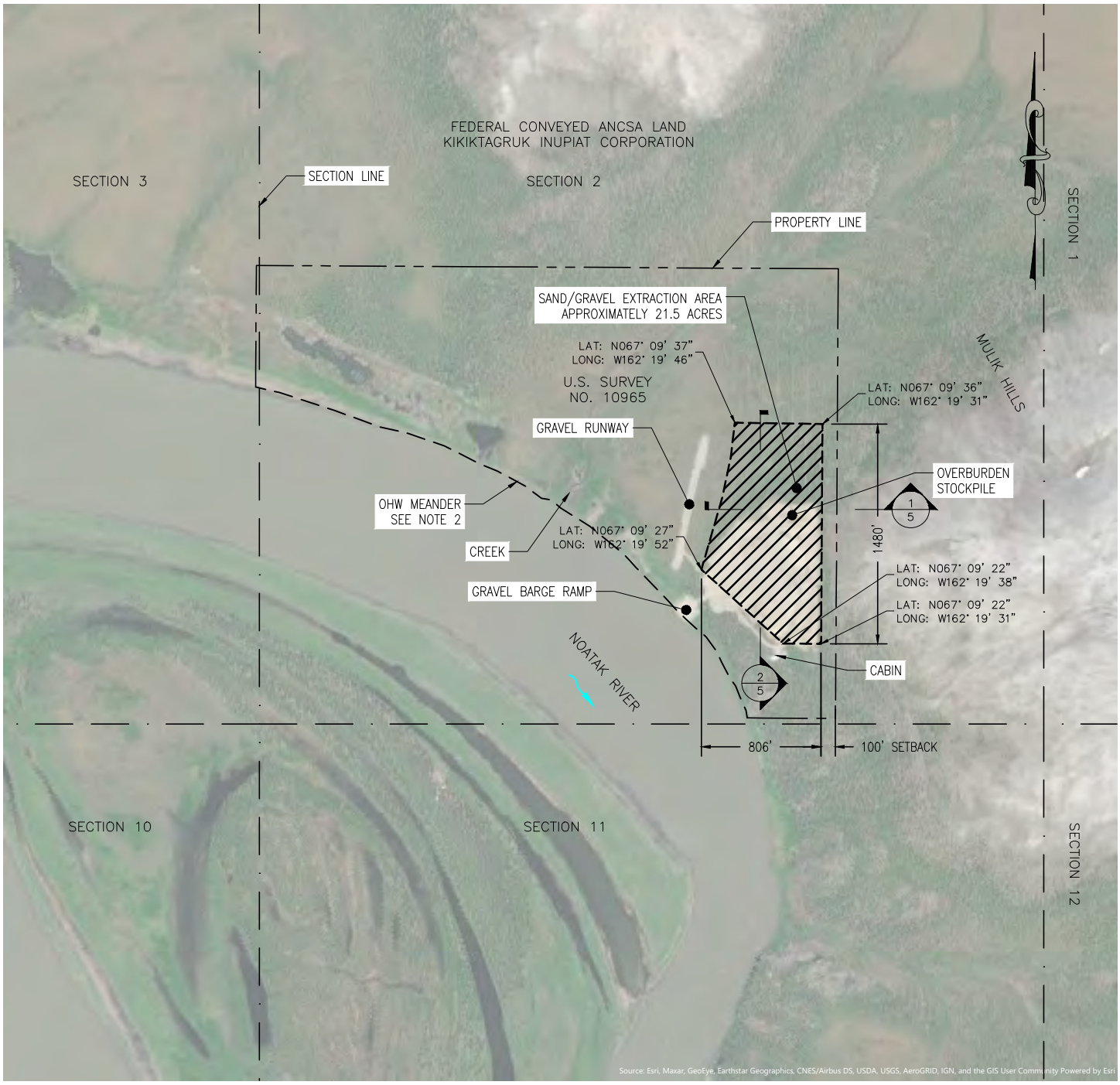


VICINITY MAP

0 5 10

SCALE IN MILES

NOATAK RIVER GRAVEL MINE
GRAVEL EXTRACTION KOTZEBUE, ALASKA
WATERBODY: HOTHAM INLET
SECT. 2; T020N; R017W MERIDIAN: KATEEL RIVER USGS QUADRANGLE NOATAK A-1 LAT: 67.15810° LONG: -162.32760°
LOCATION AND VICINITY MAP 4/2/2025 SHEET 1 OF 8



PROJECT SITE

NOTES:

1. AERIAL IMAGE OBTAINED FROM NEARMAPS.
2. ORDINARY HIGH WATERMARK FROM U.S. SURVEY NO. 10965.
3. TOPOGRAPHIC SURVEY HAS BEEN PERFORMED FOR THE PROJECT AREA.
4. EXTRACTED MATERIALS WILL BE STOCKPILED WITHIN EXTRACTION AREA.
5. CONTRACTOR STAGING OF EQUIPMENT AND MATERIALS WITHIN EXTRACTION AREA.

0 1,000 2,000

SCALE IN FEET

NOATAK RIVER GRAVEL MINE

GRAVEL EXTRACTION
KOTZEBUE, ALASKA

WATERBODY: HOTHAM INLET

SECT. 2; T020N; R017W
MERIDIAN: KATEEL RIVER
USGS QUADRANGLE NOATAK A-1
LAT: 67.15810° LONG: -162.32760°

PROJECT SITE

4/2/2025 SHEET 2 OF 8

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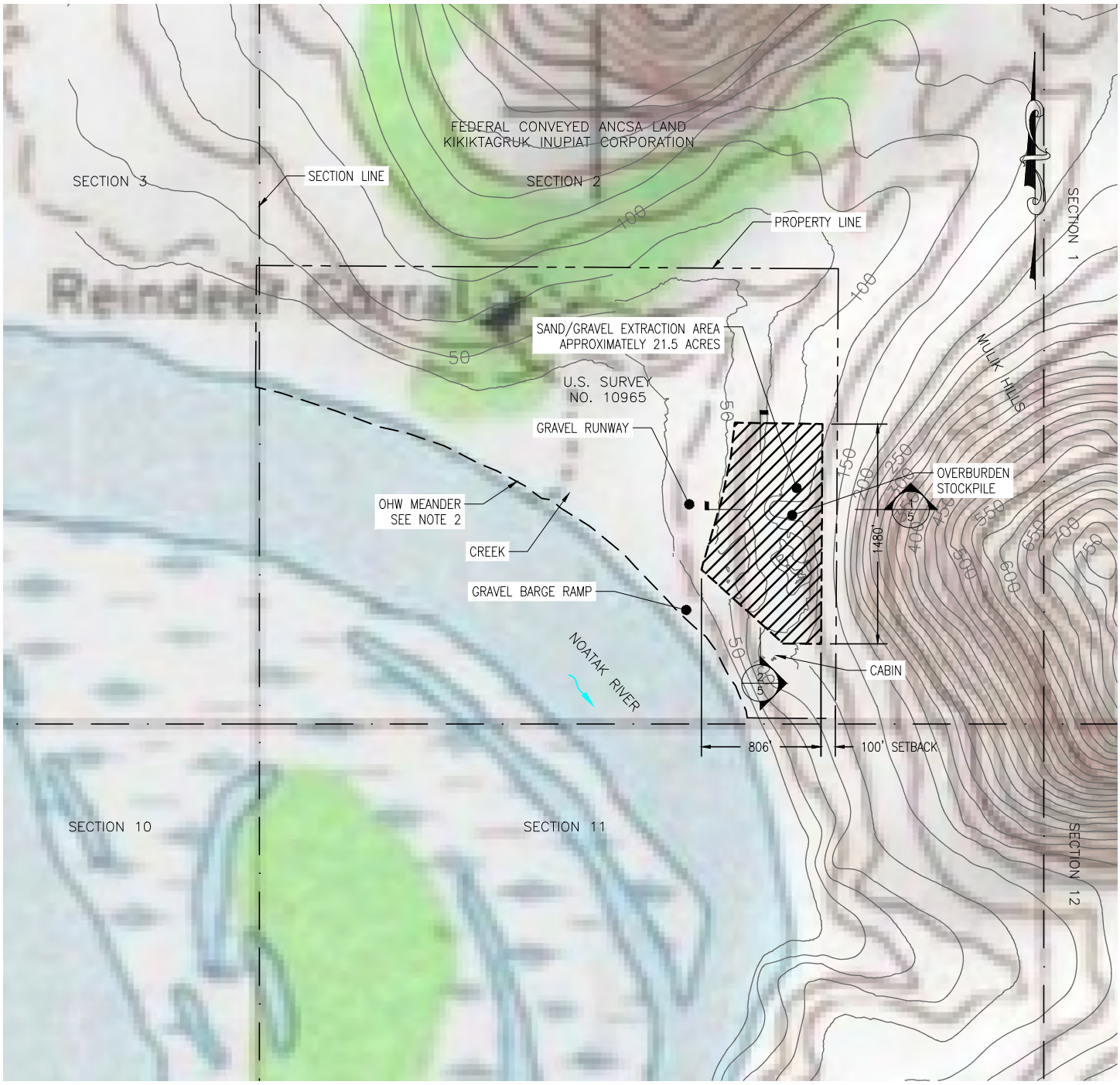

PROJECT SITE TOPOGRAPHIC

NOTES:

1. IMAGE SOURCE WEBSITE: https://mapper.dnr.alaska.gov/ OBTAINED ON 25 FEBRUARY 2025.
2. ORDINARY HIGH WATERMARK FROM U.S. SURVEY NO. 10965.
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SCALE IN FEET

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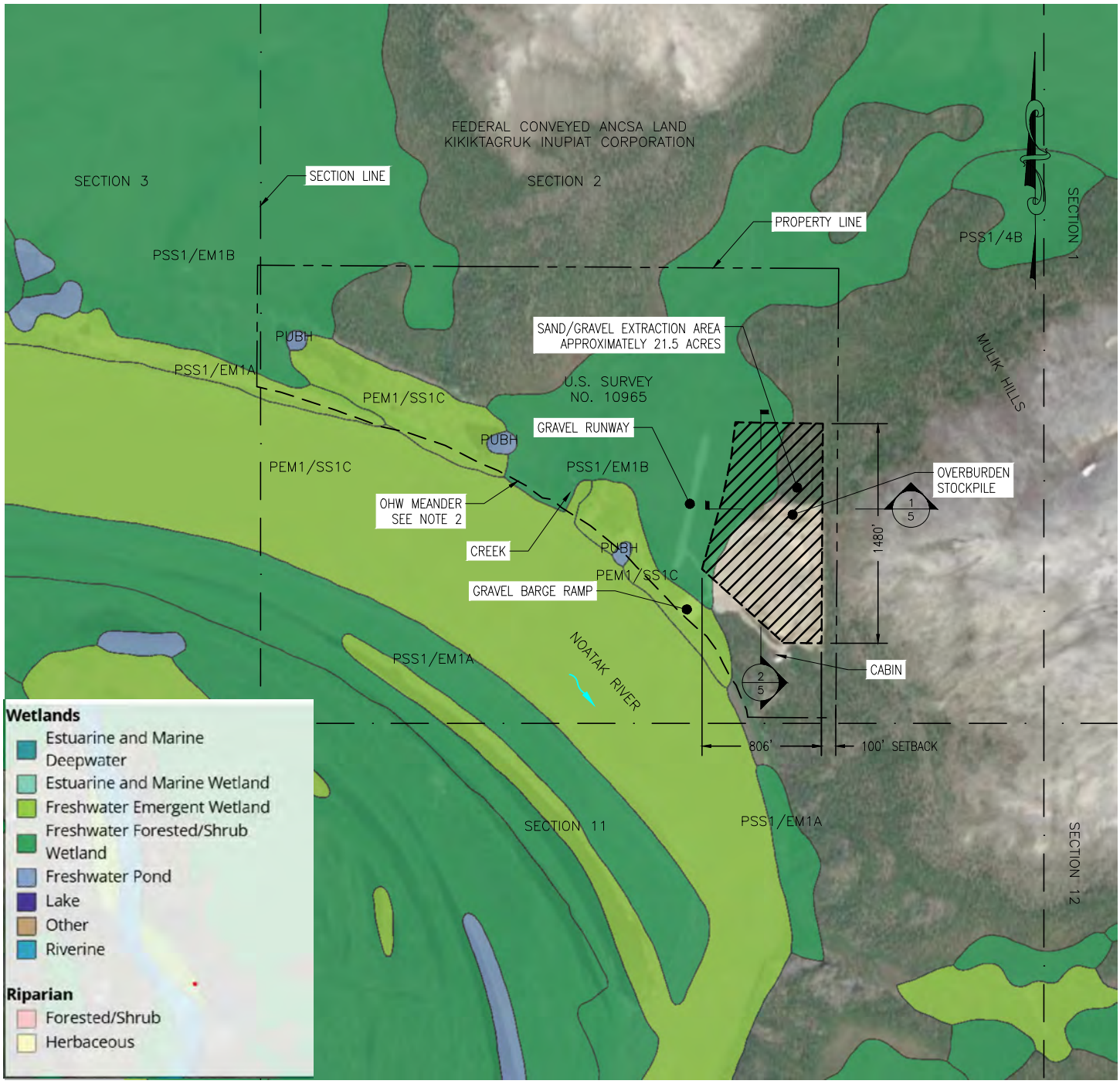
PROJECT SITE TOPO

4/2/2025 SHEET 3 OF 8



WETLANDS

NOTES:

1. IMAGE SOURCE WEBSITE: https://www.fws.gov/program/national-wetlands-inventory/wetlands-mapper OBTAINED ON 25 FEBRUARY 2025.
2. ORDINARY HIGH WATERMARK FROM U.S. SURVEY NO. 10965.
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SCALE IN FEET

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GRAVEL EXTRACTION
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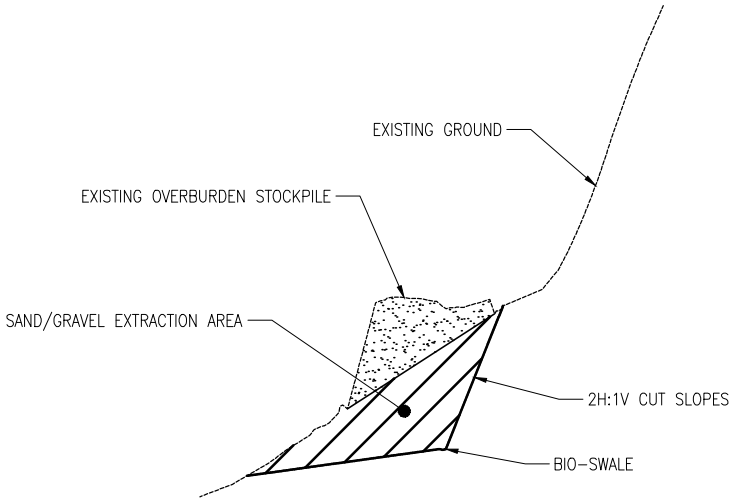
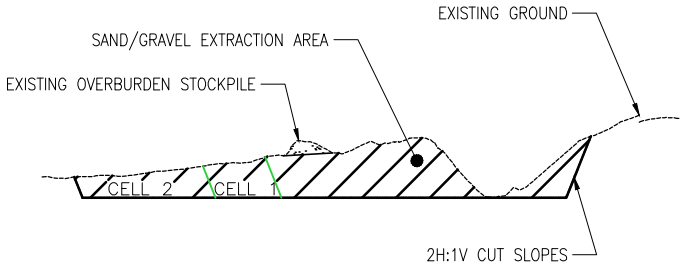
WETLANDS

4/2/2025



1 SITE SECTION



2 SITE SECTION

NOTES:

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2. EXTRACTED MATERIALS WILL BE STOCKPILED WITHIN EXTRACTION AREA.
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NOATAK RIVER GRAVEL MINE

GRAVEL EXTRACTION
KOTZEBUE, ALASKA

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USGS QUADRANGLE NOATAK A-1
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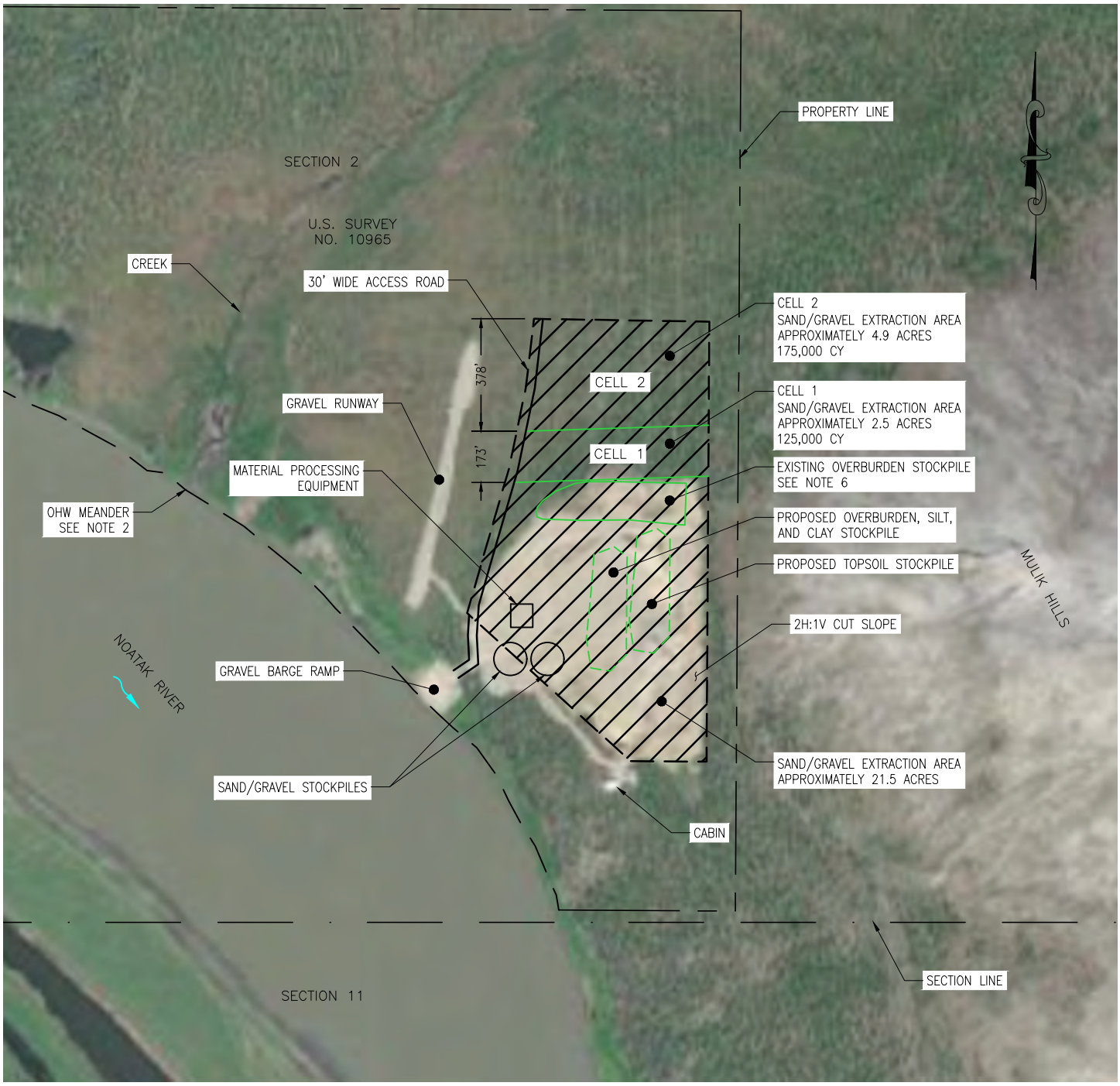
SITE SECTIONS

4/2/2025 SHEET 5 OF 8



DEVELOPMENT PLAN

NOTES:

1. AERIAL IMAGE OBTAINED FROM NEARMAPS.
2. ORDINARY HIGH WATERMARK FROM U.S. SURVEY NO. 10965.
3. TOPOGRAPHIC SURVEY HAS BEEN PERFORMED FOR THE PROJECT AREA.
4. EXTRACTED MATERIALS WILL BE STOCKPILED WITHIN EXTRACTION AREA.
5. CONTRACTOR STAGING OF EQUIPMENT AND MATERIALS WITHIN EXTRACTION AREA.
6. TOPSOIL AND OVERBURDEN TO BE SEPARATED AS GRAVEL EXTRACTION PROGRESSES.

0 500 1,000

SCALE IN FEET

NOATAK RIVER GRAVEL MINE

GRAVEL EXTRACTION
KOTZEBUE, ALASKA

WATERBODY: HOTHAM INLET

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DEVELOPMENT PLAN

4/2/2025 SHEET 6 OF 8

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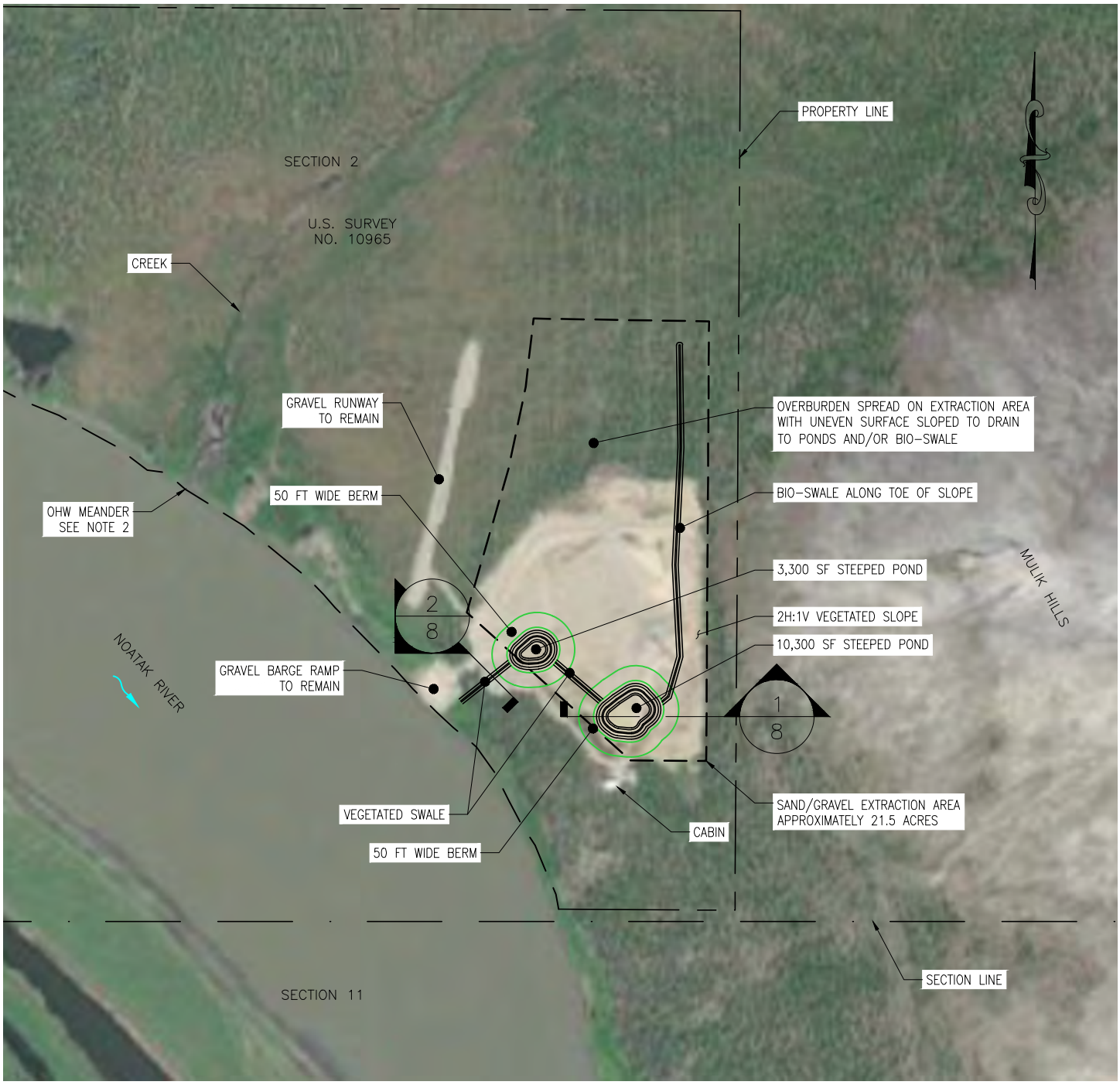

RECLAMATION PLAN

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RECLAMATION PLAN

4/2/2025 SHEET 7 OF 8

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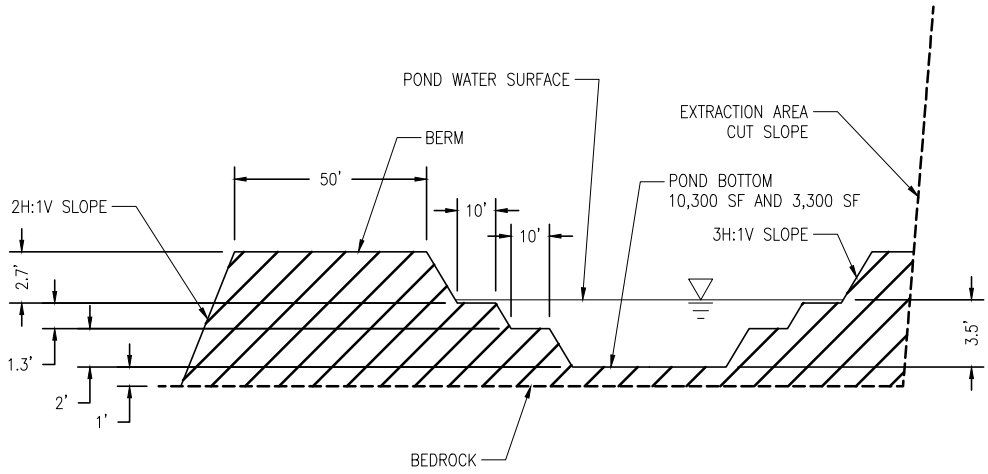

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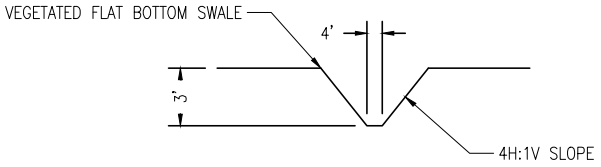

2 DITCH SECTION

NOTES:

1. POND AND BERM TO BE CONSTRUCTED FROM OVERBURDEN, SILT, AND CLAYEY SOILS FROM EXTRACTION AREA.
2. EXPOSED EXTRACTION AREA SURFACES TO BE COVERED WITH TOPSOIL AND SEEDED WITH REGIONAL SEED MIX.

0 50 100

SCALE IN FEET
HORZ. 1 : VERT. 5

NOATAK RIVER GRAVEL MINE

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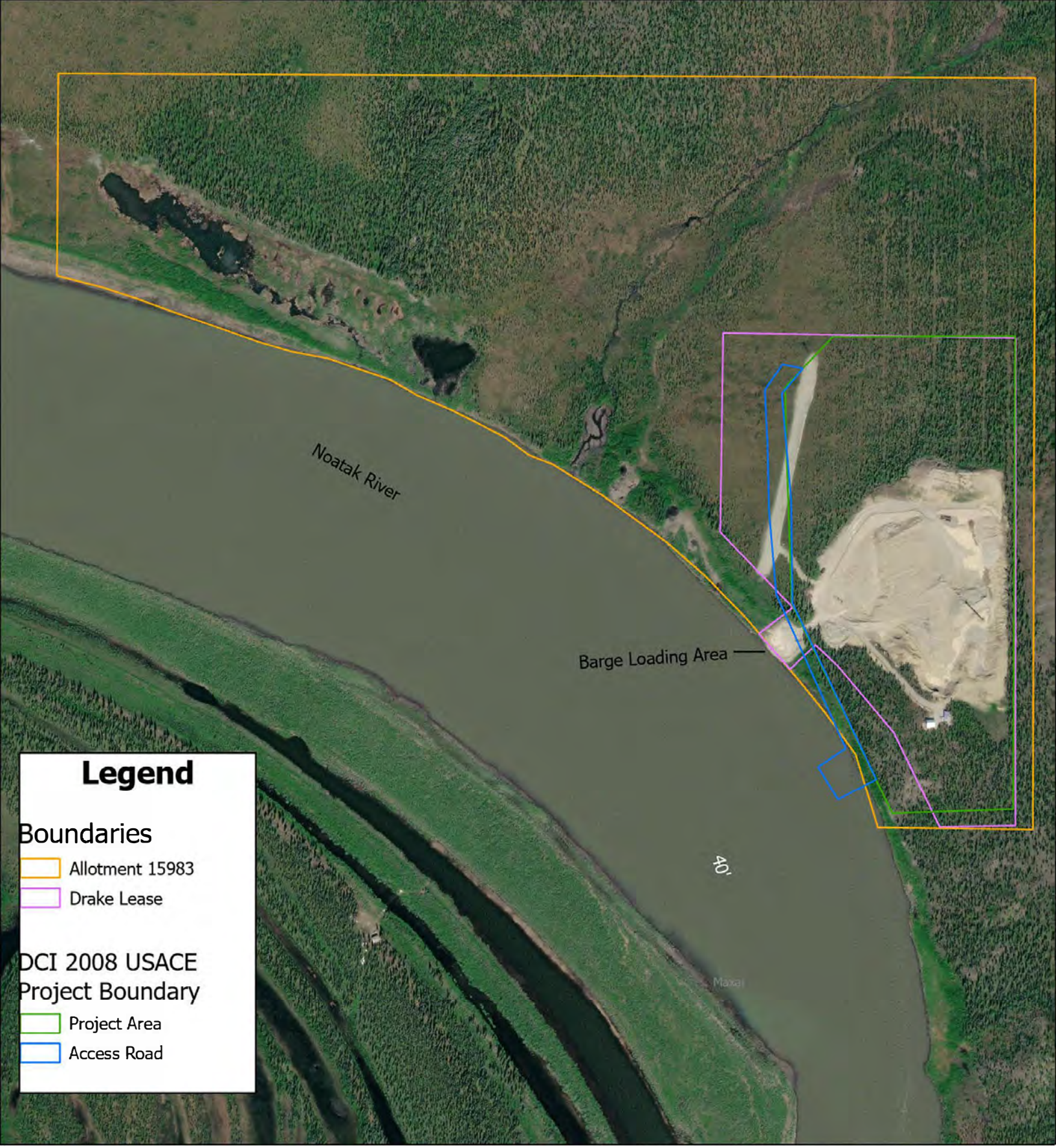
POND SECTION

4/2/2025 SHEET 8 OF 8



Sheet 9. Noatak River Gravel Mine Allotment, Lease, and Project Boundaries

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Appendix B
BMP Sheets

BMP 44.00. Ditch Maintenance

Objectives

Perform Ditch Maintenance in a manner that prevents pollutants from enteringsurface and storm waters. Pollutants may come from the road or include eroded sediment.

Debris Clearing

Accumulated debris, consisting of sediment deposits, brush, and trash, have the potential to be carried by stormwater runoff downstream and into waters of the U.S. Collect and dispose of all debris at an approved disposal site.

Regrading

Install perimeter sediment controls prior to regrading ditches to limit the potential for sediment to be transported to a water of the U.S. Establish a minimum 50-foot buffer where practicable between streams and ground-disturbing ditch work to protect water quality and fish habitat. Where appropriate, provide velocity dissipation such as temporary check dams to reduce the potential for erosion in the ditch. Riprap at culverts is a permanent best management practice (BMP) that prevents erosion due to scour at the inlet and outlet of a culvert. Ditch lining is another permanent BMP that provides protection from erosion in the ditch. Installation and maintenance methods for these BMPs are described in the standard drawings.

When regrading, restore the original cross-section and flow line. When possible, equipment is to remain on the roadway during regrading. Haul removed materials to a pre-approved disposal site. Hydroseed when ditch regrading has been completed to stabilize bare soil and prevent erosion.

Hydroseeding

Hydroseed as necessary when maintenance activities have removed the existing vegetation, such as after culvert replacement and ditch regrading. Hydroseeding establishes vegetation to prevent the ditch from eroding. Hydroseeding equipment is to remain on the roadway during hydroseeding activities. It is preferred to reseed recontoured ditches in the same day. If this isn't practicable, then reseed as soon as practicable after the regrading work is complete. Use certified native seed mixes to revegetate ditches. Avoid work that requires hydroseeding during the fall in areas with high leaf concentrations due to the need to remove the debris prior to hydroseeding. The Alaska Plant Material Center recommends seeding before the following dates for optimum success:

- Arctic Coast: July 15
- Western Alaska: August 15
- Southcentral Alaska: August 31
- Southeast Alaska and Aleutian Islands: September 15
- Interior Alaska: August 15-31

Discuss seeding with the regional maintenance environmental analyst for more information.

Cross Drain Culvert Cleaning

Cross drain culvert maintenance is specific to culverts that convey run-off from the roadway and not streams or other waters of the U.S. Perform minor cleaning by hand when possible. When wheel mounted equipment is used, keep it on the roadway whenever possible. Transport material removed from the ditch and culvert to an approved disposal site.

Prevent erosion at outlets and inlets with armoring when necessary since these are areas of high flow, concentrated drainage, and steep slopes, which are susceptible to erosion. Replace existing or augment depleted armor to maintain the erosion control function.

Stream Culvert Cleaning

In-stream culvert maintenance is associated with waterways, wetlands, or other waters of the U.S. and requires permitting from appropriate agencies. When possible, schedule work during low flow to limit impacts to the stream. Working during low flow will reduce the amount of sediment that is conveyed to the stream.

Perform minor cleaning by hand when possible. Transport material removed from the ditch and culvert to an approved disposal site.

Guardrail Cleaning

During guardrail cleaning, manage removed sediment to prevent it from entering a water of the U.S. Pull material into the roadway and collect it for disposal. Where appropriate, sweep the roadway after guardrail cleaning.

Vegetation Management

During vegetation management, avoid ground and wildlife disturbance. When possible, avoid clearing and grubbing activities during sensitive migratory bird nesting windows. Contact your Environmental Analyst to find out what the windows are.

Avoid allowing cut vegetation to enter waters of the U.S. by removing cuttings. For vegetation cutting near waters of the U.S., place any cut vegetation that is left to decompose high on the bank to prevent it from entering the water.

During grubbing (e.g., ground disturbing activities), keep these practices in mind to protect storm water. Provide perimeter controls such as compost berms or socks, fiber rolls, prefabricated barrier systems, or silt fence to prevent sediment from being transported from the grubbed area. Hydroseed the area when the grubbing is completed to stabilize bare soil and prevent erosion.

Reference Drawings

- BMP – 31.00 Temporary Check Dams
- BMP – 04.00 Compost Berm and Sock
- BMP – 10.00 Fiber Rolls for Erosion and Sediment Control
- BMP – 13.00 Prefabricated Barrier System
- BMP – 20.00 Silt Fence

BMP 40.00. Cold Weather Stabilization

Objectives

Cold Weather Stabilization measures minimize erosion caused by breakup, snowmelt runoff, and thermal degradation in order to prevent negative impacts to projects and water quality.

Description

Cold Weather Stabilization practices are applied to projects involving construction activities extending beyond one construction season. They are measures that stabilize sites that will have activities and/or exposed areas between fall freezeup and spring thaw. Projects may fall into the two following categories, but stabilization measures are similar:

1. Sites that suspend active grading operations and shut down over the winter.
2. Projects for which work must be conducted during periods of cold weather may need to implement Cold Weather Stabilization techniques. Projects that require winter work must plan on limiting the extent and duration of exposed soils and provide for stabilization of inactive areas of the site.

Specifications

Employ the following Cold Weather Stabilization techniques during the period from fall freeze up until spring thaw:

- Limit the extent and duration of winter excavation and earthwork activities to minimize potential erosion and sediment impacts.
- Generally, limit the exposed area to only those areas in which work will occur and can be stabilized as soon as practicable, but no later than 14 calendar days, and those that can be stabilized in 1 day prior to any precipitation or runoff event.
- Subsequent work areas should not be exposed until the previously exposed work area has been fully stabilized.
- An area is considered "exposed" until stabilized with one or more of the following: gravel base on a road, runway, taxiway, or parking area; pavement; vegetation; mulching; or the installation of Rolled Erosion Control Products (RECPs) or riprap.
- Minimize the area of exposed, unstabilized soil and protect against erosion by the methods described in the Stormwater Pollution Prevention Plan (SWPPP) prior to any thaw or spring melt event. The area of exposed soil may be increased if activities are conducted according to a winter construction plan approved by the engineer and amended into the site SWPPP.
- Complete stabilization within 7 days of establishing final grade or in areas that otherwise will remain unworked for more than 7 days.
- Installation of RECPs should not occur over snow greater than 1-inch in depth.
- Standard anchoring devices for RECPs used in frozen soil conditions may be limited in their effectiveness. Alternate methods may be required to secure ground covers on frozen ground, such as sandbags or weights.
- Mulch that is spread on top of snow cover will work its way to the soil as snowpack is reduced and another snowfall occurs. This will hold the mulch in place until spring thaw, allowing it to stabilize the soil during and after breakup.
- Straw may be applied to snow as it will absorb sunlight and melt a very small amount of snow and freeze into the snow. When this occurs, the straw will remain in place during spring thaw, allowing it to stabilize the soil during and after breakup. Mulching can also be done on bare soil, with a little more attention to detail:
  - If applying on frozen ground, spray a tackifier on top (water can work in some cases) to freeze it in place.
  - If the soil is freshly graded and somewhat moist, it may still be possible to track-anchor the mulch (e.g., run tracked equipment over the mulch).
  - If the soil is freshly graded, it is not windy, and snowfall is anticipated very soon, the snow will hold it in place.
- Construct and stabilize all grass-lined ditches and channels by fall freezeup. Temporarily stabilize all ditches or swales that do not exhibit

a minimum of 70 percent vegetative growth by fall freeze-up, or are disturbed after fall freezeup, with stone or RECPs appropriate for the design flow conditions.

- Cover stockpiles of soil materials for over-winter protection with mulch at twice the normal rate or with RECPs designed to last the desired timeframe. Plastic covering may be used if consideration for increased flow volumes has been planned and managed. Cover should be placed within 24 hours of stockpiling, and re-established prior to any rainfall or snowfall. If possible, stockpiles should be placed farther than 100 feet of any wetland or other waters of the U.S.
- Stockpile frozen materials, (e.g., frost layer that is removed during winter construction), separately and in a location that is away from any area needing to be protected. Stockpiles of frozen material can melt in the spring and become unworkable and difficult to transport due to the high moisture content in the soil.
- Sediment barriers that are installed during frozen conditions should consist of continuous containment berms or fiber rolls.
- Frozen ground presents a real challenge to installing silt fence, but it can be done. Instead of using traditional manual or machine-sliced installation methods, you will have to:
  - Machine dig a trench with a ditch-witch or similar equipment; then make sure you backfill with loose soil and compact. Moisten the backfilled soil well, it will freeze up and grip the silt fence fabric in place; or
  - Use a specially equipped (typically carbide tipped) slicing machine. Do not leave large frost chunks as the backfill. Compact as well as possible (before installing the posts) with a heavy piece of equipment. Fill gaps and voids with very moist, loose soil, and then compact it again.
- Silt fences should not be installed when frozen conditions prevent proper embedment of the fabric.

Relationship to Other Erosion and Sediment Control Measures

All stabilization techniques may be applicable for winter stabilization. However, proper planning and scheduling is critical for successful Cold Weather Stabilization.

Common Failures or Misuses

- The most common problem with winter conditions is lack of planning. Scheduling that does not consider current forecasts for changing weather conditions will be difficult to manage. During breakup conditions soils may be too soft or saturated to allow access, preventing the implementation and installation of best management practices (BMPs).
- Re-establish BMPs in the spring, the risk of sediment discharges are greatest in the spring when the vegetative cover has not been established.

BMP 52.00 & 53.00. Permanent Seeding and Soil Amendments

DESIGN CONSIDERATIONS

Objectives

Permanent Seeding is an erosion control measure intended to establish a perennial vegetation cover and provide full stabilization of a disturbed area. Protecting the soil with well-established perennial stands of grass, or other forms of vegetation, is one of the most effective methods of reducing erosion.

Soil amendments are commonly used in conjunction with Permanent Seeding to improve the soil. Application of the appropriate soil amendment(s) should reduce the potential for soil erosion and restore the health of the soil by improving soil structure. Amending the soil structure will improve the soil's water-holding capacity; and improve the infiltration rate and the ability to support vegetation.

Description

Permanent Seeding is applied to areas where construction has permanently ceased. The seed mix should be composed of several species and designed to establish a permanent perennial stand of vegetation that can survive in the area. Permanent Seeding should be accompanied by surface preparation, surface roughening, fertilizers, and mulch. Surface preparation and roughening enhance seed retention and germination, fertilizer boosts initial growth, and mulch retains moisture.

Soil amendments include topsoil, compost, shredded bark or wood chips, peat, biofertilizers, and mycorrhizae. Most soil amendments, except biofertilizers and mycorrhizae, should be tilled or blended into the soil.

Other Names

Permanent Seed Stabilization, Seeding with Soil Amendments, Compost Blanket with Seeding, Bonded Fiber Matrix with Seeding, Topsoil, and Seed.

Applicability

Permanent Seeding is a final stabilization measure that is generally required for all disturbed areas that are not otherwise stabilized (by paving, structures, landscaping, etc.). It should be completed in areas where ground disturbing activities have permanently ceased.

Seeding with soil amendments provides an additional control where the soil needs to be treated to support a stabilized vegetative mat. Soil amendments should be provided in areas where the soil is highly erodible and/or has poor nutrient content or structure. For example, a sandy soil needs organic matter added in order to increase the water and nutrient holding capacity.

Selection Considerations

- *Seed*: The designer should specify appropriate seed species based on the climatic and environmental conditions. The Alaska Department of Natural Resources (DNR) Plant Material Center manuals provide guidance for revegetation in Alaska, and include the *Revegetation Manual for Alaska*, *Interior Alaska Revegetation and Erosion Control Guide*, and the *Coastal Revegetation and Erosion Control Guide*. These manuals give recommended seeding species and planting dates. The dates to apply seed are dependent on the climatic conditions of the project location. These dates should be provided in the special provisions for each project.
- *Soil Amendments*: Soil amendments should be selected to increase the infiltration rate of water; improve the soil's fertility, texture, and structure; aid in the uptake of nutrients; help to stabilize the soil; aid in seed germination; increase microbial activity; and promote vegetation establishment.

  When considering a soil amendment, the designer should consider how the amendment will improve the soil properties; such as the organic content and textural class, how long the amendment must remain in the soil, and the climate and ecology of the area

Relationship to Other Erosion and Sediment Control Measures

With or without soil amendments, seeding can be used alone but it is likely that other measures should be considered to protect and support seed establishment. Construction stormwater management control measures should be used up-gradient to prevent potential washouts. Sediment

control measures should be used to prevent the release of sediments to and from the treated area.

Design

Seed Selection and Application Rate: Seed mix species should be carefully considered for each project. Several mixes may be applicable for a project depending on proximity to wetlands, roadways, and various microclimates in the general environment. The Alaska Plant Materials Center can assist with selecting species for all types of environments found in Alaska. Typically, seeds are applied at 20 - 40 lbs./acre, although site-specific conditions can affect how much seed needs to be applied. Add 30 percent to the quantity if surface roughening is required.

Fertilizer and Application Rate: Fertilizer should be used when establishing new seed. It is best to test the soils for existing nutrient content and pH to determine the appropriate fertilizer. If testing cannot be done until slopes are finished, then require a fertilizer application rate of 450 lb./acre of 20-20-10 (percent nitrogen-phosphorus-potassium) as an interim placeholder in the bid documents and the Engineer should adjust the fertilizer rate based on the test results.

Mulch: Mulch should be used when establishing new seed. Mulch helps to hold the seed to the soil surface and helps to retain moisture during seed germination. The application rate for mulching during seeding is approximately 2,000 to 4,500 lbs./acre, depending on the steepness of slopes. On slopes steeper than 3:1, tackifier should be added to the mulch (BMP 57).

Soil Stabilizer. For steeper slopes or more erodible soils, hydraulic erosion control products (HECP, BMP 51) can be considered for additional soil stabilization.

Soil Testing: This is recommended when there is uncertainty regarding the fertilizer application rate or when there are risk factors for successful grass growth. It is possible to require the contractor to sample soils, but it may be preferable to have trained Alaska Department of Transportation & Public Facilities (ADOT&PF) staff collect soil samples for laboratory analyses. If it is feasible to test the soils for their pH and nutrients, then the Project Engineer is able to change the fertilizer requirement according to the test results. The existing soil or imported topsoil can be tested to identify the soil's composition of organic matter, macro nutrients, soil texture, and pH. For more information, contact the regional stormwater specialist. Add a special provision if you determine that the contractor should test the soil once graded.

Soil Amendment Options: There are many different soil amendments in addition to fertilizer that can be applied to a project. Selecting a soil amendment can depend on location of a project and availability of the amendment. These soil amendments include the following:

- *Topsoil:* When used as a soil amendment, topsoil should be tilled or blended into the existing soil.
- *Compost:* Compost should comply with the U.S. Composting Council Testing Methods and with specified gradation for each project. Compost can be applied to almost any soil. Compost can be used in wet climates or in the wet season, whereas topsoil or other soil amendments may be prone to erosion. When used as a soil amendment, compost should be tilled or blended into the existing soil.
- *Shredded Bark or Wood Chips:* Although the composition of bark or wood chip will vary per application, material should not contain any materials that would inhibit or stunt vegetation growth. All material should be kept moist prior to the application of seed. When used as a soil amendment, shredded bark or wood chips should be tilled or blended into the existing soil before seeding.
- *Peat:* Peat can be used as a soil amendment when the existing soil texture is sandy. Application of peat will enhance the existing soil by providing organics and increase the water holding capacity. Peat may be applied to the surface or tilled or blended into the soil. It should be applied at a thickness of 1 to 2 inches and, if specified, tilled or blended into the top 4 to 6 inches of the existing soil. When tilled or blended in, the peat composition should be approximately 15 to 25 percent of the soil.

  Peat is naturally acidic. The existing soil should be tested for pH levels so the appropriate quantities of peat can be applied. Over-

application could result in limited growth of some seed species.

- Biofertilizers and Mycorrhizae: Biofertilizers and mycorrhizae are soil amendments that can be used to increase the success and shorten the establishment period of vegetation. When applied, biofertilizers and mycorrhizae help to rebuild living soil that has become damaged during earthwork. Biofertilizers and mycorrhizae help to increase microbial activity in soil resulting in increased nutrient availability to plant roots.

Common Failures or Misuses

Common failures are generally due to faulty application and maintenance. These failures include:

- Seed and slurry mix is not applied with a multi-directional flow or is applied at an inadequate application rate, resulting in non-uniform coverage or stabilization.
- The mulch, tackifier, or HECP (including bonded fiber matrix) used is inadequate to hold seed on slopes, resulting in erosion and washouts.
- Temporary seed, if not appropriately removed, may inhibit growth of permanent grass.
- Seed is not properly or adequately irrigated.
- Seed is floated away due to over-irrigation or by excessive rainfall.
- Seeded areas are disturbed by foot traffic and/or equipment after installation.
- Treated areas are compacted after the seed and amendments are applied.
- Soil amendments are inadequate to support seed growth.
- Supportive Construction Water Management or Sediment Control best management practices (BMPs) are not installed or maintained correctly.
- Fertilizer application is inadequate.
- Fertilizers with high, or quick-release, phosphorus content are used with biofertilizer and mycorrhizal soil amendments.
- Fungicides are used on or around areas that have received biofertilizers and mycorrhizal amendments.
- Inadequate quantities of amendments containing biofertilizers and mycorrhizae are applied.
- Seeding is applied too late in the season, resulting in limited growth and germination prior to freeze up.

SPECIFICATIONS

Standard Specifications

- 652 - Soil Amendments
- 650 - Compost Blanket
- 651 - Hydraulic Erosion Control Products
- 620 - Topsoil
- 712.201 - Water
- 724 - Seed
- 725 - Fertilizer
- 752 – Tackifier
- 750 – Compost
- 753 – Soil Amendments
- 751 Hydraulic Erosion Control Products

BMP 57.00. Temporary Seeding

DESIGN CONSIDERATIONS

Objectives

Temporary Seeding is intended to temporarily stabilize the soil of a disturbed area to prevent the erosion and the discharge of soil and/or sediments.

Temporary Seeding is used in areas where permanent cover is not necessary or appropriate. By protecting bare soil from raindrop impact and binding the soil with roots, a well-established vegetative cover is one of the most effective methods of reducing erosion.

Other Names

Temporary Stabilization.

Applicability

Temporary Seeding is applicable to exposed areas subject to erosion that are not actively being worked. Temporary Seeding can be used where permanent covering is not necessary or where future ground disturbing activities will occur.

By itself, Temporary Seeding is not soil stabilization because the seeds are not effective until they sprout and create a stabilizing root mat. Temporary Seeding should be accompanied by surface preparation, surface roughening, fertilizer, mulch, and maintenance to encourage seed establishment. Temporary Seeding can remain and be left to winter over only if ground-disturbing activities are scheduled to resume the following spring. Prior to application of permanent stabilization measures, Temporary Seeding should be removed from, or plowed/tilled into, the existing soil

Selection Considerations

- Consider application rate, regional climate, environment, and duration of required vegetation coverage prior to application. Temporary Seeding is intended to be used for a maximum of one growing season.
- Temporary Seeding should be applied soon after ground-disturbing activities cease in the area and in compliance with highway Section 641 (airport Section P-157). The use of fertilizers is advised to promote rapid and healthy seed growth. Fertilizer should be applied at the application rate specified by the manufacturer or per the recommendations from a soil analysis

Design

Seed Selection: Annual Ryegrass (*Lolium multiflorum*) should be used for short periods lasting no more than one growing season.

Seed Application Rate: Typical rate of 20 lbs/acre (per Plant Material Center recommendation), although the rate may be varied based on site-specific conditions.

Fertilizer Application Rate: Typical rate of 200 lbs/acre of 20-20-10 (percent nitrogen-phosphorus-potassium) fertilizer (per Plant Material Center recommendation).

Other Soil Amendments: In certain cases, in addition to fertilizer, specifying compost or topsoil may enhance vegetative growth. However, note that in some cases a layer of topsoil on gravel surfaces can increase erosion potential.

Soil Stabilization Methods: Hydraulic erosion control products (HECPs), including bonded fiber matrix, mulch, and tackifiers; and rolled erosion control products (RECPs) for slopes should be considered on a site-specific basis in conjunction with Temporary Seeding to decrease soil erosion potential

Relationship to Other Erosion and Sediment Control Measures

Seeding should be performed in conjunction with surface roughening, soil stabilization methods, and grading practices. Concentrated flows or runoff should be directed away from the seeded areas using diversions.

Common Failures or Misuses

Common failures are generally due to faulty installation and maintenance. These failures include:

- Ground or growth medium is insufficient to support seed.
- Seed is not applied at an adequate application rate.

- Mulch or HECP used is inadequate to hold seed on slopes.
- Seed is not applied uniformly and/or adequate ground coverage is not achieved.
- Seed is not properly or adequately irrigated.
- Seeded areas are disturbed by foot traffic and/or equipment after installation.
- Seeding is applied too close to freeze-up

SPECIFICATIONS

Standard Specifications

- 658 – Temporary Seeding
- 620 – Topsoil
- 657 – Tackifier
- 650 – Compost Blanket
- 653 – Permanent Seeding
- 652 – Soil Amendments
- 753 – Soil Amendments
- 725 – Fertilizer
- 651– Hydraulic Erosion Control Products
- 751—Hydraulic Erosion Control Products
- 654– Rolled Erosion Control Products for Slopes
- 754-- Rolled Erosion Control Products

Bioswale

Bioswales are grass lined ditches that remove sediment through filtration and reduction of runoff velocities. See Figure 26A for an illustration of this temporary or permanent control. Design criteria are available in the MOA DCM.

Selection

The bioswale BMP is appropriate for construction sites where concentrated runoff needs to be handled to prevent erosion or encourage infiltration.

Implementation

A healthy grass cover and moderate ditch slopes are needed, per the MOA DCM.

Maintenance

Bioswales should be repaired and grass re-established as necessary. The bioswale should be checked for scour and repairs should be made immediately. All flow impediments should be removed to maintain the ditch hydraulics. The grass must be maintained in a healthy condition at all times because it is the primary erosion protection for the bioswale. Reinforced turf may be required.

- Look for and remove trash accumulations in the ditch.
- Check for accumulated sediment in the ditch.
- Look for diseased or unhealthy vegetation and repair or correct as necessary.
- Check for and repair signs of erosion.

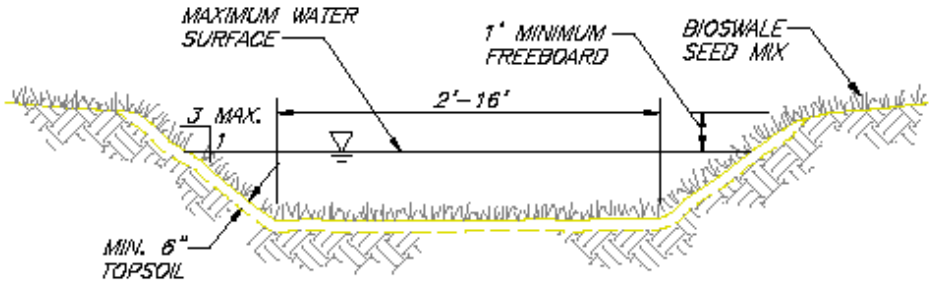


Figure 26A: Bioswale

Rock Swale

Rock swales are used to reduce water velocities and provide an erosion-resistant channel. See Figure 27A for this temporary or permanent BMP.

Selection

Rock swales are generally used on steeper slopes or in situations where water velocities are anticipated to exceed five feet per second. The contributing flow area shall not exceed 10 acres per swale.

Implementation

The inlet and outlet should have appropriate devices to inhibit erosion. The channel should have the rock placed in a manner that adequately covers the underlying soils. The stone shall be adequately sized to prevent displacement during the design storm. The ditch should be deep enough to convey the water without overtopping. If geotextile is included in the installation, it should be firmly attached with staples and should be keyed into the surrounding earth. Provide both inlet and outlet protection to minimize erosion at these locations.

Maintenance

The inlet, outlet, and channel should be kept free of flow impediments. The channel should be checked for scour and additional rock should be installed if scour has occurred. The rock should be cleaned or replaced if sediment accumulates to one half the height of the rock. If geotextile fabric is included in the installation, it shall be kept in operable condition.

- Look for evidence that the rock swale needs cleaning of flow impediments or sediment.
- Check for erosion of the inlet and outlet.
- Confirm that the inlet and outlet are functioning properly.
- Confirm that the geotextile is anchored.
- Look for geotextile that is torn or frayed.
- Confirm that the stones have not been displaced by the flow.

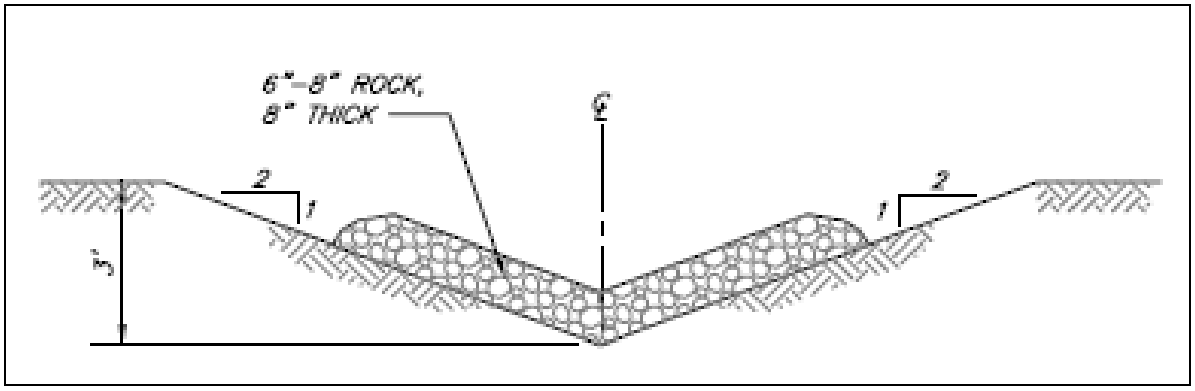
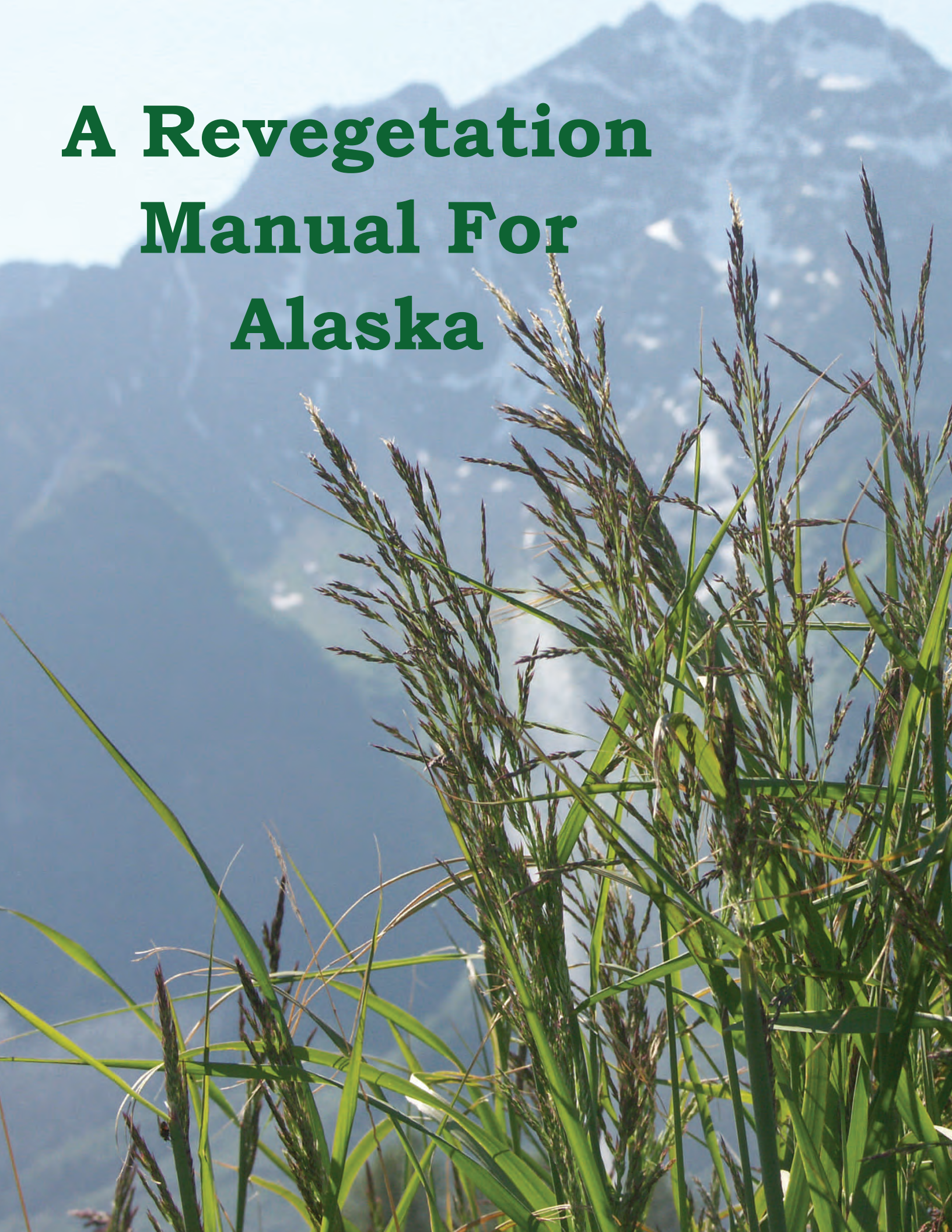


Figure 27A: Rock Swale

Appendix C

Revegetation Manual
for Alaska

A Revegetation Manual For Alaska



A Revegetation Manual For Alaska

This manual is created to help those involved in revegetation efforts select appropriate seed mixes and, to some degree, methods for revegetation.

By

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Editor and Designer, Peggy Hunt

August, 2008 update

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Table of Contents

Chapter 5: Cultivars and Species for Use in Alaska (continued)

Commercially Available Species and Cultivars (continued)

Released for Commercial Seed Production 27

Foreword

The material presented here focuses on native species and is the direct result of many years of work by employees of the Alaska Plant Materials Center. Throughout the manual, titles in blue refer to original project reports or related materials that further explain the process or study. These reports can be found on-line at http://www.dnr.state.ak.us/ag/ag_pmc.htm.

While the manual is not yet fully interactive, as seed and revegetation specifications are developed online, it will evolve into a one-stop source for native seed information and revegetation instructions. The fully developed manual, on-line, will include links to commercial seed inventories, helping the user to determine the availability of seed of any specific species and the quality of those seed lots in a Pure Live Seed format. Alaska's revegetation and restoration practitioners and seed producers can utilize this tool to plan projects with the best material and practices available.

As of 2008, the hard copy of the manual is firmly founded on the author's twenty-nine years of experience with revegetation with native seed at the Alaska Plant Materials Center. Timely updates will keep this document pertinent for future users in the dynamic art and science of revegetation.

This manual is a compilation and modification of previously published manuals prepared by the Alaska Plant Materials Center and used by both the United States Air Force and Alaska Department of Transportation and Public Facilities (DOT&PF). The two original source manuals are:

- Wright, Stoney J. and Nancy J. Moore. 1994. Revegetation Manual for Eareckson Air Force Station Shemya, Alaska. State of Alaska, Division of Agriculture, Plant Materials Center. 34 pp.
- Moore, Nancy J. and Stoney J. Wright. 1994. Revegetation Manual for King Salmon Air Force Base, King Salmon, Alaska. State of Alaska, Division of Agriculture, Plant Materials Center. 51 pp.

(http://www.dnr.state.ak.us/ag/ag_pmc.htm.)

A more recent reiteration of this information was published as:

- **2001 Alaska Highway Drainage Manual—Chapter 16 Erosion and Sediment Control**. 2001. State of Alaska, Department of Transportation and Public Facilities.

The text and charts are being reused and modified with consent from all previous authors and contributors.

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Preface

Revegetation and reseeding are concepts with a wide degree of professional interpretations and subject to varied philosophies of political, scientific, economic, social and even personal views of correctness. This manual reflects an interpretation that combines the professional and scientific views of the author with the legislation (political element) governing the Alaska Plant Materials Center.

Re-establishing vegetation can be accomplished in a number of ways, although this manual looks primarily at one – reseeding. Dogmatic insistence on the use of seed, either native or introduced, for revegetation projects is not the intent of the author. Nevertheless, this manual specifically addresses the seed component of revegetation and materially excludes all other aspects and methods (other than in mentioning) except the practice of revegetation with sprigs of beach wildrye (*Leymus mollis*), as described in Chapter 11.

Alaska Statue 03.22.020 (which establishes and governs the Plant Materials Center), states, among other things, that “the purpose of the center is… to encourage the development of a seed industry….” Developing and releasing adapted, commercially viable native species for the Alaska seed industry is critical to that mission. When these seeds are released, the Alaska Plant Materials Center recommends and specifies these native materials to end users for revegetation projects throughout the state. These recommendations and specifications are based on environmentally and scientifically sound demonstration projects and experience.

This manual culminates that work. In addition to giving sound revegetation suggestions for the use of native plants and seed, this manual also promotes the use of Alaska-grown seed and plants for the benefit of Alaskan seed growers. Regardless, both the end user and the seed growers can rest assured that specific suggestions are only given if they are found to be agronomically and environmentally sound. As a further note, revegetation suggestions should never be based solely on economic criteria.

Chapter 1: An Introduction to Revegetation

Revegetation – An introduction and background to the terms used in the field

Revegetation is a complex term with many near-synonyms; it is often broadly lumped with the terms *restoration*, *re-seeding*, *reclamation*, *land rehabilitation*, and *erosion control*. In actuality, these terms, although related, differ in purpose and definition.

For the purposes of this document revegetation is:

> *the re-establishment of plant cover by means of seeding or transplanting on a site disturbed by natural or man-caused actions.*

Activities such as surface preparation, fertilizer application, and standard horticultural and agronomic practices (i.e. irrigation and mulch application) often accompany revegetation efforts. These secondary activities will only briefly be addressed in this text because the primary purpose of this manual is seed and plant selection for revegetation projects.

Figure 1
An abandoned mine site a few weeks after seed and fertilizer were applied.

Figure 2
The same abandoned mine site after the third growing season. Note the establishment of invading tree and shrub species.

Why revegetate an area?

The reasons for revegetation are varied. This section will address some of the commonly acknowledged reasons for using seed to re-establish vegetation and some accepted types of reseeding.

Figure 3
A typical cut slope being hydroseeded in Interior Alaska.

- Erosion Control
- Landscape Plantings
- Temporary vs. Permanent Seedings
- Special Revegetation Techniques
- Natural Revegetation
- Native Species

Erosion Control

Choosing to revegetate for the purpose of erosion control is based on the assumption that soil can be kept in place with a vegetative cover. The users must bear in mind that vegetation has limitations to the degree of protection it can provide. In general, physical structures provide higher degrees of erosion protection than vegetation. The decision to use vegetation must consider the erosive forces involved. Vegetation used in erosion control can be considered analogous to shingles on a roof; the degree of protection given by vegetation, much like a shingle on a roof, is limited. The underlying surface may have more physical strength than the vegetation.

Figure 4: A small "research class" hydroseeder being used by Plant Materials Center staff in a Southcentral gravel pit plot.

The reasons to keep soil in place can include:

- Protection of engineered grades and other earthwork.
- Reduction of maintenance on buildings, structures, and other man-made objects.
- Maintaining surface water and air quality.
- Visual enhancement. (Important, but not truly erosion control.)

Landscape Plantings

Landscape plantings are included in this section simply as an informative note, because they are not primarily erosion control projects but at times do contribute to soil protection. This form of revegetation includes all plantings around buildings and special emphasis areas where aesthetics are the primary concern.

Landscape revegetation usually requires a maintenance program and intensive management, such as supplemental watering, fertilization, and mowing for survival and the desired appearance. Landscape plantings require very specific local knowledge based on exact site conditions and the designer's concept of the final product.

'Nugget' Kentucky bluegrass and 'Arctared' red fescue are often used in grass mixes intended for this purpose. Defer to local professional knowledge with regard to landscape plantings including lawns, shrubs and trees.

Temporary vs. Permanent Seedings

Temporary seedings are intended, as the name implies, to provide immediate but temporary erosion control until permanent vegetation can be established. However, the resulting vegetative mat of annual species may interfere with the establishment of perennial species if the site is not suitably prepared for the perennial seedings. An alternative to temporary seeding could be a loose mulch, such as straw.

Permanent seedings are intended to be used on final grades. The species chosen tend to be longlived and suitable for erosion control. When practical, permanent seedings should be chosen over temporary seedings.

Annual species can bridge the gap between temporary and permanent seedings. When seed is used, annual ryegrass is often chosen as a temporary or initial cover. A portion of a permanent seeding mix can also be composed of an annual species such as annual ryegrass. In this case, the annual species provides quick temporary cover on the site and may assist the permanent species in becoming established by creating microclimates that foster the germination of seed and protect seedlings from physical forces. Be aware that annual ryegrass has allelopathic properties (a form of natural herbicide) which can be detrimental to certain species.

Special Revegetation Techniques

Special or alternative techniques for revegetation, as defined in this manual, use materials other than seed to provide a vegetative cover. Usually, these techniques rely on vegetative cuttings, sprigs, or transplanting procedures.

These alternatives should be carefully assessed prior to implementation. Costs can be considerably higher than seeding. However, in certain circumstances, these alternatives will provide the best results.

Figure 5: Totes of *Arctophila fulva* (arctic pendant grass), an emergent grass species, researched by the Plant Materials Center for potential value as a habitat enhancement species. This was one of the few species used in transplanting trials.

Figure 6: A site on Shemya Island where sand erosion was controlled with beach wildrye transplants and seeded grasses, photographed in May 1987.

Figure 7: The same site on Shemya Island in September 1988.

Natural Revegetation

Natural revegetation relies on the tendency of vegetation to move into a disturbed area. Most disturbances, whether natural or man-made, will eventually be recolonized by plants. The conditions that determine the length of time needed to produce a cover of vegetation depend upon several factors, including proximity of viable seed sources, surface condition of the disturbed area, and local environmental conditions.

In time vegetation will return. Problems arise when natural revegetation does not occur rapidly enough to improve the appearance of the site or prevent erosion and sedimentation. Natural revegetation is a valid approach and should be employed when conditions and politics allow.

Figure 8: This site met the requirements for natural revegetation conditions.

Figure 9: After one full year the natural revegetation process was beginning.

Figure 10: After three years the process of natural revegetation was well underway.

Figure 11: Finally, after four years, the process was satisfactorily complete.

Figure 12: A river flood plain which was also revegetated with enhanced natural revegetation techniques.

Native Species

Availability is currently the primary obstacle to using native species in Alaska. In-state production is increasing, but market consistency is required to assure future availability. Government mandates and programs, both state and federal, are critical components in the development of the native seed industry. While mandates to use native species may originate in one agency, the agencies that buy and use seed are the ones faced with the issues associated with native species.

Figure 13: Harvesting a natural stand of Bluejoint reedgrass, *Calamagrostis canadensis*, with a standard combine.

Much has been done in the past decade to make these materials available. Their performance is superior to introduced material, but prices may be higher. Most of the price issue is related to the simple laws of supply and demand. Eventually, prices will stabilize and then decline. A list of potential commercially available native species is listed in the Native Plant Directory. As these materials become available commercially or for demonstration projects, the Alaska Plant Materials Center (PMC) will advise the end users.

Chapter 2: Basic Steps of Revegetation

Planning

The planning phase of any project should be the first step. Planning is critical in revegetation projects, since the designer works with biological processes that have specific timing and environmental requirements.

Figure 14: A sand quarry restoration project on Adak Island that relied on transplanted beach wildrye (*Leymus mollis*) sprigs and seeded grasses native to the area. The photo shows one season's growth.

Figure 15: The same area after three growing seasons.

In addition to identifying the type and purpose of revegetation, logistics need careful consideration. After receiving a project contract, immediately purchase seed and plant materials. This ensures that the revegetation portion of the project can be completed while equipment and personnel are available.

Figure 16: A small surface disturbance on the Northwest Arctic coast.

Figure 17: The same area after two growing seasons. The vegetation is the result of seeding native species and fertilizing the site with commercial fertilizer.

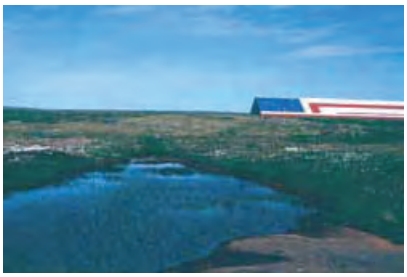


Figure 18: The same area after three growing seasons.

Those who hire contractors should recognize that although cultivars are sometimes difficult to obtain, some sub-contractors or suppliers have been known to say a particular cultivar is not available so that a less costly and often unsuitable seed could be substituted. If questions arise during this decision phase, contact local suppliers regarding availability or contact the State of Alaska, Department of Natural Resources, Plant Materials Center at (907) 745-4469.

Site Preparation

Site preparation methods are fairly standard for all forms of revegetation. An adequately prepared site will:

- Be free of construction debris.
- Have relatively few large rocks or other natural objects.
- Be free of ruts or gullies.
- Have the top two inches in a friable, non-compacted condition (allowing a heel to make a 1/4 inch impression).
- Be scarified to a depth of 6 to 8 inches if heavily compacted.

Methods of Preparation

Limited availability of soil preparation equipment need not hinder a project; such tasks can often be accomplished with standard construction machinery. For example, ripper teeth on a grader tool bar will adequately prepare a site. Ideally, scarification will be done in two passes perpendicular to each other. However, on sloping land and in areas of high wind, mono-directional scarification perpendicular to the direction of slope or prevailing wind is preferred.

If traditional surface preparation equipment such as disks and/or chisel plows is available, the conditions required for adequate surface preparation are the same as previously noted.

Note: If hydroseeding is used to apply seed, surface preparation as described in this section may not be applicable.

Chapter 3: Seed Specifications

Quality seed is a critical component to success. Specifying "certified" seed assures quality because it must meet certain standards for germination and purity; certification also provides some assurance of genetic quality.

Some native seed species are not available as certified seed. Seed quality can still be ascertained by examining percent germination and percent purity; this information is required for any seed sold in Alaska.

The true cost of seed can be determined by multiplying the percent germination by the percent purity, which equals Pure Live Seed (PLS). PLS is then multiplied by the price per pound. These calculations can increase the accuracy of bid comparisons. All seed sold or used in the state of Alaska must also be free of noxious weeds. This is noted on seed tags, along with germination and purity.

The seed mixes presented in this manual have been carefully developed and are based on results from trials throughout the state. Give careful prior consideration to any deviation from the recommendations. If problems occur or questions arise regarding seed, call the Alaska Plant Materials Center at (907) 745-4469. Seed stored on site should be kept cool, dry, and in rodent-free areas.

Certified Seed

The term “certified seed” can cause confusion because it is used to describe two different issues:

- The official use of the term Certified seed (with a capital C) is to describe seed that has been grown under the rules of the Seed Certification Program. This is a program that denotes, for lack of a better term, the pedigree of the named cultivar; i.e. ‘Arctared’ red fescue. Much like the pedigree of a registered canine, it simply states that the seed is from a defined source. Also, to be Certified seed, it must have been produced under the rules of the certification agency. Certified seed is the usual commercial category of seed. Its ancestry can be traced back to Registered Class or Foundation Class and Breeder seed. In addition, the Certified seed must meet variable standards of purity and germination. These standards are marketing tools and a means of verifying authenticity of a seed source. ‘Arctared’ red fescue can be sold as Certified or common — in fact, all the Alaska developed varieties or cultivars can be sold as either Certified or common.

- Seed can also be certified (without a capital C) to be free of weeds or as meeting a minimum germination standard. This has nothing to do with pedigree protection or variety identification — it simply indicates the quality of the seed. In other words, the buyer knows quality but has no assurance of type (other than species).

Certified seed should be used when available. Seed produced in Alaska is easy to trace to origin. Therefore, if Alaska-produced seed is used, it's likely that it is from its stated origin. It may be common (uncertified) 'Arctared', but it is still 'Arctared'. Minimum purities and germination should always be stated with orders. Common seed is a usable product and may be used to meet demands.

Common seed should meet Certified standards with regard to germination and purity, but even these may need to be relaxed to acquire sufficient material for a large job. Lower germination rates can be overcome by increasing seeding rates. Lower purities, however, should be very carefully considered as weeds can be very problematic.

Other Certification Classes

Many new native seed sources are being developed in Alaska. For the most part, these will not be sold as Certified seed. They may carry the following designations:

- Source Identified.
- Tested.
- Selected.

These classes will be in keeping with the Certification system and standards of germination and purity will be enforced, but the term Certified seed will not apply. These classes are referred to as being Pre-certified Class.

Chapter 4: Plant Evaluation

Initial Evaluation and Increase

“Initial evaluation” is the process of doing quantitative and qualitative measurements and comparisons between a number of collections of the same species of plants. The process usually occurs at a single location and can last for three to five years.

The Alaska Plant Materials Center conducts initial evaluations at Palmer. Thousands of collections have been evaluated since the Plant Materials Center’s establishment in 1973.

Figure 19: A typical initial evaluation plot, the 1979 grasses evaluation plot at the Plant Materials Center.

Figure 20: After one winter and another full growing season the 1979 plot has fewer surviving accessions.

Figure 21: After two winters and another growing season the 1979 plot looks even more depleted in 1981.

Figure 22: After initial evaluation it is necessary to increase the amount of seed in the inventory of those species selected for advance testing. This photograph is of one initial increase plot at the Plant Materials Center.

Advanced Evaluation Plots

Following the initial evaluation and subsequent increase of revegetation materials at the Plant Materials Center, the best performers are planted into advanced evaluation plots in locales ranging from Tok to Shemya and Ketchikan to Prudhoe Bay. These plots are developed with specific purposes in mind. For example, a plot intended to measure performance for mine reclamation would be treated differently than a plot measuring adaptation to grazing by livestock. Also, these plots allow for evaluation across the broad geographical and topographic conditions found in Alaska. For detailed results of evaluations performed at these plots, established for more than two decades by the Plant Materials Center, please refer to the publications listed at the end of this section.

Figure 23: An advanced evaluation plot on a mine site near Nome.

Figure 24: Another advanced evaluation plot on the Arctic coast.

Figure 25: An advanced evaluation plot on a mine site located in Interior Alaska.

Figure 26: Interior Alaska Highway advanced evaluation plot.

Publications Associated With Initial and Advanced Evaluations

(http://www.dnr.state.ak.us/ag/ag_pmc.htm.)

Moore, Nancy J. 1986. Final Report for the Bank Revegetation Program, Bethel Small Boat Harbor. State of Alaska, Division of Agriculture, Plant Materials Center. 13 pp.

Moore, Nancy J. 1987. Final Report for Evaluation of Conservation Species at Fort Richardson, 1983–1986. State of Alaska, Division of Agriculture, Plant Materials Center.13 pp.

Publications Associated With Initial and Advanced Evaluations

Moore, Nancy J. 1994. Final Report–Green's Creek Mine Revegetation Test Plantings. State of Alaska, Division of Agriculture, Plant Materials Center. 10 pp.

Wright, Stoney J. 1987. Final Report of Initial and Advanced Conservation Plantings at Ruby, Alaska, 1984–1986. State of Alaska, Division of Agriculture, Plant Materials Center. 16 pp.

Wright, Stoney J. 1987. Final Report on Evaluation of Advanced Herbaceous Conservation Species at Usibelli Coal Mine, Healy, Alaska, 1983–1986. State of Alaska, Division of Agriculture, Plant Materials Center. 13 pp.

Wright, Stoney J. 1987. Final Report on Demonstration and Advanced Conservation Plantings at Kalsin Bay, Kodiak, Alaska, 1982–1986. State of Alaska, Division of Agriculture, Plant Materials Center. 18 pp.

Wright, Stoney J. 1987. Evaluation of Conservation Species at Premier Coal Mine Near Palmer, Alaska, 1983–1986. State of Alaska, Division of Agriculture, Plant Materials Center. 14 pp.

Wright, Stoney J. 1988. Final Report of Advanced Conservation Grasses at Terror Lake Hydro Electric Project, Kodiak, Alaska. State of Alaska, Division of Agriculture, Plant Materials Center. 13 pp.

Wright, Stoney J. 1988. Final Report on Evaluations of Advanced Herbaceous Conservation Species at Diamond Alaska Test Pits Near Tyonek, Alaska, 1983–1987. State of Alaska, Division of Agriculture, Plant Materials Center. 13 pp.

Wright, Stoney J. 1989. Final Report of Data and Observations Obtained From the Chena Flood Control Project Evaluation Plots Located Near North Pole, Alaska. State of Alaska, Division of Agriculture, Plant Materials Center. 14 pp.

Wright, Stoney J. 1989. Final Report of Data Obtained From the Fairbanks Evaluation Plots and Demonstration Plots. State of Alaska, Division of Agriculture, Plant Materials Center. 12 pp.

Wright, Stoney J. 1989. Final Report on Data and Observations Obtained From the 2C Access Spur and Mine Site D Herbaceous Evaluation Plots Located in the Kuparuk Unit. State of Alaska, Division of Agriculture, Plant Materials Center. 11 pp.

Wright, Stoney J. 1990. Final Report on Data and Observations Obtained From the Red Dog Mine Evaluation and Demonstration Plots. State of Alaska, Division of Agriculture, Plant Materials Center. 16 pp.

Wright, Stoney J. 1990. Final Report on Data and Observations Obtained From the Delta Bison Range Evaluation Plan, 1986–1989. State of Alaska, Division of Agriculture, Plant Materials Center. 11 pp.

Wright, Stoney J. 1990. Final Report on Initial Evaluation Plantings at the Kenny Lake Evaluation Plots, 1980–1989. State of Alaska, Division of Agriculture, Plant Materials Center. 18 pp.

Wright, Stoney J. 1993. Final Report on the Evaluation of Herbaceous Species at Three Gold Mines Near Nome, Alaska, 1989–1992. State of Alaska, Division of Agriculture, Plant Materials Center. 10 pp.

(http://www.dnr.state.ak.us/ag/ag_pmc.htm.)

Chapter 5: Cultivars and Species for Use in Alaska

Commercially Available Species and Cultivars

The following listing of adapted, commercially available species and cultivars represents availability in Alaska as of 2007.

- Bluegrass, Alpine - 'Gruening'
- Bluegrass, Glaucous - 'Tundra'
- Bluegrass, Kentucky - 'Merion'
- Bluegrass, Kentucky - 'Nugget'
- Bluegrass, Kentucky - 'Park'
- Fescue, Red - 'Arctared'
- Fescue, Red - 'Boreal'
- Fescue, Red - 'Pennlawn'
- Hairgrass, Bering - 'Norcoast'
- Hairgrass, Tufted - 'Nortran'
- Polargrass - 'Alyeska'
- Polargrass - 'Kenai'
- Reedgrass, Bluejoint - 'Sourdough'
- Ryegrass, Annual - *Lolium multiflorum*
- Ryegrass, Perennial - *Lolium perenne*
- Sloughgrass, American - 'Egan'
- Wheatgrass, Slender - Wainwright Germplasm
- Wildrye, Beach - 'Benson'
- Wildrye, Beach - 'Reeve'
- Wormwood, Tilesius' - 'Caiggluk'

Released for Commercial Seed Production

The following germplasm are released by the Alaska Plant Materials Center for commercial seed production as Selected Class Pre-certified Germplasm seed (except for the three viviparous plant selections).

- Alkaligrass, Nootka - Ninilchik Germplasm
- Artemisia, Dusty Miller - Shemya Germplasm
- Barley, Meadow - Lowell Point Germplasm
- Bluegrass, Alpine - Teller Germplasm
- Bluegrass, Arctic - Adak Germplasm
- Bluegrass, Arctic - Council Germplasm
- Bluegrass, Arctic - Tin City Germplasm
- Bluegrass, Glaucous - Nome Germplasm
- Bluegrass, Large-glume - Andrew Bay Germplasm
- Bluegrass, Big - 'Service'
- Chamomile, Arctic Wild - Kotzebue Germplasm
- Cinquefoil, Staghorn - Mentasta Germplasm
- Fescue, Red - Henderson Ridge Germplasm
- Fescue, Viviparous - Safety Germplasm
- Fireweed, Dwarf - Kobuk Germplasm
- Fleabane, Beach - Clam Lagoon Germplasm
- Iris, Wild - Knik Germplasm
- Jacob's Ladder, Beautiful - Butte Germplasm
- Locoweed, Nodding - Franklin Bluffs Germplasm
- Lovage, Beach - Casco Cove Germplasm
- Oxytrope, Field - Black Rapids Germplasm
- Parsley, Jakutsk Snow - Tok Germplasm
- Reedgrass, Nootka - Pioneer Peak Germplasm
- Sedge, Longawn - Attu Germplasm
- Speargrass, Largeflower - Port Clarence Germplasm
- Sweetvetch, Alpine - Paxson Germplasm
- Trisetum, Spike - Nelchina Germplasm
- Wheatgrass, Thickspike - Solomon Germplasm
- Wheatgrass, Tufted - Slana Germplasm
- Wildrye, Downy - Cantwell Germplasm
- Yarrow, Boreal - Twenty Mile Germplasm

Commercially Available Species and Cultivars

Bluegrass, Alpine

'Gruening' alpine bluegrass (p.79)
***Poa alpina*, Cultivar**

'Gruening' alpine bluegrass was released by the Alaska Plant Materials Center (PMC) in 1986 (Wright, 1991c). The species is widely adapted throughout Alaska. As the name implies, the species is adapted to high elevation areas.

It also performs well on sites drier than those tolerated by Kentucky bluegrass. Seed availability is limited. Before this cultivar is included in a planting plan, the availability of the seed should be researched.

Figure 27: 'Gruening' alpine bluegrass

Bluegrass, Glaucous

'Tundra' glaucous bluegrass (p.91)
***Poa glauca*, Cultivar**

'Tundra' glaucous bluegrass was originally collected in Arctic Alaska. The cultivar was released by the University of Alaska Agricultural Experiment Station for revegetation in extreme northern areas with severe environmental conditions (Mitchell, 1979).

Figure 28: 'Tundra' glaucous bluegrass

Bluegrass, Kentucky

'Merion' Kentucky bluegrass
***Poa pratensis*, Cultivar**

'Merion' Kentucky bluegrass was released in 1947 by the USDA Plant Service Research Division, ARS and the U.S. Golf Association Green Section. The cultivar is more adapted to close mowing than any other Kentucky bluegrass (USDA, 1972). Merion is often used in lawn mixes in Alaska.

Figure 29: 'Merion' Kentucky bluegrass

Bluegrass, Kentucky

'Nugget' Kentucky bluegrass (p. 93)
***Poa pratensis*, Cultivar**

'Nugget' Kentucky bluegrass was released and developed by the University of Alaska Experiment Station in 1966. The source of this cultivar was a single plant collection made in 1957 at Hope, Alaska. 'Nugget' has outstanding winter survival (USDA, 1972) and is used extensively in Alaska for turf and lawns.

Figure 30: 'Nugget' Kentucky bluegrass is no longer recommended for standard revegetation. Its use should be limited to landscaping projects in urban or residential areas. This field is a foundation seed production field at the PMC. The other two cultivars of Kentucky bluegrass resemble 'Nugget'.

Bluegrass, Kentucky

'Park' Kentucky bluegrass
***Poa pratensis*, Cultivar**

'Park' Kentucky bluegrass was developed by the Minnesota Agricultural Experiment Station in 1957 (USDA, 1972). Hardiness of this cultivar is not as good as 'Nugget' in extreme northern areas of Alaska. However, it is still used in volume in Alaska. Like 'Nugget', its use tends to be limited to landscape and lawns.

Figure 31: 'Park' Kentucky bluegrass

Fescue, Red

'Arctared' red fescue (p. 101)
***Festuca rubra*, Cultivar**

'Arctared' red fescue was released in 1965 as a revegetation species showing extreme hardiness throughout Alaska (Hodgson, 1978). The overly aggressive, sod-forming nature of this species often makes this cultivar unacceptable in reclamation. However, the cultivar is outstanding for erosion control. Also, the aggressive nature of this sodforming species may be utilized to prevent the invasion of native shrub species such as alder and willow. The University of Alaska Agricultural Experiment Station and the USDA cooperatively developed the cultivar.

Figure 32: 'Arctared' red fescue closely resembles all the red fescues.

Fescue, Red

'Boreal' red fescue, *Festuca rubra*, Cultivar

'Boreal' red fescue was developed by the Canadian Department of Agriculture Research Station in Beaverlodge, Alberta (USDA, 1972). This very hardy cultivar is similar to 'Arctared' in adaptation and potential use in Alaska. It is often substituted for 'Arctared' and is less expensive than 'Arctared'.

Figure 33: 'Boreal' red fescue

Fescue, Red

'Pennlawn' red fescue, *Festuca rubra*, Cultivar

'Pennlawn' red fescue was released in 1954 by the Pennsylvania Agricultural Experiment Station (USDA, 1972). The cultivar has less hardiness than either 'Arctared' or 'Boreal', but still has potential in mild areas of Alaska. This cultivar was selected for turf uses and, therefore, tends to be used for landscaping more than for revegetation.

Figure 34: 'Pennlawn' red fescue

Hairgrass, Bering

'Norcoast' Bering hairgrass (p 111)
***Deschampsia beringensis*, Cultivar**

'Norcoast' Bering hairgrass was released in 1981 by the University of Alaska Agricultural Experiment Station as a forage and revegetation grass in northern areas. 'Norcoast' is recommended for revegetation use in coastal regions of Western Alaska to Southwestern Alaska and possibly in the northern maritime regions (Mitchell, 1985).

Figure 35: 'Norcoast' Bering hairgrass, *Deschampsia beringensis*, is an important revegetation species for coastal areas in Alaska. This cultivar was developed by the University of Alaska.

Hairgrass, Tufted

'Nortran' tufted hairgrass (p 113)
***Deschampsia caespitosa*, Cultivar**

'Nortran' tufted Hairgrass was also released by the University of Alaska Agricultural Experiment Station. Intended use is similar to 'Norcoast'; however, this cultivar is better adapted to northern regions of Alaska (Mitchell, 1985). Commercial availability began in 1994.

Figure 36: 'Nortran' tufted hairgrass

Polargrass

'Alyeska' polargrass (p 127)
***Arctagrostis latifolia*, Cultivar**

'Alyeska' polargrass is a cultivar developed by the University of Alaska Agricultural Experiment Station. The prime purpose for this cultivar is revegetation in Interior and Western Alaska (Mitchell,1979). The species is adapted to moderately wet areas (Wright,1992).

Figure 37: 'Alyeska' polargrass (*Arctagrostis latifolia*) is one of the cultivars being produced by the PMC for use in revegetation. This was one of the early cultivars developed by the University of Alaska.

Polargrass

'Kenai' polargrass (p 129)
***Arctagrostis latifolia*, Cultivar**

'Kenai' polargrass is a variety recommended for forage and revegetation in Central, Interior, and Southern Alaska (Mitchell, 1987). This species has potential for revegetating wet areas. This cultivar was developed by the Alaska Agriculture and Forestry Experiment Station at Palmer, Alaska.

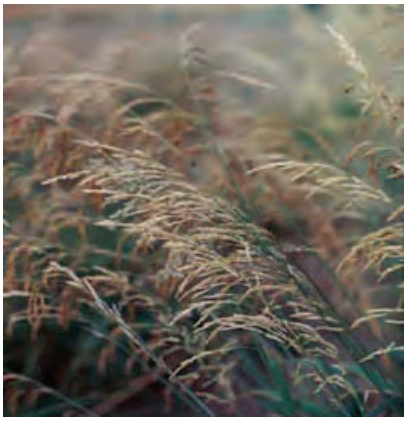


Figure 38: 'Kenai' polargrass (also *Arctagrostis latifolia*) was developed for southern regions of Alaska.

Reedgrass, Bluejoint

'Sourdough' bluejoint reedgrass (p 131)
***Calamagrostis canadensis*, Cultivar**

'Sourdough' bluejoint reedgrass is a cultivar with a wide range of adaptability. The species occurs throughout Alaska on both dry and wet sites. The cultivar was developed by the University of Alaska Agricultural Experiment Station for revegetation in northern latitudes (Mitchell, 1979). Commercial availability is erratic and when it is available, the seed is expensive (Wright, 1992).

Figure 39: 'Sourdough' bluejoint reedgrass

Ryegrass, Annual

Annual ryegrass, *Lolium multiflorum*

Ryegrass, Perennial

Perennial ryegrass, *Lolium perenne*

There are no cultivars called for in annual or perennial ryegrass since long-term survival is not critical and may not be desirable. These species provide a quick, temporary cover and should be limited to 10% or less of a seed mix. The use of these species should be limited because they use nutrients that are intended for the perennial species in the mix and can produce a heavy plant cover, slowing the growth of the perennial species. Annual and perennial ryegrasses are also very attractive to herbivores, causing potential vehicle/animal conflicts.

Figure 40: Annual ryegrass, *Lolium multiflorum*

Sloughgrass, American

'Egan' American sloughgrass (p 137)
***Beckmannia syzigachne*, Cultivar**

'Egan' American sloughgrass was released by the Alaska Plant Materials Center in 1990 as a wetland rehabilitation cultivar (Wright, 1991a). This is the state's first cultivar developed solely for wetland restoration. Additionally, the species benefits wildlife by providing forage and seed for waterfowl (Wright, 1992).

Figure 41: 'Egan' American sloughgrass

Wheatgrass, Slender

Wainwright Germplasm slender wheatgrass (p 145)
***Elymus trachycaulus* (synonym *Agropyron pauciflorum*), Selected Class "Natural"**

Wainwright is a dryland species originally collected on a gunnery range at Ft. Wainwright, Alaska. This species was selected because of its natural adaptability to colonize dry rocky/gravelly soil. It has become the largest commercially produced perennial grass in Alaska both in volume and in the number of producers. This Selected Class release was the first attempt by the PMC to develop a pre-certified category of seed for use in Alaska.

Figure 42: Wainwright Germplasm slender wheatgrass

Wildrye, Beach

'Benson' beach wildrye (p 151)
***Elymus mollis* (synonym *Leymus mollis*), Cultivar**

'Benson' is a cultivar of native species released by the Alaska Plant Materials Center in 1991 (Wright, 1994b). 'Benson' is available only from vegetative cuttings (sprigs). Seed will not be available. 'Benson' was selected for use in sandy areas of high erosion potential. Revegetation with sprigs is a preferred method of revegetating highly erodible areas (Wright, 1994c).

Figure 43: 'Benson' beach wildrye

Wildrye, Beach

'Reeve' beach wildrye (p 153)
***Elymus arenarius* (synonym *Leymus arenarius*), Cultivar**

'Reeve' beach wildrye is a 1991 release of the Alaska Plant Materials Center. The cultivar has high potential in coastal restoration, especially in the foredunes and other sandy sites throughout coastal and insular Alaska (Wright, 1994a). Unlike 'Benson' this cultivar is available as seed.

Figure 44: 'Reeve' beach wildrye was a 1991 release by the Alaska Plant Materials Center. This cultivar, unlike the native collection 'Benson' beach wildrye, was released for seed production.

Wormwood, Tilesius'

'Caiggluk' Tilesius' wormwood (p 157)
***Artemisia tilesii*, Cultivar**

'Caiggluk' Tilesius' wormwood was developed and released by the Alaska Plant Materials Center in 1989 as a reclamation species. This forb has a wide range of adaptations throughout Alaska (Wright, 1992).

Figure 45: 'Caiggluk' Tilesius' wormwood, *Artemisia tilesii*, is a cultivar developed by the PMC. This broadleaf has a wide range of adaptability throughout Alaska.

Released for Commercial Seed Production

Alkaligrass, Nootka

Ninilchik Germplasm nootka alkaligrass (p 73)
***Puccinellia nutkaensis*, Selected Class "Natural"**

Ninilchik Germplasm nootka alkaligrass is an Accession from a species that occupies a very specific niche in coastal Alaska; it is intended to be used on revegetation projects where the site is sometimes flooded by extremely high tides or storm surges. This is a species that does best on silty or gravelly coastal soils and is most often found in Southcentral and Southeast Alaska. Ninilchik was collected near the village of Ninilchik, Alaska, and was released in 2007 as a Selected Class accession (Wright, 2007).

Figure 46: Ninilchik Germplasm nootka alkaligrass

Artemisia, Dusty Miller

Shemya Germplasm dusty miller artemisia (p 75)
***Artemisia stelleriana*, Selected Class "Natural"**

Artemisia stelleriana is an interesting species in Alaska because it is only classified as native to North America on the western-most Aleutian Islands, including Shemya Island. The concept of it being native to such a limited region of North America seems to discount the fact that the original Aleut population did conduct trade with more Western societies and groups in Asia (where the species is native and widespread). Shemya germplasm was released for limited revegetation use and is only recommended for planting on the Western Aleutian Islands. It can, however, be used in landscape applications throughout Alaska where the species does well. The best performance can be expected on sandy to gravelly soils (Wright, 2007).

Figure 47: Shemya Germplasm dusty miller

Barley, Meadow

Lowell Point Germplasm meadow barley (p 77)
***Hordeum brachyantherum*, Selected Class "Natural"**

This meadow barley collection was originally harvested near Seward, Alaska. This species is an important coastal grass, most frequently found in wet areas and often on fine soils, like clays; however, at times it grows on rocky or gravelly sites, provided adequate moisture exists. The material was released as a Selected Class for commercial production in 2006 (Wright, 2006).

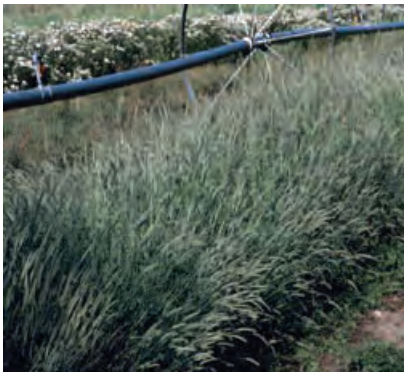


Figure 48: Lowell Point Germplasm meadow barley

Bluegrass, Alpine

Teller Germplasm alpine bluegrass (p 81)
***Poa alpina*, Selected Class "Natural"**

Teller is a native collection of *Poa alpina* intended for general revegetation projects throughout Alaska. In the future, this collection may replace 'Gruening' alpine bluegrass. The original seed source was near Teller, Alaska – a small village west of Nome, Alaska. This is a Selected Class release (Wright, 2006).

Figure 49: Teller Germplasm alpine bluegrass

Bluegrass, Arctic

Adak Germplasm arctic bluegrass (p 83)
(viviparous form), *Poa arctica*,
Selected Class "Natural"

Adak Germplasm is a PMC Selected Class Release of the species *Poa arctica*, arctic bluegrass (Wright, 2006). This collection was, as the name suggests, from Adak Island. The release is unique in the fact that it reproduces via asexual reproduction. This collection is viviparous meaning it produces small plantlets in the seedhead in place of true seed. This collection is adapted to the entire Aleutian Archipelago. It does, however, perform best on dry upland sites in the region.

Figure 50: Adak Germplasm arctic bluegrass (viviparous form)

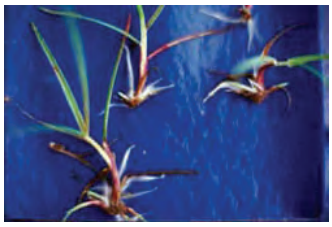


Figure 51: Viviplets of a viviparous arctic bluegrass plant are shown in this photograph. Note the root development. This root development occurred in less than 24 hours.

Bluegrass, Arctic

Council Germplasm arctic bluegrass (p 85)
***Poa arctica*, Selected Class "Natural"**

Council Germplasm arctic bluegrass represents a species that is common throughout Alaska (Wright, 2007). The PMC has released two other germplasm collections of arctic bluegrass; however, both of these were viviparous examples of the species. Council Germplasm produces true seed. This release can be used throughout Alaska on a wide variety of soils, but it will work best in Interior, Western, and Arctic revegetation zones of Alaska.

Figure 52: Council Germplasm arctic bluegrass

Bluegrass, Arctic

Tin City Germplasm arctic bluegrass (p 83)
(viviparous form), *Poa arctica*,
Selected Class "Natural"

Tin City Germplasm arctic bluegrass is another collection of viviparous *Poa arctica*. This collection, however, was obtained near the small mining town of Tin City, Alaska. The Selected Class release was placed in production in 2006 (Wright, 2006). Tin City Germplasm arctic bluegrass is intended for use in the northern half of Alaska. Like the other viviparous releases, this collection needs to be used as a vegetatively propagated species, not a seeded grass.

Figure 53: Tin City Germplasm arctic bluegrass (viviparous form) in production

Bluegrass, Glaucous

Nome Germplasm glaucous bluegrass (p 89)
***Poa glauca*, Selected Class "Natural"**

Glaucous bluegrass is a relatively common grass on dry mineral soils in the state. This collection was originally harvested near Nome, Alaska. This accession has a wider use range than the bluegrass cultivar 'Tundra'; however, it is not recommended for use in the arctic revegetation region. Nome was released in 2007 (Wright, 2007). It is also a Selected Class release.

Figure 54: Nome Germplasm glaucous bluegrass

Bluegrass, Large-glume

Andrew Bay Germplasm large-glume bluegrass (p 95)
***Poa macrocalyx*, Selected Class "Natural"**

Large-glume bluegrass is a perennial bunch grass found along coastlines inland of the primary coastal dunes and beach wildrye communities. Andrew Bay Germplasm originated on Adak Island near the Midpoint of the Aleutian Island Chain. This variety was collected in 1993 and released for commercial production in 2006 (Wright, 2006). The primary intended use of Andrew Bay Germplasm is revegetation and erosion control in coastal regions of Alaska from the Juneau area westward through the Aleutian Islands, and northward on the Western coast to roughly Scammon Bay.

Figure 55: Andrew Bay Germplasm largeglume bluegrass

Bluegrass, Big

'Service' Big Bluegrass (p 87)
Poa secunda

'Service' big bluegrass was a cultivar release in 1989, but the official registration did not occur. The seed has been released and available for commercial exploitation, but no interest in commercial production has arisen to date. The material is currently distributed for experimental purposes and likely has some value in the landscape industry.

Figure 56: 'Service' big bluegrass

Chamomile, Arctic Wild

Kotzebue Germplasm arctic wild chamomile (p 97)
***Tripleurospermum maritima*, Selected Class "Natural"**

Kotzebue Germplasm arctic wild chamomile, a perennial forb, grows on Alaska's northwestern seashores and the Arctic coast. This species was selected for revegetation, restoration, and possible landscape seedings. The material was collected south of the Kotzebue airport in August 1996 and released for commercial production in 2006 (Wright, 2006).

Figure 57: Kotzebue Germplasm arctic wild chamomile

Cinquefoil, Staghorn

Mentasta Germplasm staghorn cinquefoil (p 99)
Potentilla bimundorum (Potentilla multifida)
Selected Class "Natural"

This accession is the first cinquefoil released by the Alaska Plant Materials Center. This genus has many examples of collections developed for the horticulture trade. Mentasta however, was developed for reclamation and revegetation uses. The collection was obtained near the village of Tok in 1995. The species does best on sandy to gravely mineral soils. Like the other recent Selected Class releases, Mentasta was not genetically manipulated for specific traits. Therefore, it carries the designation "Natural".

Figure 58: Mentasta Germplasm staghorn cinquefoil

Fescue, Red

Henderson Ridge Germplasm red fescue (p 103)
***Festuca rubra*, Selected Class "Natural"**

Henderson Ridge red fescue was collected on Attu Island at the western end of the Aleutian archipelago in order to provide a seed source of red fescue native to that region. The intended use is revegetation and erosion control. Use of this material should be restricted to that region because its adaptation is not as widespread as the other red fescue cultivars used in Alaska ('Boreal' and 'Arctared'). Henderson Ridge Germplasm was collected in 1993 and was released as a Selected Class in 2006 (Wright, 2007).

Figure 59: Henderson Ridge Germplasm red fescue

Fescue, Viviparous

Safety Germplasm viviparous fescue (p 105)
***Festuca viviparoidea*, Selected Class "Natural"**

This fescue species reproduces by viviparous means. This 2006 Select Class release (Wright, 2007) will only be available as a viviparous accession, meaning it will not be available as true seed. The parent material was collected north of the Safety area of Alaska. This unique harvest site supported only two species, both of which were viviparous (the other being *Poa arctica*). This release is intended for use in Arctic, Western, and Interior Alaska.

Figure 60: Safety Germplasm viviparous fescue

Fireweed, Dwarf

Kobuk Germplasm dwarf fireweed (p 107)
***Chamerion latifolium*, Selected Class "Natural"**

This accession was collected near the village of Kotzebue, Alaska. It is a common species often found on river gravel bars throughout Alaska; hence its other common name.-.river beauty. This collection was released in 2007 and is expected to be used throughout Alaska. Production of this species (dwarf fireweed) has proven more successful than tall fireweed.

Figure 61: Kobuk Germplasm dwarf fireweed

Fleabane, Beach

Clam Lagoon Germplasm beach fleabane (p 109)
***Senecio pseudoarnica*, Selected Class "Natural"**

Clam Lagoon Germplasm is a selection of beach fleabane collected on Adak Island in 1993 and released for commercial seed production in 2006 (Wright, 2006). This species commonly occurs in coastal areas of Alaska, often in association with beach wildrye (*Leymus mollis*). Its use should be restricted to revegetation and erosion control, but there may be some secondary value as an ornamental in some applications. This forb is a rhizomatous perennial in the composite (aster) family. This release is in the Selected Class of the Pre-certified Seed Production System.

Figure 62: Clam Lagoon Germplasm beach fleabane

Iris, Wild

Knik Germplasm wild iris (p 115)
***Iris setosa*, Selected Class "Natural"**

Knik is a 2007 Selected Class release (Wright, 2007) intended for revegetation and landscaping. Production of seed is straightforward and relatively easy. The accession is best used on wet soil and in seed mixes with non-competitive grasses. Knik is best adapted for Southcentral, Southeast, and Southwest Alaska.

Figure 63: Knik Germplasm wild iris

Jacob's Ladder, Beautiful

Butte Germplasm beautiful Jacob's ladder (p 117)
***Polemonium pulcherrimum*, Selected Class "Natural"**

Butte Germplasm beautiful Jacob's ladder is a 2007 Selected Class release (Wright, 2007). This species is highly adapted to gravelly soils and has value in its colorful appearance. Using this species not only enhances diversity, it adds an aesthetic component to any revegetation mix.

Figure 64: Field production of Butte Germplasm beautiful Jacob's ladder near Fairbanks, AK.

Locoweed, Nodding

Franklin Bluffs Germplasm nodding locoweed (p 119)
***Oxytropis deflexa*, Selected Class "Natural"**

Franklin Bluffs Germplasm nodding locoweed is a 2008 Selected Class release from the Alaska Plant Materials Center. This native Alaska legume was collected on the Arctic coastal plain in 1995. This species is highly adapted to gravely sites and is intended for use in reclamation and revegetation in the northern and central regions of Alaska. Aspects of seed production will be similar to other commercial legumes in the same class.

Figure 65: Franklin Bluffs nodding locoweed

Lovage, Beach

Casco Cove Germplasm beach lovage (p 121)
***Ligusticum scoticum*, Selected Class "Natural"**

Beach lovage is in the parsley family. The species is quite common on coastal sites and will be an important component in coastal revegetation seed mixes. This particular accession was collected on Attu Island in 1993. Production has occurred at the PMC since 1994 and the germplasm was released in 2006 (Wright, 2006).

Figure 66: Casco Cove Germplasm beach lovage

Oxytrope, Field

Black Rapids Germplasm field oxytrope (p 123)
***Oxytropis campestris*, Selected Class "Natural"**

Black Rapids Germplasm field oxytrope is the first legume released from the PMC. It was released in 2007 (Wright, 2007). This selection was collected near Black Rapids on the Richardson Highway. This species is adapted to rocky and gravelly dry soils. Field oxytrope is often an early colonizer of disturbed sites. As with most legumes, field oxytrope fixes nitrogen and may increase soil fertility.

Figure 67: Black Rapids Germplasm field oxytrope

Parsley, Jakutsk Snow

Tok Germplasm Jakutsk snow parsley (p 125)
***Cnidium cnidiifolium*, Selected Class "Natural"**

Tok Selected Class Germplasm *Cnidium cnidiifolium* was collected near Tok, Alaska, and later released as Tok Germplasm Jakutsk snow parsley for revegetation purposes (Wright, 2006). It grows best on gravelly sites. Its presence in a seed mix results in a stand having a very natural, meadow-like appearance.

Figure 68: Tok Germplasm Jakutsk snow parsley

Reedgrass, Nootka

Pioneer Peak Germplasm Nootka Reedgrass (p 133)
***Calamagrostis nutkaënsis,* Selected Class "Natural"**

Pioneer Peak Germplasm nootka reedgrass was released in 2008. This was a Selected Class release with the "Natural " designation, indicating there was no intentional manipulation of the genetic base for specific traits. This accession was originally collected in 200 near the Eklutna Flats. The primary use of this collection will be revegetation through interior and south-central Alaska.

Figure 69: Pioneer Peak Germplasm nootka reedgrass

Sedge, Longawn

Attu Germplasm longawn sedge (p 135)
***Carex macrochaeta*, Selected Class "Natural"**

Attu Germplasm longawn sedge is a 2007 release by the Alaska Plant Materials Center (Wright, 2007). This sedge is quite common along coastal areas of Alaska. Its use in revegetation is suggested if coastal wetlands are impacted.

Figure 70: Attu Germplasm longawn sedge

Speargrass, Largeflower

Port Clarence Germplasm largeflower speargrass (p 139)
***Poa eminens*, Selected Class "Natural"**

Largeflower speargrass grows in coastal areas, most often behind foredunes or where foredunes do not exist. As an aggressive species that spreads vegetatively by rhizomes, it develops into large stands in coastal wetland situations. This accession was originally collected near the Port Clarence LORAN Station northwest of Nome, Alaska. This species is intended to be used on revegetation projects throughout coastal Alaska. Port Clarence germplasm was released in 2007 (Wright, 2007).

Figure 71: Port Clarence Germplasm largeflower speargrass

Sweetvetch, Alpine

Paxson Germplasm alpine sweetvetch (p 141)
***Hedysarum alpinum*, Selected Class "Natural"**

Alpine sweetvetch is an easily recognized and frequently encountered legume of Alaska. Paxson germplasm was collected near the Paxson Roadhouse. This species is most often found on dry, gravelly soils, especially near rivers. It is suspected of being a nitrogen-fixing species. Paxson germplasm is recommended for use in Interior and Southcentral Alaska. The collection was released for commercial production in 2007 (Wright, 2007).

Figure 72: Paxson Germplasm alpine sweetvetch

Trisetum, Spike

Nelchina Germplasm spike trisetum (p 143)
***Trisetum spicatum*, Selected Class "Natural"**

Nelchina was released for revegetation of dry sites with mineral soils. The species has nearly a worldwide distribution and is one of the more cosmopolitan grasses. Despite being a common grass, this release is the first for the species. Nelchina Germplasm spike trisetum is a Selected Class release developed by the PMC and released in 2006 (Wright, 2006).

Figure 73: Nelchina Germplasm spike trisetum

Wheatgrass, Thickspike

Solomon Germplasm thickspike wheatgrass (p 147)
***Elymus macrourus* (synonym *Agropyron macrourum*), Selected Class "Natural"**

Solomon Germplasm thickspike wheatgrass is a Selected Class release developed by the PMC and released in 2006 (Wright, 2006). This grass species is fairly common in Alaska. It naturally occupies dry mineral soils and gravelly sites. Solomon was collected east of Nome, Alaska, near the Solomon Roadhouse.

Figure 74: Solomon Germplasm thickspike wheatgrass

Wheatgrass, Tufted

Slana Germplasm tufted wheatgrass (p 149)
***Elymus macrourus*, Selected Class "Natural"**

Slana Germplasm tufted wheatgrass was released as a Selected Class in 2007 (Wright, 2007). As with most wheatgrass species, this accession does best on gravel soils in dry conditions and is recommended for revegetation in Interior Alaska. This accession can be interchanged with the other Alaska releases of wheatgrass in the Interior region. It was collected in 1995 near the settlement of Slana.

Figure 75: Slana Germplasm tufted wheatgrass

Wildrye, Downy

Cantwell Germplasm downy wildrye (p 155)
***Leymus innovatus*, Selected Class "Natural"**

Cantwell Germplasm downy wildrye is a 2007 precertified Selected Class release (Wright, 2007). This accession was collected near Cantwell on a dry, gravelly site and is useful on revegetation projects in Interior Alaska. Its true value shows when used for revegetation on dry mine sites and south-facing cut and fill slopes.

Figure 76: Cantwell Germplasm downy wildrye

Yarrow, Boreal

Twenty Mile Germplasm boreal yarrow (p 159)
***Achillea millefolium var. borealis*,**
Selected Class "Natural"

Twenty Mile boreal yarrow is a 2006 Selected Class Germplasm release derived from parent material collected near Portage, Alaska, in 1994 (Wright, 2006). This is a coastal collection and does well in coastal settings, but has sufficient adaptability to be useful in inland areas also. Yarrow, like the parsley family species, has the ability to create the appearance of a natural meadow stand in reseeded areas; the presence of the white/cream flowers breaks up the usual homogeneity of grass plantings.

Figure 77: Twenty Mile Germplasm boreal yarrow

Chapter 6: Choose Species/Cultivars for Revegetation Projects

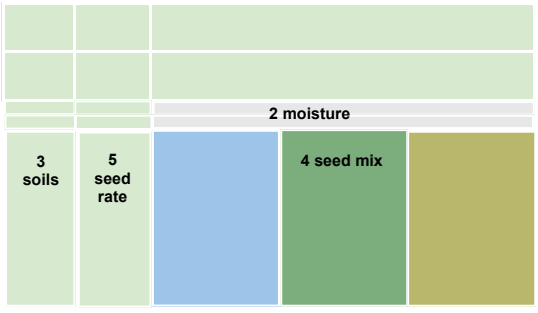
Instructions for Revegetation Suggestions Charts

1. Select region of state based on the map below.

2. Estimate the soil moisture conditions at the site.

3. Select the soil type based on standard engineering soil Classification (see p. 45).

4. Select an effective seed mix from the three categories listed in the seed mix on the appropriate map.
(It is always prudent to use more than one selection in a seed mix. Remember, it is called a mix; implying more than one component)



All entries are listed in order of preference. Listing in order of recommendation gives the designer guidance to prudently select species based on local preference and availability, as well as the secondary consideration of cost.

Contents of Chapter 6

Instructions continued

"Category 1" species should account for 80–100% of the seed mix. If the site is approximately uniform with regard to soil conditions, a two- to three-species mix of exclusively category 1 species suffices. Conversely, if soil conditions vary considerably, category 1 species should comprise the lower end of the percent range.

"Category 2" species give variety to the mix, Allowing the designer to cover a broad range of Variable conditions.

"Category 3" usually includes species in short Supply or of high cost. Category 3 material adds the highest degree of variability to the mix and may also be recommended when special concerns about environmental issues, such as stream crossings, are encountered. Category 3 material should not exceed 5% of the total mix, and its portion should reduce the category 1 percentages, not category 2.

An example:
For a project in the Southcentral region with average soil moisture and SW soils, 'Norcoast' Bering Hairgrass can form 60% of the category 1 portion of the mix. Another category 1 species should comprise 20–40% of the mix, depending on variability of soil type. If the second species comprises less than 40% of the mix, category 2 or possibly category 3 species are used to bring the total to 100%. Wainwright Germplasm slender wheatgrass is the highest recommended category 2 species, followed by 'Boreal' red fescue in this specific example.

5. Seeding rates for the entire mix are listed in the column "Seed Rate". This number is interchangeable for either pounds per acre or kilograms per hectare.

6. If the site is determined to be an erosion hazard, add no more than 10% annual ryegrass to the previously developed mix. The species, while giving temporary erosion protection, competes for nutrients with the longterm perennial species. Also, annual ryegrass is a highly palatable and attractive forage species that can attract herbivores (i.e. moose and deer).

Determining Regions

If your project lies near regional boundaries and you cannot determine what region's specifications should be used, follow these guidelines:

Arctic—Interior: Use Interior

Arctic—Western: Use Western

Western—Interior: Use Interior

Western—Southwestern: Use Western

Western—Southcentral: Use Southcentral

Southwestern—Southcentral: Use Southcentral

Southcentral—Interior: Use Interior

Southcentral—Southeast: Use Southcentral

Table 1a: Species/Cultivar Characteristic Chart (available commercially)

Species	Cultivar Or Equivalent	Availability 1	Site Conditions Adaptation	Growth Form 2	Height Average 3	Region Of Use 4	Category 5
Bluegrass, Alpine *Poa alpina*	Gruening	Fair	Dry	Bunch	6 in.	All	1,2,3
Bluegrass, Glaucous *Poa glauca*	Tundra	Fair	Dry	Bunch	10 in.	A,I,W	1,2,3
Bluegrass, Kentucky *Poa pratensis*	Merion	Excellent	Lawns	Sod	10 in.	I,SC,SE	1,2,3
Bluegrass, Kentucky *Poa pratensis*	Nugget	Good	Lawns	Sod	10 in.	I,SC,SE	1,2,3
Bluegrass, Kentucky *Poa pratensis*	Park	Excellent	Lawns	Sod	10 in.	I,SC,SE	1,2,3
Fescue, Red *Festuca rubra*	Arctared	Very Good	Dry to Wet	Sod	18 in.	All	1,2,3
Fescue, Red *Festuca rubra*	Boreal	Excellent	Dry to Wet	Sod	18 in.	W,I,SE,SC, SW	1,2,3
Fescue, Red *Festuca rubra*	Pennlawn	Excellent	Dry to Wet	Sod	12 in.	I,SC	1,2,3
Hairgrass, Bering *Deschampsia beringensis*	Norcoast	Good	Dry to Wet	Bunch	20 in.	All	1,2,3
Hairgrass, Tufted *Deschampsia caespitosa*	Nortran	Good	Dry to Wet	Bunch	20 in.	All	1,2,3
Polargrass *Arctagrostis latifolia*	Alyeska	Fair	Wetter Areas	Sod	24 in.	A,I,W,SC	2,3
Polargrass *Arctagrostis latifolia*	Kenai	Fair	Wetter Areas	Sod	24 in.	SC,SE,SW	2,3
Reedgrass, Bluejoint *Calamagrostis canadensis*	Sourdough	Fair	All	Sod	36 in.	All	3

1 Availability varies from year to year and within any given year.
2 Growth form and height will vary with conditions.
3 Typical DOT/PF sites will tend to produce shorter and more bunchy stands of these species.
4 Region of Use: W = Western Alaska; I = Interior Alaska; SE = Southeast Alaska; SC = Southcentral Alaska; SW = Southwest Alaska; A = Arctic Alaska; All = All of Alaska.
5 Category ratings (from Revegetation Suggestions Chart) often reflect availability. Availability is subject to change. This will in the future cause many category 3 selections to be raised to 2 or even 1.

Table 1a: Species/Cultivar Characteristic Chart (available commercially)

Species	Cultivar Or Equivalent	Availability 1	Site Conditions Adaptation	Growth Form 2	Height Average 3	Region Of Use 4	Category 5
Ryegrass, Annual *Lolium multiflorum*	-	Excellent	Dry, Limited Use	Temp.	16 in.	All	3
Ryegrass, Perennial *Lolium perenne*	-	Excellent	Dry, Limited Use	Temp.	16 in.	All	3
Sloughgrass, American *Beckmannia syzigachne*	Egan	Good	Wet	Bunch	18 in.	I,W,SC,SE	1,2,3
Wheatgrass, Slender *Elymus trachycaulus*	Wainwright Germplasm	Excellent	Dry, Gravel	Bunch	20 in.	I,W,SC	1,2,3
Wildrye, Beach *Leymus mollis*	Benson	Poor	Sandy, Dry	Sod	24 in.	W,SC,SW, SE	3
Wildrye, Beach *Leymus arenarius*	Reeve	Poor	Sandy, Dry	Sod	24 in.	W,SC,SW, SE	3
Wormwood, Tilesius' *Artemisia tilesii*	Caiggluk	Poor	All	Bunch	20 in.	W,I,SC, SE,SW	3

1 Availability varies from year to year and within any given year.
2 Growth form and height will vary with conditions.
3 Typical DOT/PF sites will tend to produce shorter and more bunchy stands of these species.
4 Region of Use: W = Western Alaska; I = Interior Alaska; SE = Southeast Alaska; SC = Southcentral Alaska; SW = Southwest Alaska; A = Arctic Alaska; All = All of Alaska.
5 Category ratings (from Revegetation Suggestions Chart) often reflect availability. Availability is subject to change. This will in the future cause many category 3 selections to be raised to 2 or even 1.

Table 1b: Species/Cultivar Characteristic Chart (not available commercially)

These species have been released, but are not yet available commercially.

Species	Cultivar Or Equivalent	Availability 1	Site Conditions Adaptation	Growth Form 2	Height Average 3	Region Of Use 4	Category 5
Alkaligrass, Nootka Puccinellia nutkaensis	Ninilchik Germplasm	Poor	Coastal	Sod	8 in.	W,SC,SE	3
Artemisia, Dusty Miller Artemisia stelleriana	Shemya Germplasm	Poor	Coastal Western Aleutians	Stolens	12 in.	SW	3
Barley, Meadow Hordeum brachyantherum	Lowell Point Germplasm	Poor	Coastal	Bunch	24 in.	W,SW, SC,SE	3
Bluegrass, Alpine Poa alpina	Teller Germplasm	Poor	Dry, Gravel	Bunch	8 in.	W,I, SW,SC	3
Bluegrass, Arctic Poa arctica	Adak Germplasm viviparous form	Poor	Most	Bunch	12 in.	A,I,W, SW,SC	3
Bluegrass, Arctic Poa arctica	Council Germplasm	Poor	Most	Bunch	12 in.	A,I,W, SW,SC	3
Bluegrass, Arctic Poa arctica	Tin City Germplasm vivparous form	Poor	Dry, Sand, Gravel	Bunch	12 in.	W, I, SW,SC	3
Bluegrass, Glaucous Poa glauca	Nome Germplasm	Poor	Most	Bunch	12 in.	W,I, SW,SC	3
Bluegrass, Large-glume Poa macrocalyx	Andrew Bay Germplasm	Poor	Coastal	Bunch	16 in.	SW,SC,SE	3
Bluegrass, Big Poa secunda	Service	Poor	Dry	Bunch	16 in.	I,SC	3
Chamomile, Arctic Wild Tripleurospermum maritima	Kotzebue Germplasm	Poor	Coastal	Bunch	8 in.	A,W	3

1 Availability varies from year to year and within any given year.
2 Growth form and height will vary with conditions.
3 Typical DOT/PF sites will tend to produce shorter and more bunchy stands of these species.
4 Region of Use: W = Western Alaska; I = Interior Alaska; SE = Southeast Alaska; SC = Southcentral Alaska; SW = Southwest Alaska; A = Arctic Alaska; All = All of Alaska.
5 Category ratings (from Revegetation Suggestions Chart) often reflect availability. Availability is subject to change. This will in the future cause many category 3 selections to be raised to 2 or even 1.

Table 1b: Species/Cultivar Characteristic Chart (not available commercially)

These species have been released, but are not yet available commercially.

Species	Cultivar Or Equivalent	Availability 1	Site Conditions Adaptation	Growth Form 2	Height Average 3	Region Of Use 4	Category 5
Cinquefoil, Staghorn Potentilla bimundorum	Mentasta Germplasm	Poor	Dry	Bunch	6 in.	I,W,SC	3
Fescue, Red Festuca rubra	Henderson Ridge Germplasm	Poor	Coastal	Sod	14 in.	SW	3
Fescue, Viviparous Festuca viviparoidea	Safety Germplasm	Poor	Dry, Sandy, Gravel	Bunch	6 in.	A,W,I, SW,SC	3
Fireweed, Dwarf Chamerion latifolium	Kobuk Germplasm	Poor	Dry, Gravel, Sand	Bunch	12 in.	I,W,SC	3
Fleabane, Beach Senecio pseudoarnica	Clam Lagoon Germplasm	Poor	Coastal, Sand, Gravel	Sod	24 in.	W,SW SE,SC	3
Iris, Wild Iris setosa	Knik Germplasm	Poor	Coastal	Sod	12 in.	W,SW, SC,SE	3
Jacob's Ladder, Beautiful Polemonium pulcherrimum	Butte Germplasm	Poor	Dry, Gravel	Bunch	16 in.	I,SC	3
Locoweed, Nodding Oxytropis deflexa	Franklin Bluffs Germplasm	Poor	Dry, Gravel	Bunch	8 in.	A,W,I	3
Lovage, Beach Ligusticum scoticum	Casco Cove Germplasm	Poor	Coastal	Bunch	16 in.	W,SW, SC,SE	3
Oxytrope, Field Oxytropis campestris	Black Rapids Germplasm	Poor	Dry, Gravel	Bunch	8 in.	A,W,I	3
Parsley, Jakutsk Snow Cnidium cnidiifolium	Tok Germplasm	Poor	Most	Bunch	24 in.	I,SC	3

1 Availability varies from year to year and within any given year.
2 Growth form and height will vary with conditions.
3 Typical DOT/PF sites will tend to produce shorter and more bunchy stands of these species.
4 Region of Use: W = Western Alaska; I = Interior Alaska; SE = Southeast Alaska; SC = Southcentral Alaska; SW = Southwest Alaska; A = Arctic Alaska; All = All of Alaska.
5 Category ratings (from Revegetation Suggestions Chart) often reflect availability. Availability is subject to change. This will in the future cause many category 3 selections to be raised to 2 or even 1.

Table 1b: Species/Cultivar Characteristic Chart (not available commercially)

These species have been released, but are not yet available commercially.

Species	Cultivar Or Equivalent	Availability 1	Site Conditions Adaptation	Growth Form 2	Height Average 3	Region Of Use 4	Category 5
Reedgrass, Nootka *Calamagrostis nutkaensis*	Pioneer Peak Germplasm	Poor	All	Sod	24 in.	W,I,SW, SC,SE	3
Sedge, Longawn *Carex macrochaeta*	Attu Germplasm	Poor	Coastal	Sod	12 in.	W,SW, SC	3
Speargrass, Largeflower *Poa eminens*	Port Clarence Germplasm	Poor	Coastal	Sod	24 in.	W,SW, SC,SE	3
Sweetvetch, Alpine *Hedysarum alpinum*	Paxson Germplasm	Poor	Dry, Gravel	Bunch	24 in.	W,I,SC	3
Trisetum, Spike *Trisetum spicatum*	Nelchina Germplasm	Poor	All	Bunch	18 in.	W,I, SW,SC	3
Wheatgrass, Thickspike *Elymus macrourus*	Solomon Germplasm	Poor	Dry	Bunch	24 in.	W,I,SC	3
Wheatgrass, Tufted *Elymus macrourus*	Slana Germplasm	Poor	Dry, Gravel	Bunch	24 in.	I,SC	3
Wildrye, Downy *Leymus innovatus*	Cantwell Germplasm	Poor	Dry, Gravel, Sand	Bunch	24 in.	I,SC	3
Yarrow, Boreal *Achillea millefolium*	Twenty Mile Germplasm	Poor	All	Sod	24 in.	W,I, SW,SC, SE	3

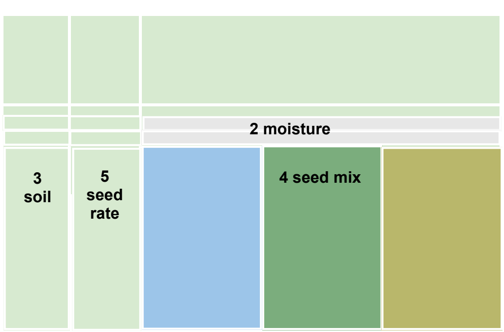
1 Availability varies from year to year and within any given year.
2 Growth form and height will vary with conditions.
3 Typical DOT/PF sites will tend to produce shorter and more bunchy stands of these species.
4 Region of Use: W = Western Alaska; I = Interior Alaska; SE = Southeast Alaska; SC = Southcentral Alaska; SW = Southwest Alaska; A = Arctic Alaska; All = All of Alaska.
5 Category ratings (from Revegetation Suggestions Chart) often reflect availability. Availability is subject to change. This will in the future cause many category 3 selections to be raised to 2 or even 1.

Table 2: Chart Symbols for Soil Types

Symbol	Soil Type
GW	well-graded gravel
GP	poorly-graded gravel
GM	silty gravel
GC	clayey gravel
SW	well-graded sand
SP	poorly-graded sand
SM	silty sand
SC	clayey sand
ML	silt
CL	lean clay
OL	organic clay/silt - low plasticity
MH	elastic silt
CH	flat clay
OH	organic clay/silt - high plasticity
Pt	peat - high organic

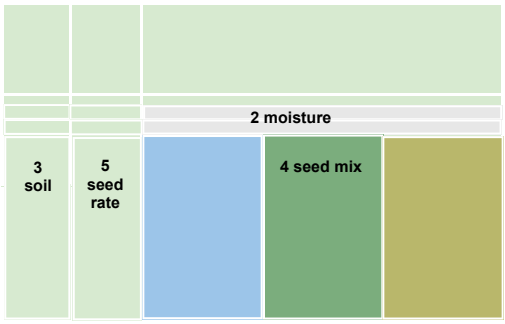
Revegetation Suggestions for Arctic Alaska
Based on Soil Characteristics & Available Moisture

Soil Group *(Refer to Soil Type Chart)*	**Seed Rate** *(Refer to Directions)*	**Species/Cultivar Selection** *(Refer to Species/Cultivar Characteristic Chart For Category Ratings)*		
High Organic		Suggest fertilizer only. If seeding is stipulated use suggestions for SW, SP, SM, SC soils.		
GW, GP		Suggest scarification and fertilizer only. If seeding is stipulated use suggestions for GM, GC soils and moisture.		
		Soil Moisture Characteristics		
		Saturated (Hydric)	**Average (Mesic)**	**Very Dry (Xeric)**
GM, GC	**20**	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **2** ‘Tundra’ glaucous bluegrass **2** ‘Norcoast’ Bering hairgrass **3** ‘Egan’ American sloughgrass **3** ‘Boreal’ red fescue	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **1** ‘Tundra’ glaucous bluegrass **2** ‘Nortran’ tufted hairgrass **2** ‘Gruening’ alpine bluegrass	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **1** ‘Tundra’ glaucous bluegrass **2** ‘Gruening’ alpine bluegrass
SW, SP, SM, SC	**40**	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **1** ‘Tundra’ glaucous bluegrass **2** ‘Gruening’ alpine bluegrass **2** ‘Nortran’ tufted hairgrass **3** ‘Norcoast’ Bering hairgrass **3** ‘Caiggluk’ Tilesy sagebrush	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **1** ‘Tundra’ glaucous bluegrass **2** ‘Gruening’ alpine bluegrass **2** ‘Nortran’ tufted hairgrass **3** ‘Norcoast’ Bering hairgrass **3** ‘Caiggluk’ Tilesy sagebrush	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **1** ‘Tundra’ glaucous bluegrass **2** ‘Gruening’ alpine bluegrass **2** ‘Nortran’ tufted hairgrass **3** ‘Norcoast’ Bering hairgrass **3** ‘Caiggluk’ Tilesy sagebrush
ML, CL, OL **MH, CH, OH**	**30**	**1** ‘Arctared’ red fescue **1** ‘Alyeska’ polargrass **2** ‘Tundra’ glaucous bluegrass **2** ‘Norcoast’ Bering hairgrass **3** ‘Egan’ American sloughgrass		



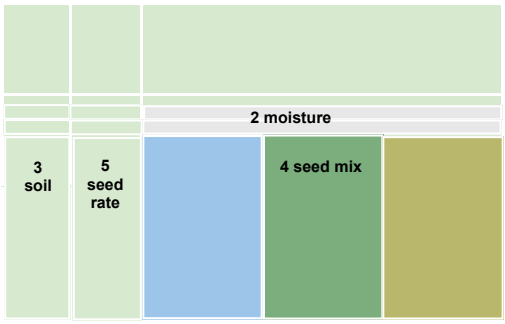
Revegetation Suggestions for Western Alaska
Based on Soil Characteristics & Available Moisture

Soil Group *(Refer to Soil Type Chart)*	Seed Rate *(Refer to Directions)*	Species/Cultivar Selection *(Refer to Species/Cultivar Characteristic Chart For Category Ratings)*		
High Organic		Suggest fertilizer only. If seeding is stipulated use suggestion for MH, CH, OH Hydric.		
GW, GP		Suggest scarification and fertilizer only. If seeding is stipulated use suggestions for SW, SP, SM, SC soils.		
		Soil Moisture Characteristics		
		Saturated (Hydric)	**Average (Mesic)**	**Very Dry (Xeric)**
GM, GC	**20**	**1** 'Norcoast' Bering hairgrass **1** 'Arctared' red fescue **1** 'Egan' American sloughgrass **2** 'Nortran' tufted hairgrass **2** 'Boreal' red fescue **2** 'Alyeska' polargrass **3** 'Caiggluk' Tilesy sagebrush	**1** 'Arctared' red fescue **1** 'Norcoast' Bering Hairgrass **1** 'Tundra' glaucous bluegrass **2** 'Boreal' red fescue **2** 'Alyeska' polargrass **2** 'Nortran' tufted hairgrass **2** 'Gruening' alpine bluegrass **3** 'Caiggluk' Tilesy sagebrush	**1** 'Arctared' red fescue **1** 'Norcoast' Bering Hairgrass **1** 'Gruening' alpine bluegrass **2** 'Nortran' tufted hairgrass **2** 'Tundra' glaucous bluegrass **2** 'Boreal' red fescue **3** 'Sourdough' bluejoint reedgrass **3** Wainwright slender wheatgrass
SW, SP, SM, SC	**40**	**1** 'Arctared' red fescue **1** 'Norcoast' Bering hairgrass **1** 'Nortran' tufted hairgrass **1** 'Gruening' alpine bluegrass **2** 'Alyeska' polargrass **2** 'Kenai' polargrass **2** 'Tundra' glaucous bluegrass **3** 'Sourdough' bluejoint reedgrass	**1** 'Arctared' red fescue **1** 'Norcoast' Bering hairgrass **1** 'Nortran' tufted hairgrass **1** 'Gruening' alpine bluegrass **2** 'Alyeska' polargrass **2** 'Kenai' polargrass **2** 'Tundra' glaucous bluegrass **3** 'Sourdough' bluejoint reedgrass *Note: If the area to be revegetated is adjacent to a coast line, consider transplanting beach wildrye.*	**1** 'Arctared' red fescue **1** 'Norcoast' Bering hairgrass **1** 'Nortran' tufted hairgrass **1** 'Gruening' alpine bluegrass **2** 'Alyeska' polargrass **2** 'Kenai' polargrass **2** 'Tundra' glaucous bluegrass **3** 'Sourdough' bluejoint reedgrass *Note: If the area to be revegetated is adjacent to a coast line, consider transplanting beach wildrye.*
ML, CL, OL **MH, CH, OH**	**30**	**1** 'Norcoast' Bering hairgrass **1** 'Egan' American sloughgrass **1** 'Arctared' red fescue **2** 'Alyeska' polargrass **2** 'Boreal' red fescue **3** 'Caiggluk' Tilesy sagebrush		



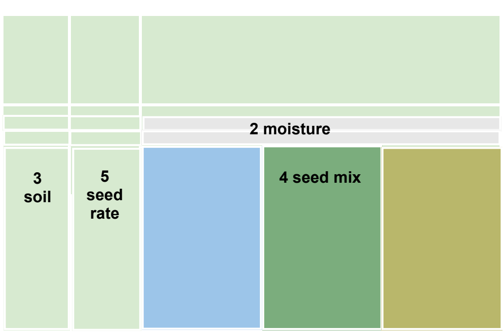
Revegetation Suggestions for Interior Alaska
Based on Soil Characteristics & Available Moisture

Soil Group *(Refer to Soil Type Chart)*	Seed Rate *(Refer to Directions)*	Species/Cultivar Selection *(Refer to Species/Cultivar Characteristic Chart For Category Ratings)*		
High Organic		Suggest fertilizer only. If seeding is stipulated use suggestions for MH, CH, OH Mesic or Xeric depending on site.		
GW, GP		Suggest scarification and fertilizer only. If seeding is stipulated use suggestions for GM, GC soils and soil moisture.		
		Soil Moisture Characteristics		
		Saturated (Hydric)	**Average (Mesic)**	**Very Dry (Xeric)**
GM, GC	**20**	**1** 'Egan' American sloughgrass **1** 'Norcoast' Bering hairgrass **1** 'Alyeska' polargrass **1** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Boreal' red fescue **2** 'Kenai' polargrass **2** 'Gruening' alpine bluegrass **3** 'Sourdough' bluejoint reedgrass	**1** 'Arctared' red fescue **1** 'Norcoast' Bering hairgrass **1** 'Gruening' alpine bluegrass **2** 'Boreal' red fescue **2** 'Alyeska' polargrass **2** 'Nortran' tufted hairgrass **2** Wainwright slender wheatgrass	**1** Wainwright slender wheatgrass **1** 'Arctared' red fescue **1** 'Gruening' alpine bluegrass **2** 'Nortran' tufted hairgrass **2** 'Norcoast' Bering hairgrass **2** 'Boreal' red fescue **3** 'Sourdough' bluejoint reedgrass
SW, SP, SM, SC **ML, CL, OL**	**40**		**1** 'Arctared' red fescue **1** Wainwright slender wheatgrass **1** 'Norcoast' Bering hairgrass **1** 'Nortran' tufted hairgrass **1** 'Gruening' alpine bluegrass **2** 'Alyeska' polargrass **2** 'Kenai' polargrass **2** 'Boreal' red fescue **3** 'Egan' American sloughgrass **3** 'Sourdough' bluejoint reedgrass	**1** 'Arctared' red fescue **1** Wainwright slender wheatgrass **1** 'Norcoast' Bering hairgrass **1** 'Nortran' tufted hairgrass **1** 'Gruening' alpine bluegrass **2** 'Alyeska' polargrass **2** 'Kenai' polargrass **2** 'Boreal' red fescue **3** 'Egan' American sloughgrass **3** 'Sourdough' bluejoint reedgrass
MH, CH, OH	**30**	**1** 'Norcoast' Bering hairgrass **1** 'Egan' American sloughgrass **2** 'Alyeska' polargrass **2** 'Gruening' alpine bluegrass		



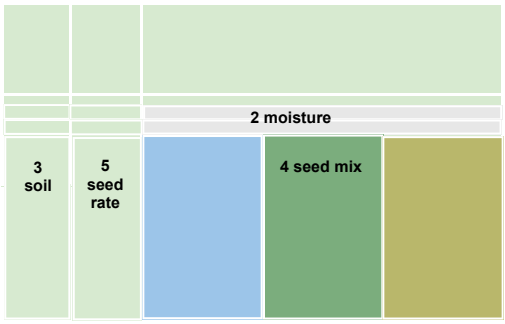
Revegetation Suggestions for Southwest Alaska
Based on Soil Characteristics & Available Moisture

Soil Group *(Refer to Soil Type Chart)*	**Seed Rate** *(Refer to Directions)*	**Species/Cultivar Selection** *(Refer to Species/Cultivar Characteristic Chart For Category Ratings)*		
High Organic		Suggest fertilizer only. If seeding is stipulated use suggestion below.		
GW, GP		Suggest scarification and fertilizer only. If seeding is stipulated use suggestions below.		
		Soil Moisture Characteristics		
		Saturated (Hydric)	**Average (Mesic)**	**Very Dry (Xeric)**
GM, GC **SW, SP, SM, SC** **ML, CL, OL** **MH, CH, OH**	**40**	**1** 'Norcoast' Bering hairgrass **1** 'Boreal' red fescue **2** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' Bluejoint reedgrass **3** 'Pennlawn' red fescue *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*	**1** 'Norcoast' Bering hairgrass **1** 'Boreal' red fescue **2** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' Bluejoint reedgrass **3** 'Pennlawn' red fescue *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*	**1** 'Norcoast' Bering hairgrass **1** 'Boreal' red fescue **2** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' Bluejoint reedgrass **3** 'Pennlawn' red fescue *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*



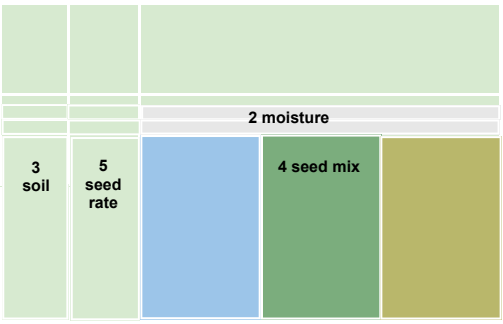
Revegetation Suggestions for Southcentral Alaska
Based on Soil Characteristics & Available Moisture

Soil Group *(Refer to Soil Type Chart)*	Seed Rate *(Refer to Directions)*	Species/Cultivar Selection *(Refer to Species/Cultivar Characteristic Chart For Category Ratings)*		
High Organic		Suggest fertilizer only. If seeding is stipulated use suggestions for MH, CH, OH Mesic or Xeric depending on site.		
GW, GP		Suggest scarification and fertilizer only. If seeding is stipulated use suggestions for GM, GC and soil moisture.		
		Soil Moisture Characteristics		
		Saturated (Hydric)	**Average (Mesic)**	**Very Dry (Xeric)**
GM, GC	**20**	**1** 'Norcoast' Bering hairgrass **1** 'Egan' American sloughgrass **1** 'Kenai' polargrass **1** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Boreal' red fescue **2** 'Alyeska' polargrass **3** 'Sourdough' bluejoint reedgrass	**1** 'Norcoast' Bering hairgrass **1** 'Arctared' red fescue **1** 'Gruening' alpine bluegrass **2** 'Boreal' red fescue **2** 'Kenai' polargrass **2** 'Nortran' tufted hairgrass **2** Wainwright slender wheatgrass **3** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' bluejoint reedgrass *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*	**1** 'Arctared' red fescue **1** Wainwright slender wheatgrass **1** 'Nortran' tufted hairgrass **1** 'Gruening' alpine bluegrass **2** 'Norcoast' Bering hairgrass **2** 'Boreal' red fescue *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*
SW, SP, SM, SC	**40**			
ML, CL, OL				
MH, CH, OH	**30**	**1** 'Norcoast' Bering hairgrass **1** 'Arctared' red fescue **1** 'Egan' American sloughgrass **2** 'Alyeska' polargrass **2** 'Gruening' alpine bluegrass		



Revegetation Suggestions for Southeast Alaska
Based on Soil Characteristics & Available Moisture

Soil Group *(Refer to Soil Type Chart)*	Seed Rate *(Refer to Directions)*	Species/Cultivar Selection *(Refer to Species/Cultivar Characteristic Chart For Category Ratings)*		
High Organic		Suggest fertilizer only. If seeding is stipulated use suggestion below.		
GW, GP		Suggest scarification and fertilizer only. If seeding is stipulated use suggestions below.		
		Soil Moisture Characteristics		
		Saturated (Hydric)	**Average (Mesic)**	**Very Dry (Xeric)**
GM, GC **SW, SP, SM, SC** **ML, CL, OL** **MH, CH, OH**	**30**	**1** 'Norcoast' Bering hairgrass **1** 'Boreal' red fescue **2** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' bluejoint reedgrass **3** 'Gruening' alpine bluegrass *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*	**1** 'Norcoast' Bering hairgrass **1** 'Boreal' red fescue **2** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' bluejoint reedgrass **3** 'Gruening' alpine bluegrass *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants.*	**1** 'Norcoast' Bering hairgrass **1** 'Boreal' red fescue **2** 'Arctared' red fescue **2** 'Nortran' tufted hairgrass **2** 'Caiggluk' Tilesy sagebrush **3** 'Sourdough' bluejoint reedgrass **3** 'Gruening' alpine bluegrass *Note: If the area to be revegetated is adjacent to a coast line, consider using beach wildrye transplants..*



Chapter 7: Species Notes

Species to Avoid

Introduced species have the potential to escape into the natural environment. This problem has not occurred in Alaska, yet some introduced species have become well established; clovers are a good example. In most areas of Alaska, clovers should be avoided because they have been known to invade native plant communities. This is especially true in remote areas.

Native Species

Revegetation with native species is strongly encouraged. Federal agencies are directed or strongly encouraged to use native species by various Executive and Administrative Orders. These orders do not, as yet, specify germplasm source. However, species collected near a disturbance tend to be more biologically suited for revegetating the site.

Revegetation with native species provides the advantages of better adaptation to the environmental conditions and a more natural appearance in their setting than introduced species. In general, the use of introduced species for lawns and playing fields is acceptable.

Figure 78: A coastal wetland site needing revegetation. This area was reseeded with locally collected Lyngby's sedge seed and fertilized in May 1995. This project is an example of what can be accomplished with locally harvested seed.

Figure 79: The same site after one growing season.

Figure 80: This photograph, taken in September 1997, shows the results after three complete growing seasons.

The complete report on this project can be found at the following link: Wright, Stoney J. 1997. 1996 Final Report, Chugach Electric Association, Inc., Girdwood to Ingram Creek Restoration Project. State of Alaska, Division of Agriculture, Plant Materials Center. 39 pp. (http://www.dnr.state.ak.us/ag/ag_pmc.htm.)

The need to select more native species for revegetation in Alaska provided the incentive to fund the seed collection program. These photos show the industry at work.

Figure 81: Harvesting a wild stand of fireweed with standard farm equipment.

Figure 82: Removing harvested fireweed from a flail vac. Note the condition of the yet-to-be-cleaned seed.

Figure 83: A tow-behind seed stripper being used to harvest beach wildrye seed on the Chukchi Sea coast. This is a natural stand being harvested. Note that only the seed is being removed.

Some of the newly released germplasm, such as Kobuk Germplasm dwarf fireweed, come from this new seed collection program. This section (Species Notes) will be updated when new native species become available. In 2000, a Native Plant Directory was published (last revised in 2005) to enable buyers to find growers who are marketing native plants: http://www.dnr.state.ak.us/ag/NEWnative_directory.htm. The Native Plant Directory will be revised periodically and will be an additional source of information on native species availability.

Chapter 8: Fertilizer & Other Soil Amendments

Fertilizer

In all forms of revegetation, applications of fertilizer at the time of seeding are necessary. Most commercial fertilizers meet minimum standards and quality problems are seldom encountered. If problems arise with fertilizers, as a product, they can usually be traced to the product becoming wet during storage or shipment.

Fertilizer is described by a three number designator; for example, 20-20-10. These numbers are percentages of three elements: nitrogen, phosphorus, and potassium, respectively. Therefore, 20-20-10 fertilizer contains 20% nitrogen, 20% phosphorus, and 10% potassium by weight.

If possible, fertilizer should be applied concurrent with or prior to seeding, because once the seed has been applied no additional traffic should be allowed on the site.

Lime and Other Amendments to Adjust pH

Testing throughout the state has verified that using adapted or native species eliminates the need to use lime or soil-acidifying agents. The species and varieties called for in this manual will survive and produce effective stands of vegetation without pH-altering amendments.

Lawns, playing fields, and other high maintenance areas may require lime if extremely lush growth is required. These areas will only benefit from such application if the original pH is lower than 5.0.

Topsoil

The topsoil layer in undisturbed areas in Alaska is often very thin and expensive, or impractical, to salvage. However, this layer is a source of native seed, plant propagules, organic matter, and soil microbes which can enhance the quality of the substrate being revegetated. If possible, top soil should be salvaged.

Gravelly sites tend not to be highly erodible. If some fine particles are present in the gravelly soil, adapted species will grow without additional topsoil. In fact, the addition of a layer of topsoil on a gravel surface can increase erosion potential.

Chapter 9: Specialized Equipment Needs

Usually, the contractor supplies the equipment needed to complete a revegetation project. This manual includes a section on equipment in order to inform the project designer of the advantages and drawbacks of each.

Broadcast Seeders

Of all reseeding machinery, hand-operated broadcast seeders are usually the least expensive and require the least training and support equipment. Broadcast-type equipment can usually be used for both seed and fertilizer.

Figure 84: Broadcast seeding using shoulder-carried seeders works well on small areas and steep slopes where motorized equipment may have problems.

Drop Spreaders

Drop application methods rely on gravity feed, are simple in design and easy to use. Two problems can occur with this method: stripes can appear if the drop pattern is not overlapped and the equipment will corrode if it is not thoroughly cleaned after applying fertilizer. Stripes can be avoided by setting the spreader at half the recommended application rate and running two tracks perpendicular to each other over the site. Drop spreaders tend to be more precise than broadcast seeders.

Drill Seeders

Drill seeders are used most often in agricultural settings. One brand of drill seeder, the Brillion, has been used for revegetation of mine and construction sites. This seeder has been successful on most soil types, with the exception of very gravelly soils.

Figure 85: Drill seeders are specialized types of equipment that work best on level sites with fine soils.

Figure 86: Brillion seeders are forgiving and can be used on gravelly and rocky sites more reliably than other drill seeders.

Fertilizer cannot be applied with drill seeders. However, the unit incorporates the seed into the soil, packs the seed in place, and provides accurate application rates. The seeding rate can be reduced by 50 percent when a drill seeder is used because of this accuracy.

Hydroseeding

In recent years, hydroseeding has been portrayed as the most effective means for revegetating an area. However, many professionals are finding that this claim is overstated. Hydroseeders are well suited for seeding steep slopes and rocky areas, and they apply mulch, seed, and fertilizer in one step. The primary disadvantage is the requirement for large quantities of water, which can result in numerous trips across the land that is being revegetated. The equipment is complex and mechanical problems can cause delays. Hydroseeder manufacturers have claimed that hydroseeding promotes more vigorous plant growth, but that claim has not proven to be true. In fact, grass growth can be inhibited if too much mulch is applied.

Figure 87: A small tow-behind hydroseeder in use.

Figure 88: Hydroseeding a large-cut slope. This is the ideal area and use for a hydroseeder.

Hydroseeders come in truck-mounted and trailer forms. Major contractors either have a hydroseeder or can easily subcontract one. Hydroseeders are also useful as supplemental watering trucks once seed has been applied. Additional watering increases project costs and is not always necessary to produce a good stand of vegetation. Even without additional water application, seed will remain dormant until rainfall provides sufficient moisture for germination.

A hydroseeding contract should state that seed will not remain in the hydroseeder for more than one hour. This will prevent seed from absorbing excess water and being damaged by the dissolved fertilizer.

Table 3: Characteristics of Various Spreading Equipment*

Type	Advantages	Disadvantages
Hand-held Spinner Type Spreaders	• Inexpensive • Simple to use & repair • Can apply both fertilizer & seed • No special training needed	• Slow • High labor use • Skip & overlap possible • Seed may need to be incorporated into the soil following application
Mechanical Spinner Type Spreaders	• Fast operation • Can apply both seed & fertilizer • Relatively low-cost equipment	• Skip & overlap possible • Seed may need to be incorporated into the soil following application
Drop Type Spreaders	• Fast operation • Simple to use • Can usually be used to apply both fertilizer & seed	• Skip & overlap can be a serious problem if care is not taken • Difficult to calibrate accurately • Equipment needs higher degree of care
Drill Type Seeders**	• Seed incorporation not needed as a separate step • Precise application possible • Skip usually not a problem • Uses seed at half the prescribed rate	• Does not usually apply fertilizer • Equipment can be more costly • Needs higher degree of seedbed preparations
Hydroseeders	• Degree of slope usually not a problem • Skip not a problem when used with mulch • Can apply both seed & fertilizer in one application	• Equipment costly to own and operate • Needs water source • Equipment more complex

* The type of machinery used to apply seed and fertilizer should be the choice of the contractor. It is often based on local availability. The method should be noted in the bid response so accurate comparison can be made by the contracting officer.

** Note: If drill seeders are employed, the recommended seeding rate can usually be reduced by 50%.

Chapter 10: Mulch and Erosion Matting

When deciding on the use of a mulch, such as straw or an erosion matting, several factors should be considered; erosion potential due to wind or water is the first consideration. If the soil does not have a high erosion potential, then mulch and/or matting should be skipped.

Figure 89: Well-placed excelsior blankets being used to control erosion prior to vegetation growth.

Figure 90: Damage to an excelsior blanket product when used in severe wind areas. The plastic backing separated from the wood fiber and created a non-degradable mess capable of entrapping small wildlife.

The second consideration is cost. Application of mulch and matting add significant costs to a project; not only in materials, but also in labor.

The third consideration is safety. Sections of netting may come loose and cause hazards to wildlife and property.

Figure 91: The plastic web or backing has created traps that have ensnared birds and fish - the use of this product should be carefully considered and based on true need and area of use, considering potential consequences.

A final concern is that straw may introduce unwanted weeds.

The above concerns do not apply to wood and paper fiber or similar products used in hydroseeders. When hydroseeders are used, mulch is standard. The mulch fiber forms a slurry that acts as a carrier for the seed and fertilizer. Without the mulch, seed and fertilizer would not suspend in solution and uniform distribution would be impossible. The mulch also marks the area that has been treated.

Table 4. Mulch and Netting Comparison Chart

Mulch/ Netting Type	Difficulty In Using Correctly	Erosion Resistance (Relative)	Cost (Relative)	Cost to Apply (Relative)	Environment Restrictions For Use	Soil Type Where Most Effective
Wood or Paper Fiber Mulch	No	Low	Low	Low	Few	All
Straw Mulch	No	Medium	Low	Moderate	High Winds Hamper Use	Fine Grain
Jute Mesh Type Netting	Yes	Medium	Moderate	High	None	Course Grain
Tack Netting	Yes	Low	Moderate	High	None	Course Grain
Excelsior Type Blankets	Yes	High	High	High	Plastic Netting Can Be A Problem	All
Chemical Stabilizers	No	Varies	Varies	Low	Temperature Requirement For Application	Course Grain

Chapter 11: Transplanting and Sprigging (Advanced Techniques)

Of all revegetation techniques, the use of living plants or parts of living plants is the most labor intensive. However, there are times when the most appropriate revegetation method is planting transplants, sprigs or cuttings.

Figure 92: The technique of using a clam gun to extract sedges for transplanting.

The most common and historically-used method of vegetative plantings in Alaska is the use of willow cuttings. Another more recent method of transplanting was developed and proven effective on the Aleutians under various Department of Defense contracts and studies. This technique relies on planting sprigs of beach wildrye (*Elymus mollis*, synonym *Leymus mollis*).

Revegetation techniques with vegetative material require a great deal of planning and should not be attempted without consulting experienced persons. Transplanting whole plants is not covered in this report.

Willow and Other Woody Cuttings

The use of willow cuttings has proven successful in all areas of Alaska where willow occurs naturally. Because timing is critical to both collection and planting, prior planning is an absolute necessity.

For detailed instructions, please refer to the Streambank Manual:
Moore, Nancy J., Jeanne Walter, Dean Hughes, Gay Muhlberg. 2005. Streambank Revegetation and Protection, A Guide for Alaska, Revised 2005. http://www.sf.adfg.state.ak.us/sarr/restoration/techniques/techniques.cfm. Alaska Department of Fish and Game, Division of Sport Fish. 91pp.

Beach Wildrye Sprigging

Sprigging with beach wildrye, one of the most widely used transplant species, was initially developed and proven effective on Shemya Island. The species can be used anywhere in coastal and insular Alaska, however, dune areas adjacent to shorelines are ideal. Sand is the ideal medium for planting, but gravels and rocky soil will also support the species.

Figure 93: A typical beach wildrye sprig. Note that this example could be divided into at least three individual sprigs.

Figure 94: A mechanically prepared planting area ready for sprigs of beach wildrye.

Figure 95: A worker demonstrates the proper drop and stomp technique for large-scale beach wildrye planting.

Figure 96: A site correctly transplanted with beach wildrye sprigs. A Brillion seeder plants perennial seeded grasses over the sprigs.

Figure 97: The nearly completed beach wildrye transplanting project in May 1987 at Shemya.

Figure 98: Shemya project in 1988.

Figure 99: Final product as it appeared in 1989.

For directions, please refer to the Beach Wildrye Manual:

Wright, Stoney J. 1994. Beach Wildrye Planting Guide. State of Alaska, Division of Agriculture, Plant Materials Center. 29 pp. (http://www.dnr.state.ak.us/ag/ag_pmc.htm.)

Chapter 12: Natural Revegetation

With time, most disturbed sites will revegetate naturally. However, very few landowners and managers find this revegetation approach acceptable. Proper surface preparation and fertilization can hasten the establishment of native plants, but the process can take many years. Also, prediction of the eventual cover or species composition of an area designated to be revegetated by natural processes is uncertain. Even an educated guess may have serious flaws if certain predetermined conditions need to be met on the disturbed site.

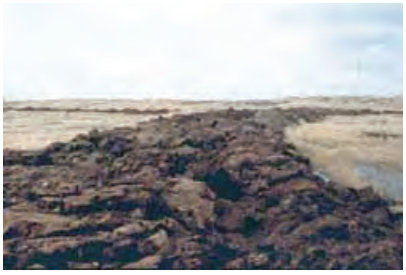


Figure 100: An area selected for natural revegetation monitoring on Shemya Island. This road is being reclaimed with a locally excavated peat overlay that is allowed to develop a vegetation cover without assistance.

Figure 101: The same area after five growing seasons. The natural process works, but takes time.

Most people considering natural revegetation fail to recognize the fact that it is actually an active process. Simply doing nothing is not “natural revegetation” as defined by professionals in the field. At the very least, an active monitoring program needs to be in place to prevent erosion and/or invasive species encroachment. In short, this technique does not mean “walk away from the site”.

Natural revegetation can be assisted or enhanced with any combination of surface preparation or modification techniques, fertilizers, soil amendments and even light seed applications. This then becomes “enhanced natural revegetation”, an acceptable alternative to natural revegetation. Anyone wishing to apply this technique must understand the potential for failure and be willing to move to an active form of revegetation if the process does not perform well or erosion and other problems emerge.

Figure 102: A landfill compacter being used to loosen and imprint the surface of an old gravel pit.

Figure 103: The imprinted pattern on the surface of the gravel pit. The pock marks trap moisture and seed. The steel wheels of the compacter (sheep’s foot) on the hard surface loosen the soil, forming a more vegetation-friendly condition.

Figure 104: The effect of natural revegetation after two years. Note the establishment of woody species.

Figure 105: The same area after three years.

Figure 106: An area being prepared for natural revegetation by using a ripper bar on a grader. This is the final condition of the prepared surface.

Figure 107: The effect of surface scarification on plant establishment and regrowth after two growing seasons. No seed was applied to the site, but it was fertilized with 500 pounds of 20-20-10 per acre.

The author prefers enhanced natural revegetation over all other forms, but has rarely applied the technique, as few sites actually offer either the ideal conditions or the regulatory process precludes methods that cannot give specifics of final vegetative cover and/or composition.

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(http://www.dnr.state.ak.us/ag/ag_pmc.htm.)

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The references in this section are cited in the text of the Revegetation Manual. Many other references are listed in the Manual as background material. Digitally scanned publications by the Alaska Plant Materials Center are located on the Center's website: http://www.dnr.state.ak.us/ag/ag_pmc.htm.

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Addendum

Plant Flyers

Use and cultivation of Alaska native plant seeds

Alaska Plant Materials Center

Addendum: Plant Flyers

Use and cultivation of Alaska native plant seeds