Jumbo Mine Road Corridor

Part C: Environmental Resource Information

Permit Renewal

May 2018

USIBELLI COAL MINE, INC.

MASTER TABLE OF CONTENTS
JUMBO DOME ROAD CORRIDOR

VOLUME 1

CHAPTER II: GEOLOGY

CHAPTER III: OVERBURDEN AND INTERBURDEN ASSESSMENT

CHAPTER IV: HYDROGEOLOGY

CHAPTER VIII: VEGETATION

CHAPTER IX: FISH AND WILDLIFE INFORMATION

CHAPTER X: SOIL RESOURCES

CHAPTER XI: LAND USE INFORMATION

PART D: OPERATION AND RECLAMATION PLAN

LIST OF TABLES

LIST OF PLATES

LIST OF EXHIBITS

LIST OF APPENDICES

LIST OF FIGURES

PART C

ENVIRONMENTAL RESOURCE INFORMATION

CHAPTER I

CULTURAL AND HISTORICAL INFORMATION

TABLE OF CONTENTS

1.0 INTRODUCTION

Usibelli Coal Mine, Inc. (UCM) is proceeding with plans to develop the Jumbo Road Corridor project located north and east of Healy, in central Alaska. This proposed road is an extension of the company's existing surface mining operation in the Hoseanna Creek valley and leads to the next logical mining unit within their coal reserve area; Jumbo Dome Mine SMCRA Permit S-0606. The permit area for the proposed surface mining operation includes state coal leases (See Plate A-1).

The regulations most relevant to field investigations for cultural resources are the National Historic Preservation Act of 1966 (PL 89-665, as amended in 1976, 1980, and 1992) which authorizes the National Register of Historic Places, and 36 CFR 800, which executes Section 106 of the National Historic Preservation Act through the definition of the review procedures for any cultural resource affected by a project located wholly or in part on federal lands funded wholly or in part with federal money or licensed wholly or in part by a federal agency. Cultural or paleontological resources located wholly or in part on State of Alaska lands are protected by the Alaska State Historic Preservation Act of 1971 (A.S. 41.35.000). The Alaska Surface Coal Mining Control and Reclamation Act (A.S. 27.21.000) further requires mine developers to complete cultural resource surveys on areas associated with surface coal mining operations.

A fairly large portion of the permit area for UCM's Two Bull Ridge mine had been previously subjected to systematic cultural resource surveys. These surveys concluded that the study areas did not contain any significant cultural properties. In addition, it was also determined that the surrounding areas had poor potential for site preservation (Bacon 1987).

The area within the permit boundary as described in Stephen Wilbur’s dissertation, “Fluvial and Geomorphology of Hoseanna Creek Watershed Central Alaska A Thesis: (May, 1995), the Hoseanna Creek watershed is rabidly eroding, and the high landsliding and badland densities are due to the asymmetric geologic structure and weakly consolidated lithologies. Both regional glaciofluvial processes and tectonism during the late Quaternary have changed the local base

level by at least 100 m., inducing headward incision through weak lithologies and yielding high rates of sediment production.

2.0 PROJECT AREA DESCRIPTION

The proposed access road will parallel the existing Hoseanna Road just to the north and uphill of it for a distance of ca. 4,000 feet. This section is characterized by steep slopes and bluffs of active erosion. In fact, in May of 2005, a rainstorm resulting in erosion of fossilized "clinkers" from the bluff face. The proposed road then turns north and runs a long a side slope of an unnamed creek bed, crossing at least 13 V-notches in the process of ascending to the muskeg plateau. The proposed access road then continues northward to link up with and parallel the existing pioneer access trail to terminate on the east side of Marguerite Creek south of the bulk sampling sites that were archaeologically surveyed and reported upon in 2002 ("An archaeological Survey of Two Bulk Sampling Sites… Jumbo Mine Preliminary Mining Limits, Undertaking for Usibelli Coal Mine, Healy , Alaska" Chris Rabich Campbell, November).

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2.1 PHYSICAL ENVIRONMENT

The project area is contained within the subarctic physiographic province of the northern foothills of the Alaska Range. The Nenana River, which flows northward into the Tanana River, is the predominant drainage. Hoseanna Creek (also known as Lignite Creek) is a tributary of the Nenana River. The northern foothills are flat-topped east trending ridges ranging in elevation from 2,000 to 4,500 feet. They are separated by rolling lowlands 700 to 1,500 feet in altitude. The foothills are largely unglaciated, but some valleys were widened during the Pleistocene Epoch by glaciers from the Alaska Range. Badlands, such as those found in the UCM project area, are not uncommon (Warhaftig 1965).

2.2 CLIMATE

The climate in this vicinity is continental, with extreme seasonal temperatures fluctuating from a maximum of 93 degrees f. in the summer months to a minimum of 63 degrees below zero F. in the winter months. Winter temperatures are decreased even further by the wind chill factor. The region is relatively dry, with precipitation in the form of rain during the summer (predominantly in August) and in the form of snow during the winter. Snow cover lasts for little more than half of the year (Streten 1974).

2.3 FAUNA

Modern day land mammals include black and grizzly bear (Ursus Americanus and Ursus Arctos), moose (Alces alces), barren ground caribou (Rangifer Tarandus), dall sheep (Ovis dalli), wolf (canis lupus), coyote (Canis latrans), red fox (volpes fulva), and lynx (Lynx canadensis). Additionally Arctic ground squirrel (Citellis parryi), porcupine (Erthyzon canadensis), beaver (Castus canadensis), wolverine (Gulo Loscus), hare (Lepus americanus), and squirrels (sabrinus spp.) are found within the area (US Department of Interior 1974). In mid-August, 1996, the presence of moose was noted by the large numbers of tracks impressed in the soil and the large

amount of pellet deposits. Although bear had reportedly been sighted within the project area on an intermittent basis throughout the spring and summer months, no sign was identified.

Extinct megafauna are known to have occurred in this vicinity. They include steppe bison (Bison priscus), wapiti (Cervus canadensis), and mammoth (Mammuthus primigenius). These species have been dated from over 13,000 to c. 10,500 years old (Guthrie 1990; Powers et. al. 1983; Powers and Hoffecker 1989).

2.4 GEOLOGIC HISTORY IN RELATION TO PREHISTORY

The identification of archeological sites in a region is largely dependent upon a few major factors, the first being whether people had actually left behind traces of their use, such as tools, garbage, or camps which have been preserved. The second factor is dependent upon whether any such remains are actually identified in the field by the archeologist prior to ground disturbance. The third factor is dependent upon whether any such remains have since been destroyed by geomorphological processes, such as fluvial and colluvial dynamics.

The Hoseanna Creek drainage is rapidly eroding to such an extent that it qualifies as badlands. All of the surface morphology in the Hoseanna Creek drainage dates to late Pleistocene Epoch or is of an even more recent derivation. Several important events have influenced the way that surface processes operate today. The first of these is associated with deglaciation. After the continental ice-sheets receded, the land base uplifted. The Alaska Range experienced isostatic rebound between 24,000 and 10,000 years ago. During this period, there was heavy downcutting as the Nenana River and its tributaries adjusted their gradients. Another contributing factor was late Quaternary tectonism which resulted in differential movement. Between 25,000 and 10,000 years ago, a major earthquake occurred along the Poker Flats fault. This dropped the local base level by c. 300 feet (100 m) at the confluence of Hoseanna Creek and the Nenana River (Wilbur 1995).

These glaciofluvial processes and tectonism caused headward incision along Hoseanna Creek and its tributaries. More recently, prior to 2,170 years ago, the Nenana River migrated eastward

at the confluence with Hoseanna Creek. This shortened Hoseanna Creek, and it adjusted its gradient by cutting through the fan and into bedrock. The gradient at the mouth increased the carrying capacity of Hoseanna Creek and resulted in the creek migrating eastward, accelerating the downcutting into the upper part of the watershed (ibid.).

The rate at which Hoseanna Creek incised the land base was dependent upon the parent material: it rapidly eroded stream deposits, but the rate was slower through coal bearing deposits and even more slow through metamorphic rock. As the downcutting continued toward the headwaters of Hoseanna Creek, the gradients of the tributary streams were increased too and they, in turn, incised headward. Headward incision intensified hillslope failure, landslide formation, increased erosion and sediment delivery to the mouths of the tributaries and the mouth of Hoseanna Creek (ibid.).

When the Hoseanna Creek fan first prograded westward, c. 1,000 to 2,000 years ago, the lower reaches of Hoseanna Creek adjusted by aggrading, which reduced the gradient of the main channel. The reduced gradient resulted in fans being built in the main channel at the mouths of the tributary creeks. The end result is that over five percent of the Hoseanna Creek watershed is covered by landslide deposits, and these highly accelerated erosional processes continue to this day (ibid.).

3.0 CULTURAL HISTORY OF THE REGION

3.1 PREHISTORY

In 1973, Dr. Charles Holmes discovered a deeply stratified archeological site at Dry Creek that appeared to hold much promise for answering questions about the peopling of the New World (Holmes 1974). Dry Creek was excavated under the supervision of Dr. Roger Powers under the auspices of the National Geographic Society with support from the National Parks Service. Simultaneously, archeological excavations were undertaken by graduate students David Plaskett and Peter Bowers at sites located near the Nenana River Gorge and Carlo Creek, respectively. Subsequently, field surveys in the Nenana River region were carried out by archeologists David Plaskett and Tim Smith, with support from geologist Robert Thorson. Their studies enabled a better understanding of local glaciation. They also found enough archeological sites to begin developing a predictive model (1978).

The potential significance of the Nenana River Valley seemed particularly promising due to a number of factors. First, it had remained largely unglaciated throughout the Pleistocene. During glacial peaks, when the Bering Land Bridge had been opened, the Nenana River Valley had been vegetated grassland supporting ungulates and megafauna sought by early hunters in the New World. Second, the soils include pockets of deeply stratified loess located on prominences and overlooks where early hunters liked to wait for game, manufacturing tools as they whiled away time.

It appeared as though there was the potential for the archeological record to stretch back beyond 12,000 years. As a result, 1977 saw the formation of a study jointly sponsored by the National Geographic Society and the National Park Service, called "The North Alaska Range Project." Its mission was to search for Late Pleistocene sites in the Nenana River Valley. Subsequently, the National Geographic Society withdrew from the project because of the dearth of paleoenvironmental data. The project refocussed and expanded to include a series of valleys in the north Alaska Range. By 1980, after the discovery of only a small number of sites, the scope

of the project was scaled down to include more recent cultural resources in the Nenana River Valley (Hoffecker 1985; Ten Brink 1984).

In the mid-1980's, UCM contracted with Alaska Heritage Research Group, Inc. to conduct archeological surveys and develop a cultural resources management plan for the Hoseanna Creek watershed. Two historic sites were identified along Hoseanna Creek. Overall, the remainder of the area was believed to be of low potential for locating archeological sites (Mobley 1985; Bacon 1987).

3.2 CULTURAL CHRONOLOGY

People have exploited the Nenana River Valley for nearly 12,000 years. Some of oldest, best documented archeological sites in the Americas are located in this region. The prehistory is documented nearly continuously from 12,000 years ago to the present.

The earliest component is the Nenana Complex, which dates back 12,000 years. People used tools with specific forms, such as the teardrop-shaped Chindadn points and triangular, bifacially flaked projectile points. The environment probably more closely resembled the steppes of the former Soviet Union, supporting herds of ungulates and megafauna, including bison, camels, horse, and mammoth (Powers and Hoffacker 1989). The climate was warmer and dryer than it is presently.

The next complex is called the Denali Complex, and is typified by wedge-shaped microblade cores, microblades, macroblades, burins, scrapers, and leaf-shaped bifacial knives. It is a widespread tradition, with similar archeological components found to the northwest in Siberia (West 1981). Although this tradition is believed by some to have superseded the Nenana Complex, and to date from 10,690 to c. 7,000 years BP, this theory has yet to be proven. If true, this means that people who created these tools lived during the advent of the Holocene Epoch. Climatic changes resulted in the xeric steppe environment giving way to tundra-shrub vegetative communities.

The Northern Archaic tradition follows the Denali Complex, dating between 6,000 and 2,000 years BP. The most diagnostic tool in this tradition is the side-notched projectile point. The Northern Archaic tradition is believed to represent adaptation to spruce forests. Palynological data point to this era as being a time when boreal forests gained hold in the region (Ager 1975).

The last identified tradition found in this region is the Athapaskan tradition, dating from 2,000 years BP to the present. This tradition was well documented at the nearby Nenana Gorge Site, which had been occupied c. 1500 and 1685 A.D. The artifact assemblage discloses many items associated with Athapaskans at the time of contact, including copper tools as well as stone and bone tools (Plaskett 1977).

4.0 FIELD SURVEY METHODS AND RESULTS

The archeological survey was performed by Chris Campbell. Methodology included a literature review. Following this, consultation with the State Office of History and Archeology took place to identify any sites within or adjacent to the project area. Study and analysis of aerial photographs provided by UCM also occurred to identify areas of high potential based on the land forms of the region. Also noted were the many slides in the badlands. Concurrently, topographic maps were examined to ascertain elevation and slope of the topography, and these findings were compared against the aerial photographs.

The next step was the site visit, which took place May 17 and 18 2005. During that visit, the proposed access road was flown over.

5.0 DISCUSSION AND CONCLUSIONS

The archeological survey for this project did not discover any new cultural resources. The area had previously been determined to be of low potential for discovering archeological sites. This opinion is reinforced by recent geological work demonstrating the instability of the area during the Pleistocene-Holocene interface and throughout the Holocene. Clearly, the land base supports abundant sign of game. However, the overlooks so preferred by prehistoric hunters, where they patiently awaited sign of game while manufacturing tools, would probably have been destroyed by erosion. However, the topography and vegetation is such that any artifacts would likely be isolated finds, like a single projectile point that missed its prey. Suitable overlooks were surveyed with negative results. The presence of an archeological site can never be ruled out. If a site is found during the course of project completion, work in the vicinity of the discovery should be suspended until consultation and mitigation procedures, as outlined in 36 CFR 800, are completed.

6.0 REFERENCES CITED

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Wilber, S.C. 1995 Fluvial and hillslope geomorphology of the Hoseanna Creek watershed, central Alaska, a thesis. Presented to the faculty of the University of Alaska in partial fulfillment of the requirement for the degree of a doctorate in philosophy. University of Alaska, Fairbanks.

7.0 RESPONSIBLE PARTY

The responsible party for this chapter is Chris R. Campbell, C.R.C. Cultural Resources Consultant, 1901 Bragaw, Suite 200, Anchorage, Alaska 99508-3440 601 Contact phone number is 907/729-3798.

EXHIBIT CI-1

MEMORANDUM

STATE OF ALASKA

Department of Natural Resources Division of Mining, Land and Water

TO: Judith Bittner
State Historic Preservation Officer

DATE: January 17, 2006

FROM: Bruce Buzby Bruce
Coal Regulatory Program Manager

TELEPHONE NO.: 269-8650

RECEIVED
JAN 1 9 2006
OHA

SUBJECT: Archaeological Survey of the Jumbo Dome Access Road

Attached please find correspondence from archaeologist Chris Campbell, including an aerial photograph, regarding archaeological potential of the proposed road to access the Jumbo Mine permit area, under development by the Usibelli Coal Mine (USM). Ms. Campbell visited UCM in September, and upon reviewing a much larger version of the aerial photograph, concluded that there was little or no likelihood of encountering archaeological sites due to the numerous erosional features at the southern end, the fact that the road will traverse a side slope of an unnamed creek northward to the muskeg covered plateau. Ms. Campbell telephoned Margie Goatley, Review and Compliance archaeologist, who agreed with Ms. Campbell's conclusions. Thus, we are seeking your concurrence that construction of the proposed Jumbo Mine access road will have no effect on historic properties.

Please let me know if you have any questions.
/BJB

CC: Bartly Coiley, UCM

No Historic Properties Affected
Alaska State Historic Preservation Officer
Date 2/9/06
3130-2R DOM MG

Concur/Do Not Concur _____
Judith Bittner, State Historic Preservation Officer Date

EXHIBIT [redacted]

[redacted]

CHAPTER II

GEOLOGY

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

The geology of the region of the Jumbo Dome Road Corridor permit area is discussed in this chapter.

2.0 REGIONAL OVERVIEW OF THE GEOLOGY

The coal bearing group in the Nenana Coal field is of Tertiary age, overlain in some areas by several thousand feet of Tertiary gravels (the Nenana Gravels). In areas mined by surface methods, the Nenana Gravels are eroded off, and up to one hundred feet of Quaternary outwash gravels overlay the coal bearing formations. The Usibelli Group is subdivided into five formations, all of which are of Tertiary age. The oldest is the Healy Creek Formation, which ranges from the late Oligocene to early Miocene in age. Working up from this lies the Sanctuary Formation (early to middle Miocene), the Suntrana Formation (middle Miocene), the Lignite Creek Formation (middle Miocene), and the Grubstake Formation (late Miocene). Capping off the region are the Nenana Gravels (late Miocene). For a more detailed description of each formation, refer to USGS Bulletin 1274-D (Wahrhaftig, 1969). To the west of Cut 13, a gravel deposit was identified by UCM which is transected by the original exploration trail that is suitable for road construction and maintenance for access of the Jumbo Dome Mine. This is being called Gravel Site A, with gravel thickness estimated at 20’ thick over an area of roughly 42 acres, above an elevation of 2750’. Several test pits were dug along the exploration trail in this area to determine the extent of this potential gravel source. No coal resources are expected along the route to access Gravel Site A

Figure CII-1 shows the surficial geology of the Hoseanna Creek area and Figure CII-2 provides a copy of the lithologic log for the Usibelli Coal Group from USGS Bulletin 1274-D. The Two Bull Ridge mine is geologically located within the Suntrana formation, as is the case with the Poker Flats mine. Mining is presently in progress on the at Two Bull Ridge. The coal bearing

group continues its surface exposure to the east on either side of Hoseanna Creek, and to the northeast towards Jumbo Dome, a hornblende dacite intrusive.

FIGURE CII-1
SIMPLIFIED GEOLOGIC MAP OF
TWO BULL RIDGE AND VICINITY

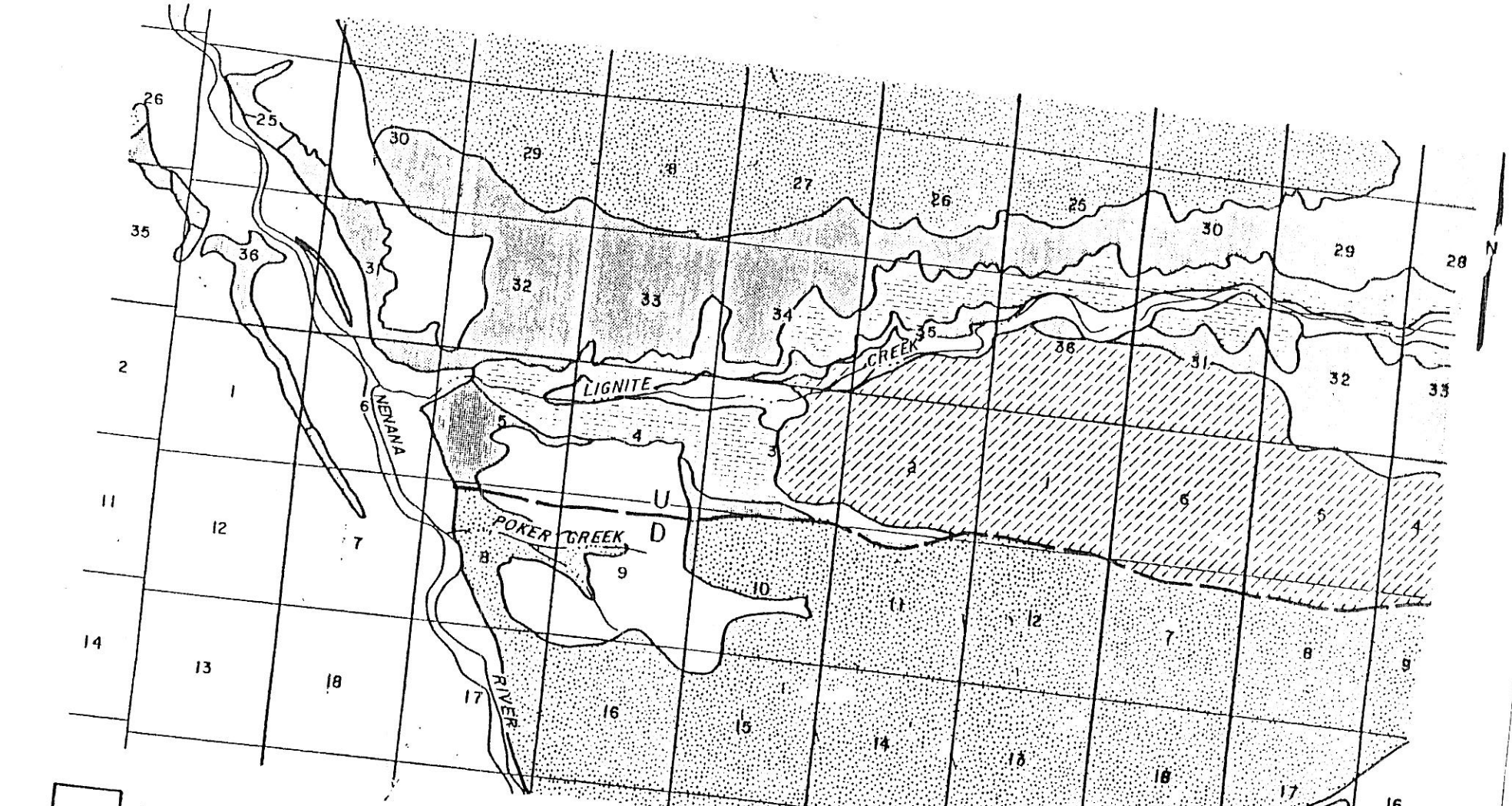

FIGURE CII-1
SIMPLIFIED GEOLOGIC MAP OF
TWO BULL RIDGE AND VICINITY

FIGURE CII-2
STRATIGRAPHIC SECTION OF COAL
BEARING GROUP

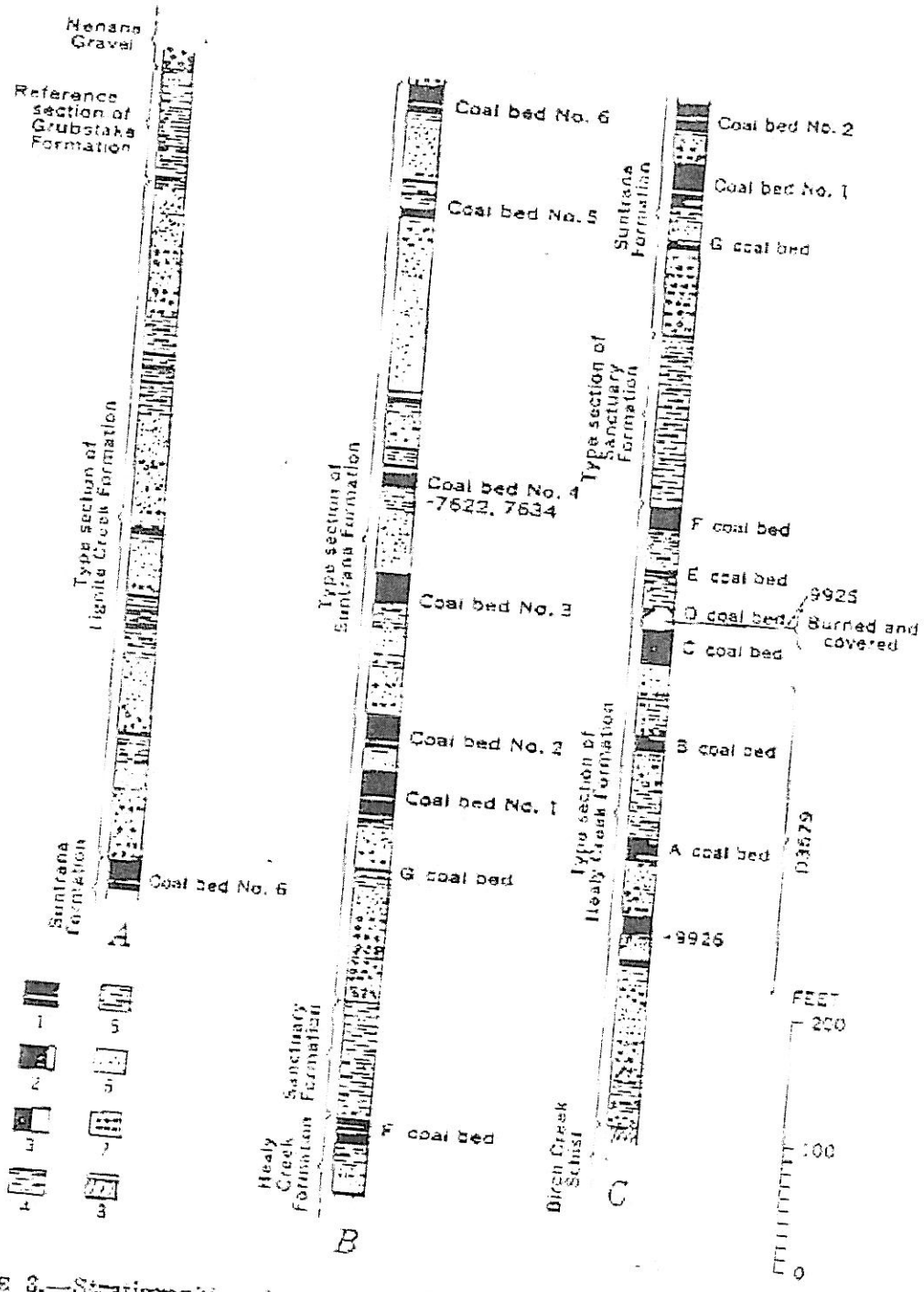

FIGURE 3.—Stratigraphic column of the type sections of the formations of the coal-bearing group at Suntrana, showing locations of plant megafossil localities and microfossil localities. Section *A*, measured along Suntrana Creek from coal bed No. 6 to the base of the Nenana Gravel; section *B*, measured along Suntrana Creek from near the railroad bridge to coal bed No. 6; section *C*, measured on the north bank of Healy Creek from the Usibelli tipple to top of the badland exposure east of the Suntrana mine. 1, coal (showing bone or clay parting); 2, bony coal; 3, bone; 4, claystone and shale; 5, siltstone; 6, sandstone, in part crossbedded; 7, pebbles and conglomerate; 8, schist (unconformity at top).

FIGURE CII-2

STRATIGRAPHIC SECTION OF COAL

BEARING GROUP

The Hoseanna Creek basin is characterized by high erosion rates, resulting in numerous landslides, and badlands topography (Wilbur, 1995). Both of these features are prevalent in the Jumbo Mine Road Corridor area. Badland or barren areas are shown on Plate C-1 Vegetation Map.

3.0 STRATIGRAPHY AND STRUCTURE OF THE PERMIT AREA

The Jumbo Dome Road Corridor area lies geologically within the Suntrana Formation. There are three seams of primary interest in the area; 3, 4, and 6 Seam. The majority of the 3, 4, 5, and 6 Seams are structurally dipping to the north at an average dip angle of 10 degrees and striking east-west.

The lowest mineable Seam in the JDRC project area is the 3 Seam, which is between 16 and 20 feet thick. The interburden between 3 and 4 Seam is 40 to 90 feet thick and 4 Seam is 20 to 35 feet thick.

Above 4 Seam, there is 120 to 145 feet of interburden to the footwall of 6 Seam. 6 Seam coal thickness is 20 to 28 feet. The overburden above 6 Seam varied from minimal cover at the outcrop to over 200 feet on the north and west edges of the mining area. The interburden material consists of pebbly sandstone near the bottom grading up through fine sandstone to a clay bed immediately below a coal seam cap. Grains within the sandstone are composed of 70 to 75 percent quartz, 5 to 10 percent orthoclase, 1 to 5 percent plagioclase, 5 to 10 percent chert and rock fragments, and about 6.5 percent heavy minerals, chiefly of low grade metamorphic suites. The overburden above 6 Seam is part of the Lignite Formation, which is very similar to the Suntrana Formation and is characterized by a gray to olive-green cross bedded sandstone.

The base of each coal seam is generally underlain by footwall clay. The thickness varies from seam to seam as well as beneath any given seam. Analysis of drill data indicates that, for those logs that verify the presence of footwall clays, the average thickness is 3.5, 2.0, 3.0 and 3.0 feet for the 6,5,4 and 3 seams, respectively. The actual thicknesses appear to be highly variable

(ranging from 0 to 11' thick) with no definitive trend or depositional basin. Where no clay is present or indicated, a siltstone is generally present. Footwall clays are 30 to 50 percent montmorillonite, 30 to 50 percent kaolinite-chlorite, and 10 to 30 percent illite.

4.0 GEOLOGY OF THE PROPOSED SURFACE MINING AREA

The Suntrana Formation consists of 6 coal seams numbered from 1 at the bottom to 6 at the top. Two partings of clay and bone make 1 Seam unattractive for mining. The quality of 2 Seam is poor and it is not economical to mine at this time. The 5 Seam is very thin or absent and is not mineable except possibly in Frances Ridge where the seam thickens to an average of eight feet thick.

The coal seams sub crop on the flats above the south facing slope and gently dip to the north. The strike of the coal seams is generally east-west.

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7.0 RESPONSIBLE PARTIES

This section was prepared by Usibelli Coal Mine, Inc.

CHAPTER III

OVERBURDEN AND INTERBURDEN ASSESSMENT

TABLE OF CONTENTS

LIST OF TABLES

.....

1.0 INTRODUCTION

1.1 PURPOSE

The proposed road building activities, including both excavation and placement of material, will result in exposure of overburden and interburden materials to potential weathering, erosion, and leaching. In order to address those concerns, UCM relied on past observations and studies from the area. This was based on the extension of the geologic formation as well as indications from exploration. Overburden and interburden materials within the adjacent Two Bull Ridge Mine area have been sampled and analyzed in order to assess the potential for surface or ground water degradation due to weathering and leaching of these materials and to determine their suitability relative to mine reclamation and revegetation objectives. Coal seams have been sampled and analyzed to determine basic coal quality characteristics.

1.2 SCOPE OF WORK

Regulatory requirements for overburden and interburden assessment under 11 AAC 90.045 are:

- Physical properties such as texture, swell, and erodibility (11 AAC 90.045 (b)(3))
- Chemical analyses to identify horizons which may contain potentially acid-forming, toxic-forming, or alkalinity-producing materials (11 AAC 90.045 (b)(4))
- Coal seam analyses including but not limited to total sulfur content (11 AAC 90.045 (b)(5))

These requirements are addressed in the following sections, with physical and chemical analysis of overburden and interburden and proximate analysis of coal seams addressed in Sections 3.0 and 4.0 and the associated summary tables. In order to evaluate the potential for surface or ground water degradation and reclamation suitability, representative overburden and interburden samples have been collected, analyzed, and the analysis results compared with applicable suitability criteria to identify and assess any potential concerns.

2.0 METHODOLOGY

In order to adequately characterize overburden and interburden units within the proposed Two Bull Ridge mine area, a total of 10 boreholes ranging from approximately 60 to 260 feet in depth were completed. The boreholes covered the entire area of the adjacent Two Bull Ridge mining activities, and intercepted all strata to be disturbed by mining down to and including the strata immediately below 3 Seam, the lowermost coal seam to be mined. Additional samples from boreholes were collected for samples down to the lowest Seam (1 Seam) in the Suntrana Formation.

3.0 CONCLUSIONS

Overburden and interburden analysis results, as summarized by Table CIII-3 were compared with accepted suitability criteria as presented in Table CIII-4, Guidelines for Evaluating Overburden and Interburden Suitability. This comparison indicated that overburden and interburden materials within the adjacent mine area are not potentially acid-forming, toxic-forming, or alkalinity-producing and therefore, do not represent a concern relative to potential surface or ground water contamination or reclamation suitability. Only minor textural limitations were noted for surface gravel (Samples 96TM7 [0-25’] and 96TM8 [0-26’]) and coal seam underclays (Samples 96TM6B-1A [159.5-162’] and 96T1 [176-180’]). However, these textural limitations will be addressed through normal overburden mixing in the mining process. Topsoil is proposed for salvage and use at Two Bull Ridge. However, in the absence of topsoil a mixed spoil is also a suitable growth medium.

4.0 REFERENCES

Applicable regulatory requirements for overburden and interburden assessment and coal analysis are as cited in Section 1.2 (11 AAC 90.045[b][3] through 11 AAC 90.045[b][5]). Suitability criteria as discussed in Section 4.0 were obtained from Guideline 1 - Topsoil and Overburden (Wyoming Department of Environmental Quality - Land Quality Division, November, 1984).

5.0 RESPONSIBLE PARTIES

Those individuals responsible for collection, analysis, and presentation of the information provided in this Chapter include the following:

Larry Jackson - Usibelli Coal Mine, Inc. (Reclamation Engineer)
Dan Graham - Usibelli Coal Mine, Inc. (Development Engineer)
Richard Burtell - TerraMatrix Inc. (Senior Hydrogeologist)
Jerry Nettleton - TerraMatrix Inc. (Senior Engineer)

Tables

TABLE CIII-1 CHEMICAL AND PHYSICAL CHARACTERISTICS OF OVERBURDEN AND INTERBURDEN
(Page 1 of 2)

Borehole Number and Sample Interval[1]	Acid-base Potential[3] (T/KT)	Arsenic-extractable (mg/kg)	Boron-soluble (mg/kg)	Cation Exchange Capacity (meq/100g)	Conductivity-saturated paste (mmhos/cm)	Molybdenum-extractable (mg/kg)	Nitrate-soluble (mg/kg as N)	Nitrite-soluble (mg/kg as N)	pH-saturated paste[2] (s.u.)	Phosphorous-extractable (mg/kg as P)	Potassium-soluble (mg/kg)	Rock Fragments (%>2mm)	Saturation (%)	Sulfur-total (%)	% clay	% Sand	% Silt	Classification[2]
89F-6 (0-50)	9	0.20	<0.05	3.10	0.082	<0.5	<0.1	0.10	5.7	2	0.187	10.3		<0.01	11	68	21	SL
89F-6 (50-75)	4	0.14	0.05	5.08	0.161	<0.5	0.4	0.05	5.5	1	0.311	2.8		<0.01	10	74	16	SL
89F-6 (97-125)	27	0.09	0.20	5.32	0.190	<0.5	0.2	0.10	6.1	<1	0.271	12.9		<0.01	13	71	16	SL
89F-6 (138-160)	25	0.21	0.11	10.60	0.289	<0.5	0.1	0.10	7.2	<1	0.260	7.0		0.01	26	33	41	L
89F-6 (167-220)	25	0.05	0.14	5.23	0.270	<0.5	0.1	0.10	7.4	<1	0.219	8.2		0.01	15	64	21	SL
96T1 (0-25)	10	0.05	0.05	3.23	0.099	<0.5	<0.1	0.05	6.6	1	0.123	21.7		<0.01	8	88	5	LS
96T1 (40-70)	19	0.25	0.08	6.98	0.265	<0.5	<0.1	<0.05	6.4	<1	0.179	54.4		0.02	14	70	16	SL
96T1 (80-165)	26	1.92	0.15	11.10	0.523	0.6	1.3	<0.05	8.0	2	0.319	<0.1		0.02	28	28	45	CL
96T1 (176-180)	11	0.10	0.30	15.60	0.186	<0.5	5.0	0.40	8.1	<1	0.501	<0.1		<0.01	49	4	48	SiC
96TM3B (0-20)	8	0.05	<0.05	4.59	0.066	<0.5	<0.1	<0.05	5.7	1	0.111	43.8		<0.01	8	84	9	LS
96TM3B (34-62.5)	14	0.58	0.13	5.62	0.239	<0.5	<0.1	<0.05	6.0	<1	0.241	14.8		0.01	15	63	23	SL
96TM4B (0-50)	8	0.11	<0.05	2.78	0.073	<0.5	<0.1	<0.05	6.6	2	0.103	7.8		<0.01	9	76	15	SL
96TM4B (50-115)	3	0.15	0.06	3.25	0.175	<0.5	<0.1	<0.05	6.6	<1	0.229	11.5		<0.01	11	73	16	SL
96TM4B (146-190)	20	0.32	0.10	5.34	0.332	<0.5	<0.1	<0.05	6.7	<1	0.274	9.7		0.01	19	61	20	SL
96TM4B (190-257)	31	0.58	0.17	7.05	0.473	<0.5	0.2	<0.05	7.2	<1	0.268	<0.1		0.01	23	41	36	L
96TM5B (0-20)	4	0.10	<0.05	6.55	0.083	<0.5	<0.1	<0.05	5.2	1	0.357	11.3		<0.01	11	66	23	SL
96TM5B (61-110)	5	0.32	0.07	2.07	0.421	<0.5	<0.1	<0.05	5.6	<1	0.350	8.5		0.01	9	79	13	LS/SL
96TM5B (110-149)	4	0.18	<0.05	1.48	0.319	<0.5	<0.1	<0.05	6.8	<1	0.300	5.8		<0.01	10	75	15	SL
96TM6B (0-50)	10	0.07	<0.05	3.47	0.060	<0.5	<0.1	<0.05	6.3	2	0.078	9.9		<0.01	10	73	18	SL
96TM6B (50-98)	4	0.09	<0.05	3.07	0.079	<0.5	<0.1	<0.05	6.6	1	0.223	1.1		<0.01	9	71	20	SL
96TM6B (240)	21	0.23	0.25	26.20	0.264	<0.5	<0.1	<0.05	7.0	<1	0.143	67.5		0.02	29	25	46	CL
96TM6B-1A (159.5-162)	26	0.95	0.43	18.60	0.605	0.5	<0.1	<0.05	6.1	<1	0.311	<0.1		0.05	33	16	51	SiCL
96TM7 (0-25)	11	<0.05	<0.05	5.45	0.129	<0.5	<0.1	<0.1	6.9	<1	0.047	58.8		<0.01	4	89	8	S
96TM7 (25-75)	11	<0.05	0.05	13.10	0.091	<0.5	<0.1	0.05	6.3	<1	0.070	20.7		0.01	16	59	25	SL
96TM7 (75-98)	9	<0.05	<0.05	5.04	0.060	<0.5	<0.1	<0.05	6.7	1	1.190	1.2		0.04	9	68	24	SL
96TM7 (126-175)	13	0.10	<0.05	6.86	0.147	<0.5	<0.1	<0.05	7.2	<1	0.108	7.3		<0.01	13	65	23	SL
96TM7 (180-230)	28	0.25	0.16	16.10	0.259	<0.5	0.2	<0.05	6.8	<1	0.196	5.2		0.04	21	41	38	L
96TM8 (0-26)	19	0.05	<0.05	4.98	0.121	<0.5	<0.1	0.05	7.2	<1	0.079	46.9		<0.01	3	90	8	S
96TM8 (26-50)	28	<0.05	0.23	15.90	0.127	<0.5	<0.1	<0.05	6.3	<1	0.084	26.5		0.01	18	63	20	SL

TABLE CIII-1 CHEMICAL AND PHYSICAL CHARACTERISTICS OF OVERBURDEN AND INTERBURDEN
(Page 1 of 2)

Borehole Number and Sample Interval[1]	Acid-base Potential[3] (T/KT)	Arsenic-extractable (mg/kg)	Boron-soluble (mg/kg)	Cation Exchange Capacity (meq/100g)	Conductivity-saturated paste (mmhos/cm)	Molybdenum-extractable (mg/kg)	Nitrate-soluble (mg/kg as N)	Nitrite-soluble (mg/kg as N)	pH-saturated paste[2] (s.u.)	Phosphorous-extractable (mg/kg as P)	Potassium-soluble (mg/kg)	Rock Fragments (%>2mm)	Saturation (%)	Sulfur-total (%)	% clay	% Sand	% Silt	Classification[2]
96TM8 (50-100)	27	0.08	0.60	29.30	0.215	<0.5	<0.1	0.10	6.3	<1	0.139	19.1		0.06	19	49	33	L
96TM8 (100-140)	13	0.15	0.05	6.01	0.306	<0.5	<0.1	<0.05	7.8	<1	0.157	10.4		<0.01	10	71	19	SL
96TM8 (140-180)	20	0.11	<0.05	9.69	0.314	<0.5	1.0	0.05	7.6	<1	0.121	13.9		0.01	16	60	24	SL
96TM8 (180-228)	10	<0.05	0.05	6.45	0.442	<0.5	1.0	0.05	6.9	<1	0.120	7.9		<0.01	10	69	21	SL
96TM9 (0-50)	15	<0.05	<0.05	3.51	0.098	<0.5	<0.1	<0.05	7.1	0.6	0.112	9.5		<0.01	6	78	16	LS
96TM9 (50-100)	29	0.17	0.21	21.60	0.261	<0.5	<0.1	0.05	5.6	<0.1	0.199	9.3		0.05	21	34	45	L
96TM9 (100-150)	16	0.09	0.13	17.50	2.310	<0.5	2.0	<0.05	5.6	1	0.433	13.2		0.06	16	56	28	SL
96TM9 (150-200)	24	0.09	0.07	13.80	1.370	<0.5	2.6	<0.05	7.2	<1	0.229	9.8		0.03	18	51	31	L
96TM9 (200-235)	6	<0.05	<0.05	4.47	0.329	<0.5	1.0	<0.05	7.7	<1	0.074	2.3		<0.01	8	78	15	LS/SL
96TM10B (0-25)	9	<0.05	<0.05	5.57	0.099	<0.5	1.8	0.05	5.5	<1	0.062	28.3		<0.01	9	74	18	SL
96TM10B (33-85)	10	0.05	0.05	6.18	0.134	<0.5	<0.1	<0.05	7.0	<1	0.111	7.0		<0.01	15	58	28	SL
96TM10B (85-103)	10	0.06	<0.05	2.23	0.113	<0.5	<0.1	<0.05	7.2	1	0.083	4.9		<0.01	8	81	11	LS
96TM10B (140-170)	8	0.20	<0.05	2.78	0.182	<0.5	<0.1	<0.05	7.3	<1	0.153	1.7		<0.01	8	71	21	SL
96TM10B (170-200)	19	<0.05	0.51	14.50	0.321	<0.5	<0.1	<0.05	5.7	<1	0.251	8.0		0.01	6	80	14	LS

Notes:
1. See Table CIII-1, Overburden and Interburden Sample Summary, for lithology and geologic units associated with overburden samples. Borehole locations are shown on Plate CIII-1, Location of Boreholes Used for Overburden and Interburden Sampling.
2. Shaded results indicate overburden interval may be marginal or unsuitable. Refer to Table CIII-5, Guidelines for Evaluation of Overburden and Interburden Suitability.
3. Acid-base potential calculated by subtracting total sulfur content (as T/KT) from the acid neutralization potential.

TABLE CIII-2

Guidelines for Evaluating Overburden and Interburden Suitability[1]

		Criteria			
Parameter	**Units**	**Suitable**	**Marginal**	**Unsuitable**	**Unsuitable (Aquifer Restoration)**
Acid/Base Potential	T/KT	> -5		< -5	< -5
Arsenic	mg/kg	<2.0	>2.0		Depends on pre-mining water quality and overburden quality
Boron	mg/kg	<5		>5	Depends on pre-mining water quality and overburden quality
Conductivity	mmhos/cm @ 25EC	0 to 8	8 to 12	>12	Depends on pre-mining water quality and overburden quality
Molybdenum	mg/kg	<1.0	>1.0		
Nitrate/Nitrogen	mg/kg as N				>50
pH	s.u.	5.5 - 8.5	5.0 - 5.5 8.5 - 9.0	< 5 > 9	Unsuitable as stated in the below referenced source.
Texture	Classification		c, sic, s		

[1] Source: Wyoming Department of Environmental Quality Land Quality Division. Guideline No. 1, Topsoil and Overburden, November 1984.

CHAPTER IV

HYDROGEOLOGY

TABLE OF CONTENTS

1.0 INTRODUCTION

Per Section 047 (Ground Water Information) of Article 4 (Environmental Resource Information Requirements) of 11 AAC 90, each permit application shall include *"a description of the ground water hydrology for the proposed mining area*". Therefore, Section 4.0 of the permit application describes groundwater flow and quality characteristics, ground water monitoring schedules, and general aquifer morphology within the regional hydrogeology which also applies to the. Jumbo Mine Road Corridor area.

2.0 METHODOLOGY

2.1 APPROACH

Specific components of the hydrogeologic evaluation required by 11 ACC 90 include the following:

- the depths, thickness and aerial distributions of water-bearing units within the mining area;
- stratigraphy of the aquifer matrices;
- ground water uses;
- ground water quality;
- ground water/surface water interactions; and
- recharge, storage and discharge characteristics of the aquifers.

In order to address the above concerns, UCM relied on past observations and studies from the general area (Hoseanna Creek Valley) to develop a conceptual model of the groundwater regime for existing mine areas and expanded it to the Jumbo Road Corridor project area. This was based on the extension of the geologic formation as well as indications from previous exploration drilling and preliminary geotechnical and hydrological studies. UCM, with assistance from

Terramatrix, Inc., developed a detailed and thorough baseline program to confirm the regional conceptual model as it applies to the Two Bull Ridge mine area. This model can be applied regionally within these geologic formations. The basic points of the model are:

- The coal seams act as the primary water bearing unit. Coal seams generally have a higher permeability than the adjacent strata with groundwater storage and movement being predominantly fracture controlled.
- The overlying sandstone units act as aquitards, being of a lower permeability. The sandstone's are hydrologically tied to the underlying coal seams, with the coal/sandstone forming 1 hydrostratigraphic unit.
- The underclays and/or siltstones act as efficient aquicludes.
- Fault systems generally act as hydrogeologic conduits and behave as recharge boundaries where they intersect coal seams.
- Groundwater systems generally contribute to stream surface flow where the drainage valleys intersect the coal outcrops.

3.0 GENERAL AREA HYDROGEOLOGY

The groundwater model presented above has been proven in several instances, including the 1996 baseline study for the Two Bull Ridge project area. It can be applied throughout the Hoseanna Creek Valley. Due to the stratigraphic and structural controls of the aquifer matrices, most coal-bearing sequences within the region have the ability to contain multi-layered aquifers. The coal seams act as the primary water bearing unit with fracture-controlled flow being the primary mechanism of transfer. These are affected locally by folds and faulting as well as drainage systems. Faults have generally been viewed as recharge boundaries, supplying water into the adjacent coal formations. Flow within the coal can be locally controlled by folding, creating structural domes to impede flow, along with creating fractures to enhance flow and structural lows to collect water. Drainages cutting through the coal formations can create discharge points, particularly where coal outcrops cross a drainage.

The Hoseanna Creek Valley, under this model, has various areas that are primarily recharge zones, discharge zone, and some areas that have no significant aquifers established. Two Bull Ridge is an example of a recharge area, with coal crops traversing flat terrain where they have an enhanced exposure for infiltration. Poker Flats is an example of an area that is more of a discharge area - a major fault to the south provides a recharge boundary with a hydraulic gradient to the north towards the coal outcrops. Other regions, such as the Popovitch Badlands, have limited exposure for infiltration due to outcrops on a steeply dipping terrain. Only limited infiltration may occur vertically and will, in most cases, perch itself within the first coal seam encountered. These areas are very inactive from the groundwater perspective. The basic principles defined in the Two Bull Ridge baseline study can reasonably be applied to other areas throughout the region containing similar geology with only limited additional data required to support such an application and interpret local, site-specific factors affecting the hydrogeology.

4.0 REFERENCES

Golder Associates, Inc., 1995, 1994 Geotechnical Drilling Program, Two Bull/Frances Ridge Mining Area: Report to Usibelli Coal Mine, Inc., Healy, Alaska, February 1995.

Wilbur, Stephen C., 1995, Fluvial and Hillside Geomorphology of Hoseanna Creek Watershed, Central Alaska: Ph.D. Thesis, University of Alaska, Fairbanks, December, 1995.

Golder Associates, Inc., 1991, Pump Test at Phase I, Poker Flats on September 10-13, 1991: Letter from David C. Lanning and Rupert G. Tart to Dan Graham, Usibelli Coal Mine, Inc., December 20, 1991.

Golder Associates, Inc., 1985, Hydrological Investigation at Poker Flats, Usibelli Coal Mine: Prepared for Usibelli Coal Mine, Inc., Healy, Alaska, January 1985.

Fetter, C.W., 1980, Applied Hydrogeology: Bell and Howell Company, Columbus, Ohio, 488p.

Driscoll, Fletcher G., 1986, Groundwater and Wells, Second Edition, Johnson Filtration Systems, Inc., St. Paul, MN, 1089p.

5.0 RESPONSIBLE PARTIES

Part C, Chapter IV, Hydrogeology, was prepared by Usibelli Coal Mine, Inc..

CHAPTER VIII

VEGETATION

TABLE OF CONTENTS

LIST OF APPENDICES

1.0 INTRODUCTION

To support environmental permitting for development of the Jumbo Road Corridor the vegetation and wetlands were mapped and identified initially by Travis/Peterson Engineering in 2005. The report resulting from this effort titled Jumbo Dome Road Corridor Preliminary Wetland Delineation and Vegetation Survey was submitted as the Chapter CVIII in the original permit application. This report can be found in Appendix CVIII-1.

In 2010, as part of the Jumbo Dome Mine Wetland Delineation and Vegetation Survey conducted by HDR Inc., several discrepancies were found in an area of the proposed Jumbo Dome Mine that overlapped with the Jumbo Road Corridor. In March of 2011, HDR prepared the document titled Jumbo Dome Access Road Wetland Mapping Revisions. This document can be found in Appendix CVIII-2. The document was submitted to the United States Army Corps of Engineers (USACE). USACE agreed that where discrepancies and agreed with HDR's interpretation of the data sheets.

HDR completed an in-depth functional assessment and revised mapping of the wetlands within the Jumbo Road Corridor. This effort titled Wetland Functional Assessment, Jumbo Dome Mine Access Road can be found in Appendix CVIII-3.

These efforts have met the requirements of 11 AAC 90.055.

2.0 RESPONSIBLE PARTY

Travis/Peterson 329 2nd Street Fairbanks, Alaska 99701
HDR Alaska, Inc 2525 C Street Suite 305 Anchorage, Alaska 99503-2632
Usibelli Coal Mine, Inc PO Box 1000 Healy, Alaska 99743

APPENDIX CVIII-1

JUMBO DOME ROAD CORRIDOR

PRELIMINARY WETLAND DELINEATION AND VEGETATION SURVEY

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

This report summarizes a vegetation survey and preliminary wetland delineation performed along the proposed Jumbo Dome Road Corridor at Usibelli Coal Mine near Healy, Alaska.

1.1 PROJECT LOCATION

The proposed Jumbo Dome Road Corridor is located within Sections 8, 9, 16, 21, and 28, Township 11 South, Range 6 West, Fairbanks Meridian (Figure 1). The proposed corridor is approximately 8.9 kilometers (5.5 miles) long and 300 meters (1,000 feet) wide. The total project area is 267 hectares (660 acres).

1.2 PURPOSE AND NEED FOR PROJECT

The proposed Jumbo Dome Road Corridor is required to access coal deposits northeast of Jumbo Dome (Figure 1). The purpose of the vegetation sampling was two-fold: first, to identify vegetation communities within the Jumbo Dome Road Corridor; and second, to identify dominant plant species for the purposes of wetland delineation.

Pursuant to 11 AAC 90.055 (a) An application must contain a map that delineates existing vegetative types and a description of the plant communities within the proposed permit area and within any proposed reference area. This description must include information and quantitative measurements adequate to predict the potential for successful propagation, regeneration, and reestablishment of vegetation. Additionally, sufficient adjacent area must be included in the description to allow evaluation of vegetation as important habitat for fish and wildlife species identified by the Commissioner (11 AAC 90.055 (b)).

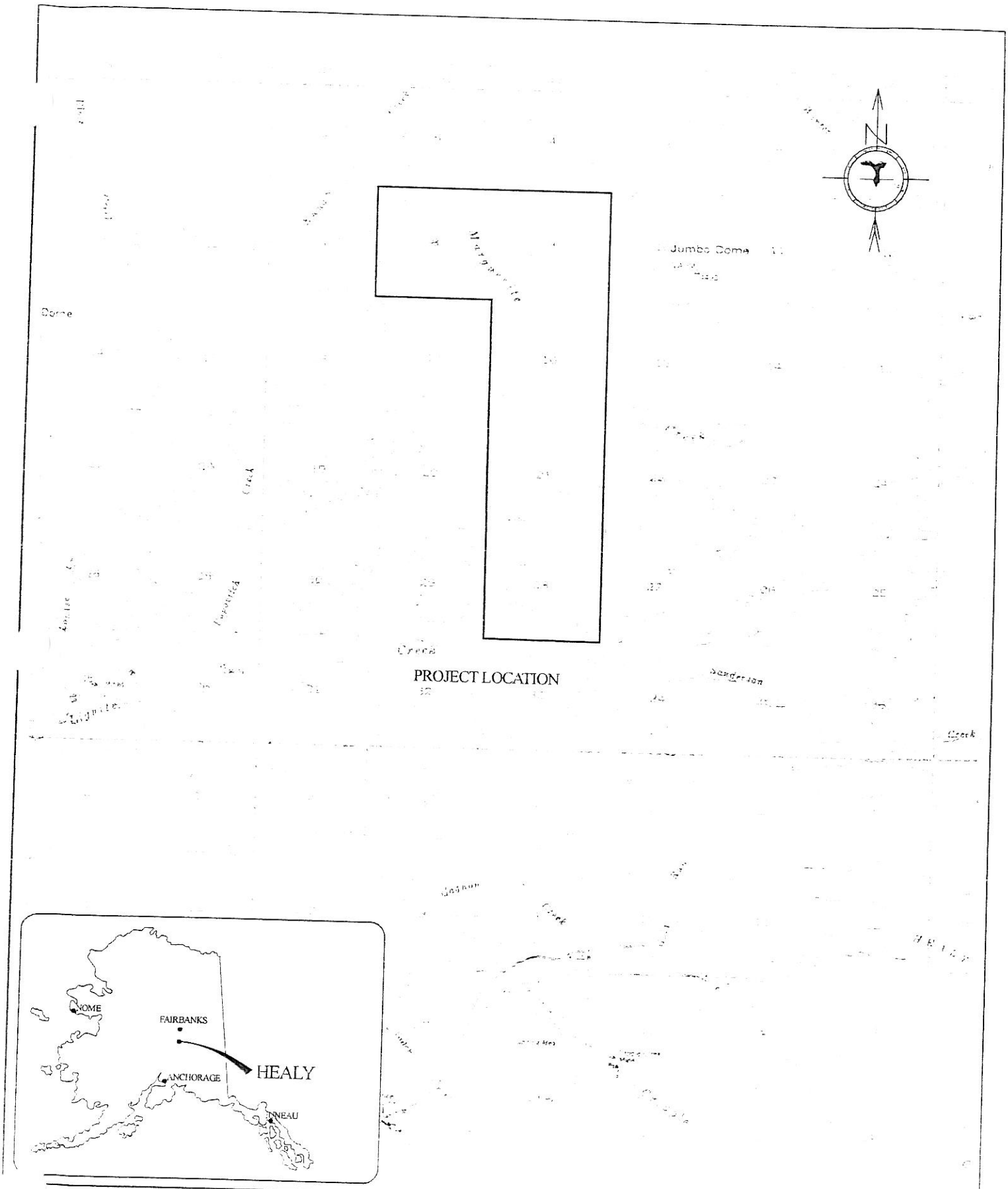
This Preliminary Wetland Delineation is a Routine Determination for areas greater than 5 acres in size[1]. In order to increase reliability and defensibility of this Preliminary Wetland Delineation, unless otherwise noted, Travis/Peterson Environmental Consulting, Inc. (TPECI) personnel performed field investigations in accordance with the U.S. Army Corps of Engineers standards required for Routine Wetland Determinations[2].

2.0 WETLAND DELINEATION METHODS

A variety of methods and techniques were employed to identify and determine the areal extent of wetlands within the Jumbo Dome Road Corridor. Existing information about the wetlands within the proposed area is presented in Section 2.1.

---

[1] U.S. Army Corps of Engineers, 1987. *Corps of Engineers Wetlands Delineation Manual.* Waterways Experiment Station, U.S. Army Corps of Engineers, Technical Report Y-87-1 (on-line edition). Section D.
[2] U.S. Army Corps of Engineers, 1987. *Corps of Engineers Wetlands Delineation Manual.* Waterways Experiment Station, U.S. Army Corps of Engineers, Technical Report Y-87-1 (on-line edition). Section E.



..VIS/PETERSON ENVIRONMENTAL CONSULTING, INC.
329 2ND STREET
FAIRBANKS, ALASKA 99701

USIBELLI COAL MINE, INC.

FIGURE 1
LOCATION & VICINITY

PROJECT No: 1230-01	FILE: 1230/01/Figures/Figure 1.skf	DATE: 12/12/05	SCALE: NO SCALE

2.1 DESK TOP STUDIES

Desktop studies for this project included:

1. A review of existing soil surveys for the site;
2. A review of the existing wetland determinations; and
3. A review of existing hydrologic information for the site.

2.1.1 Existing Soils Information

Detailed soils mapping of this area has not been completed. The *Exploratory Soil Survey of Alaska*[3] provides the most recent soils information for the site (Figure 2).

2.1.2 Existing Wetland Mapping

The U.S. Army Corps of Engineers, Regulatory Branch, has not prepared a wetland delineation for the subject property that complies with the provisions of RGL-94-01[4]. The National Wetlands Inventory (NWI) map for this project has been reviewed (Figure 3).

2.1.3 Existing Hydrological Data

There is no existing hydrologic data for the site.

2.2 ISOLATED WETLANDS

In order to be consistent with the Supreme Court ruling in *Solid Waste Agency of Northern Cook County (SWANCC) vs. US Army Corps of Engineers*[5], the wetland must be either navigable in fact, contiguous with a navigable water body or tributary thereof, or have a discernible surface water connection to a navigable water body via natural or manmade conveyances. The contention that groundwater is a 'hydrologic connection' and establishes jurisdiction over otherwise isolated wetlands is not supported at this time by case law. The most frequently cited basis for groundwater connection establishing Clean Water Act jurisdiction is the findings in *United States vs. Riverside Bayview Homes*. According to legal analysis of the findings of that case[6]: "Nothing in [*United States vs.*] *Riverside Bayview Homes* purports to consider or approve federal jurisdiction over a wetland that does not immediately adjoin a navigable water and have a regular surface hydrological (sic) connection to that water. There is no basis in that case to support jurisdiction, as the Corps has suggested, over wetlands that do not "actually abut" navigable waters, over uplands [sic] wetlands that drain via overland surface runoff to navigable waters at lower elevations, or over wetlands connected only through groundwater."[7]

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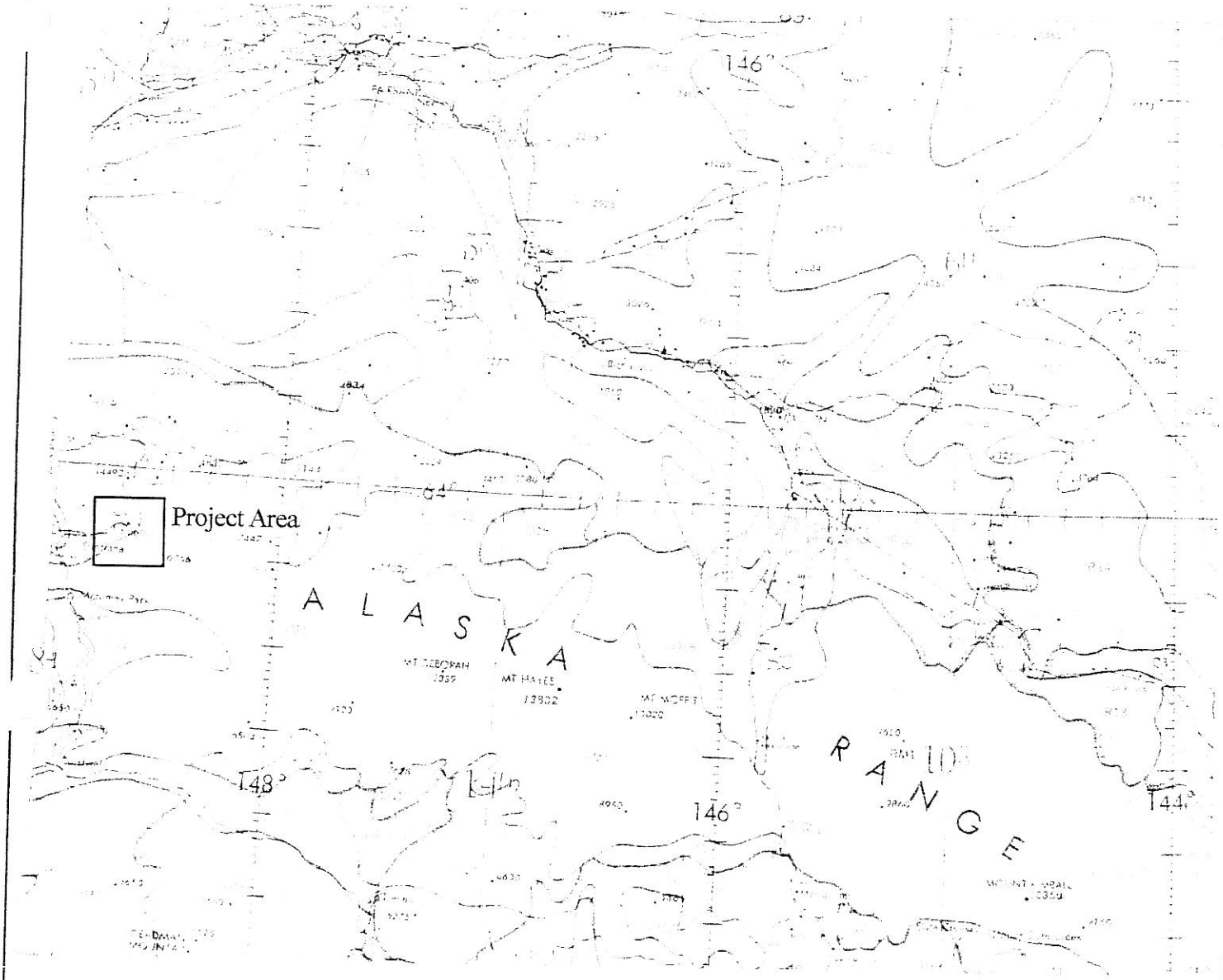
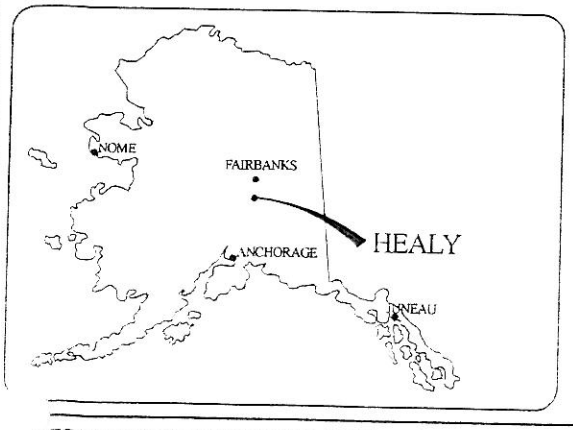
[3] USDA, 1979. *Exploratory Soil Survey of Alaska.* U.S. Department of Agricultures, Soil Conservation Service, 242 pages.
[4] Elmore, J.P. 1994. *Regulatory Guidance Letter 94-01: Expiration of Geographic Jurisdictional Determinations.* U.S. Army Corps of Engineers, Directorate of Civil of Works. 1 page.
[5] *SWANNC vs. Corps of Engineers*
[6] Albrecht, V.S. and S.M Nickelsburg, 2002. Could *SWANCC* Be Right? A New Look at the Legislative History of the Clean Water Act. *Environment Law Review*, Vol 32, pp. 11042-11058.
[7] *Ibid. pp. 11058*





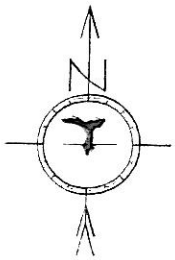


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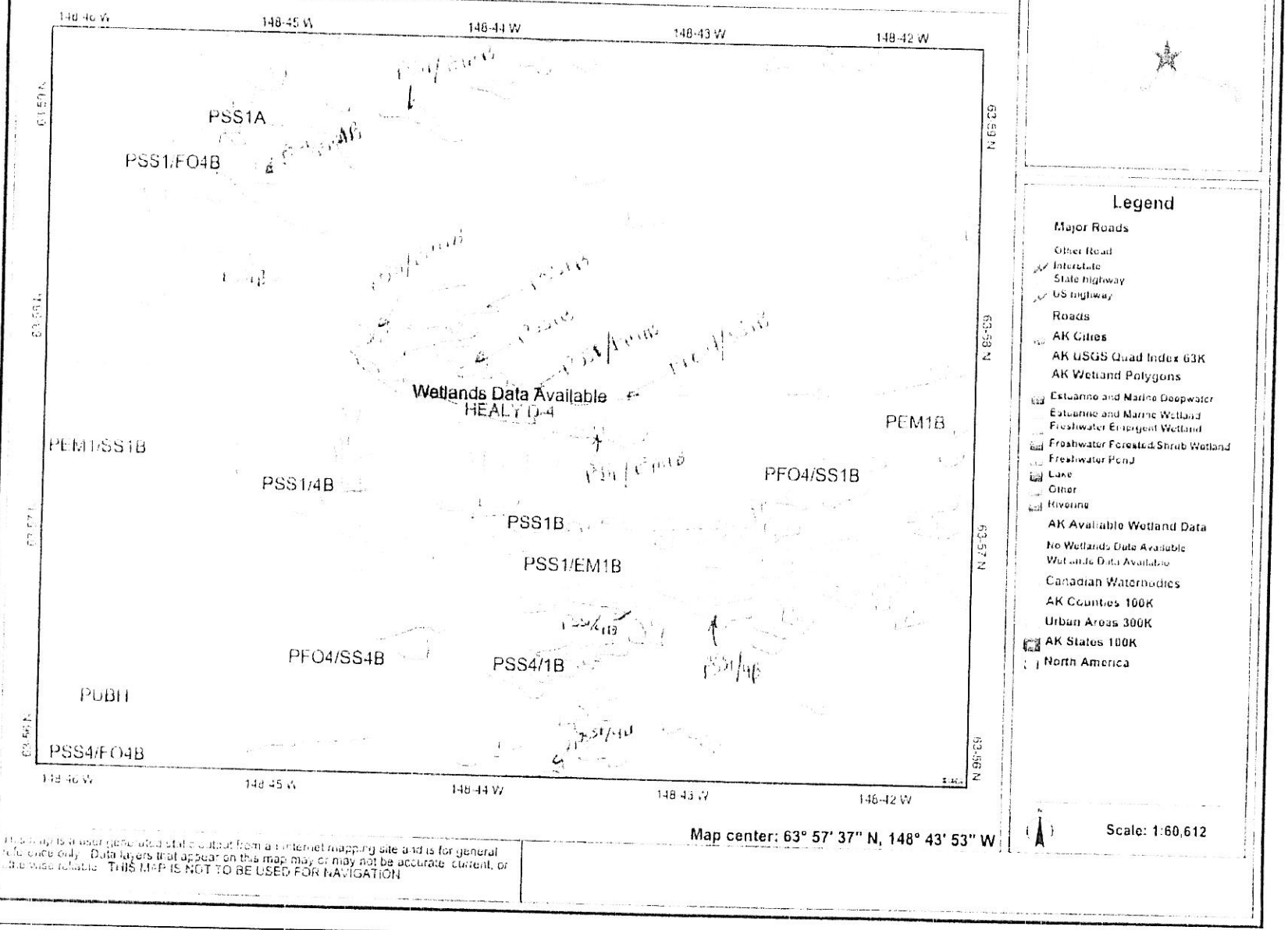
FIGURE 2
NRCS Soils Map

PROJECT No: 1230-01	FILE: 1230/01/Figures/Figure 2.skf	DATE: 12/12/05	SCALE: NO SCALE

NWI MAP Jumbo Dome Road Corridor



This map is a user generated static output from a Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION

TRAVIS/PETERSON ENVIRONMENTAL CONSULTING, INC. 329 2ND STREET FAIRBANKS, ALASKA 99701	USIBELLI COAL MINE, INC.		FIGURE 3 NWI MAP
PROJECT No: 1230-01	FILE: 1230/01/Figures/Figure 3.skf	DATE: 12/12/05	SCALE: No Scale

Further, since the *SWANCC* decision, federal courts have affirmed that groundwater cannot be used as a hydrologic connection for establishing Corps jurisdiction. "In *Rice vs. Harken Exploration*[8] the Court of Appeals for the Fifth Circuit stated that"[u]nder *Solid Waste Agency*, it appears that a body of water is subject to regulation under the [CWA] if the body of water is actually navigable or is adjacent to an open body of navigable water." The court held that several intermittent streams are not "navigable waters" and that connections through groundwater cannot establish jurisdiction under the Clean Water Act."

From the proceeding discussion, wetlands regulated by the provisions of the Clean Water Act and subject to Corps' permitting (jurisdictional wetlands) must be contiguous with a navigable water body or tributary thereof. Isolated wetlands are not subject to the provisions of the Clean Water Act and no permits would be required for alteration or filling.

In *Northern California River Watch vs. City of Healdsburg*[9] the court concluded that "even its narrowest reading, *SWANCC* appears to recognize jurisdiction over (i) actually navigable waters (ii) their tributaries, and/or (iii) wetlands adjacent to each." "The term **"adjacent"** means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands."[10] Relying on the preceding definition, the Court concluded, "a surface-water requirement would be inconsistent with this definition, for dikes and barriers and levees are ***manifestly intended to prevent a surface-water connection***" [emphasis added]. Hence, within the Ninth Circuit, wetlands separated from other waters of the United States can only be considered adjacent if the "manifest intention" of the manmade barrier was to separate surface waters.

The findings in *Northern California River Watch vs. City of Healdsburg* further indicated that groundwater may be considered tributary of a navigable water body if "there is, is in fact, an intimate and persistent hydrologic connection". Although not specifically defining what is meant by an "intimate" connection, the intimate connection between the adjacent wetland and the navigable water body in *Northern California River Watch vs. City of Healdsburg* was that:

> "The pond drains into the aquifer and at least 26 percent of the ponds volume concededly surfaces itself in the river itself (and this order finds that substantially more drains actually into the river). There is an immediate underground hydrologic connection between the two water bodies, such that the water level in each immediately affects the water level in the other. Even on the *surface,* there is an episodic connection, when the levee breaches, as it has three times in the last eight years, the two water bodies substantially commingle".

The Court further states: "Although unnecessary to reach it, this order holds that Basalt Pond and the subterranean groundwater that flows through it are "tributaries" of the Russian River. This order recognizes that caselaw [sic] is divided over whether the "tributary" prong can be satisfied by *groundwater* as opposed to surface waters. The 9th (sic) Circuit has not yet addressed the

[8] *Ibid pp. 11056*
[9] *Northern California River Watch vs. City of Healdsburg,* No. C01-04686 WHA, January 23, 2004
[10] 33 CFR 328 (c)

question. The court finds persuasive the line of authority represented by *Idaho Rural Council v. Bosma, 143 F. Supp. 2d 1169, 1178 (D. Idaho 2001)*, holding that the Act extends federal jurisdiction over groundwaters hydrologically connected to surface waters that are themselves navigable waters." In *Northern California River Watch vs. City of Healdsburg*, as in *Idaho Rural Council vs. Bosma,* a pollutant could be traced from the adjacent wetland through the groundwater system and into a navigable water body or tributary of a navigable water body.

Most recently, the Ninth Circuit Court has indicated in *Baccarat Freemont Developers, LLC. vs. U.S. Army Corps of Engineers* (Case No. 03-16586) that "The Corps jurisdiction over wetlands falling within the adjacency clause in 33 C.F.R. § 328.3(a)(7) does not depend on the existence of a significant hydrologic or ecological connection between the particular wetlands at issue and waters of the United States." The decision in *Baccarat Freemont Developers, LLC. vs. U.S. Army Corps of Engineers* is based largely upon the conclusions of law in *Carabell vs. U.S. Army Corps of Engineers*, which is currently under review by the U.S. Supreme Court with a ruling anticipated in June 2007.

From the preceding discussion, wetlands regulated by the provisions of the Clean Water Act and subject to Corps' permitting (jurisdictional wetlands) must be adjacent to a navigable water body or tributary thereof. In the case of otherwise adjacent wetlands that are separated from navigable water bodies or tributaries thereof by manmade barriers, the manmade barrier must have been "manifestly intended to separate surface waters" in order for the wetlands to be subject to regulation. Additionally, groundwater can only be invoked to support jurisdiction over otherwise isolated wetlands if there is an intimate and immediate hydrologic connection between the wetland and the navigable water body or if a pollutant can be traced from the wetland through the groundwater system to a navigable water body or tributary thereof. Isolated wetlands are not subject to the provisions of the Clean Water Act and, hence, no permits are required for alteration or filling.

2.3 WETLAND AREAS WITHIN THE PROJECT BOUNDARIES

The information contained in the most recent wetland maps (Figure 3) for the site indicates that the northern half of the subject property will impact wetlands. The most recent wetland mapping indicates that the proposed Jumbo Dome Road will be within uplands until it crosses into the Marguerite Creek drainage basin. Wetland types within the Marguerite Creek basin are primarily shrub-scrub and emergent wetlands.

2.3.1 Soils

The *Exploratory Soil Survey for Alaska*[11] indicates that soils within the project area belong to mapping Unit IQ25 *Pergelic Cryaquepts –Pergelic Cryochrepts association, very gravelly, hilly to steep.* Mapping scale is insufficient to provide project specific information. C.L. Ping, Ph.D. mapped soils within the project area. Dr. Ping's soil data was used as part of this wetland delineation.

[11] USDA. 1979. *Exploratory Soil Survey of Alaska.* U.S. Department of Agricultures, Soil Conservation Service. 242 pages.

2.3.2 Vegetation

A cursory inspection of the vegetation at the site revealed a mix of upland and wetland species in the shrub and tree canopies. The mix of upland and wetland species is likely due to historic disturbance, especially in the southern third of the property.

2.3.3 General Site Hydrology

During the site inspection two principal surface water conveyances were noted on within the project corridor property. The first is a series of drainages (continuous blue line Figure 4) in the northern half of the project area. Surface waters flow north into Marguerite Creek, a tributary of the Tanana River. The southern half of the project corridor drains south to Hoseanna Creek, a tributary of the Nenana River. The open water portions of all drainages within the project area are Waters of the United States, or tributaries thereof, and subject to the permitting requirements of the Clean Water Act. Drainages and direction of surface flow are shown in blue on the wetland and vegetation maps for this project (Appendix C).

2.3.4 Isolated Wetlands

Based on the information contained in the *Exploratory Soil Survey of Alaska*, connections between the wetlands within the project corridor and other wetlands and the underlying aquifer are intact. Thus, the wetland areas within the project boundaries appear not to be isolated and are likely jurisdictional wetlands pursuant to the Supreme Court ruling in *Solid Waste Agency of Northern Cook County vs. US Army Corps of Engineers*[12] and subsequent case law. The nearest navigable Water of the United States is the Nenana River a tributary of the Tanana River. The field inspection indicates that any wetlands within the southern half of the subject property likely discharge into the Nenana River via surface conveyances including manmade and natural drainage structures. Wetlands within the northern half of the subject property discharge to the Tanana River via Marguerite Creek.

3.0 FIELD INVESTIGATIONS

The location of routine observation points was determined in the field during a walking survey of the proposed Jumbo Dome Road Corridor. The location of each observation point was established using a handheld global positioning satellite system (GPS). Data collected in accordance with the following sections was recorded on the routine data sheet (Appendix C).

3.1 VEGETATION SAMPLING METHODS

Vegetation sampling was performed in accordance with the *1987 Corps of Engineer's Wetland Delineation Manual*[13]. Each distinctive vegetation canopy was sampled in accordance with the methodology described in the following sections. Vegetation was sampled based upon the

[12] *SWANNC vs Corps of Engineers*

[13] U.S. Army Corps of Engineers, 1987. *Corps of Engineers Wetlands Delineation Manual.* Waterways Experiment Station, U.S. Army Corps of Engineers, Technical Report Y-87-1 (on-line edition).

canopy height classification proposed by Viereck et al. (1992)[14]. Table 1 provides the recognized canopy classes and definitions for this vegetation survey and wetland delineation.

TABLE 1

WOODY PLANT CANOPY CLASSIFICATION

Canopy Class	Height Class
Tree	Height greater than 3 meters
Tall scrub	Height greater than 1.5 meters but less than 3 meters
Low scrub vegetation	Height greater than 0.20 meters but less than 1.5 meters
Dwarf scrub vegetation	Height less than 0.20 meters

Source: Viereck et. al., 1992.[15]

The purpose of vegetation sampling at each location was twofold. The following sections describe the methods employed to quantify the vegetation within the Jumbo Dome Road Corridor.

3.1.1 Stand Selection

The general approach to stand selection was to traverse the proposed road corridor by foot and identify vegetation stands. In general, a vegetation stand was sampled only if it exceeded 2.0 hectares (5 acres) in size. Once identified, vegetation sampling was performed within the stand as outlined in the following sections. Due to operational constraints, one sampling point was located within each stand.

3.1.2 Foliage Cover

Cover is the vertical projection of vascular plant material on the ground. Additional categories of cover include moss, lichens, and bare ground. Hence, cover within a canopy (Table 1) will always total to 100 percent or less. Due to the inherent reproducibility and efficiency, systematic point techniques were used to quantify cover. A sampling point was located randomly within the stand but no closer than 15 meters (50 feet) to an obvious vegetation boundary. A sampling point for foliage cover is defined as 40 observation points (50 centimeters apart) along a 20-meter long transect. At each observation point, a pin was dropped and the first plant species hit recorded. The number of hits per species was counted for each transect and divided by the total number of observation points to obtain percentage cover for each species.

3.1.3 Density of Woody Vegetation

Density is the number of plants per unit area. The tree, tall shrub, and low shrub canopies were assessed using 20 meter belt transects centered on the foliage cover transect. The density of each species was obtained by counting the number of stems or clumps within the belt transect. Belt transect dimensions are provided in Table 2.

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[14] Viereck et al., 1992. *The Alaska Vegetation Classification System*. Gen. Tech Rep. PNW-GTR-286. Department of Agriculture Forest Service. Pacific Northwest Research Station, Portland, OR. 278 pages.
[15] *Ibid.*

TABLE 2

BELT TRANSECT DIMENSIONS BY CANOPY

Canopy	Canopy Definition	Transect Dimensions (m)	Quadrat Area (ha)
Low Shrub Canopy	0.20 meters < *X* < 1.5 meters	1 x 20	0.002
Tall Shrub/Dwarf Tree	1.5 meters < *X* < 3.0 meters	3 x 20	0.004
Trees	3 meters < *X*	5 x 20	0.01

Note: '*X*' is the height of the individual being measured.

All woody species were placed into categories by height, irrespective of species. Hence, the same species may appear in different canopies.

3.1.4 Woody Plant Measurements

For the tall shrub and tree canopies, diameter at breast height (DBH) was measured. For low shrubs, stems identified as originating from a single clump were identified and the clump basal diameter was measured.

3.2 SOIL SAMPLING

Soil sampling consists of digging a test pit at each routine observation point. The soil profile is described along with indicators of hydric soils. Data is recorded on the Routine Wetland Determination form for each wetland unit (Appendix B).

3.3 HYDROLOGIC OBSERVATIONS

As required by the *1987 Corps of Engineer's Wetland Delineation Manual*, soil temperature, measured at a 20-inch depth, is the primary definition of growing season[16]. If site specific soil temperature data are unavailable, secondary criteria, the 28°F map entitled "growing seasons for wetland hydrology", may be consulted to determine the starting date and ending date of the growing season[17,18]. The Alaska District currently uses the 28°F map as the primary criterion for growing season in Alaska. When measured soil temperatures contradict the growing season map, growing season is defined by the Alaska District's criterion, which is a generalized map.

[16] The 1987 Manual defines "growing season" as the portion of the year when soil temperature (measured 20 inches below the surface) is above biological zero (5°C or 41°F).
[17] Williams, A.E., 1992. *CECW-OR Memorandum: Clarification and Interpretation of the 1987 Manual.* Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 4 pages.
[18] District Engineer, 2003. *Special Public Notice 03-05: Wetland Delineations Growing Season.* U.S. Army Corps of Engineers, Alaska District, Regulatory Branch.

4.0 PRELIMINARY WETLAND MAPPING

Based upon available information, wetland areas and suspected wetland areas on the subject property were identified (Appendix C). A total of 39 points along the 8.9-kilometer road corridor were identified and sampled. Mapping results are summarized in Table 3, which contains vegetation types identified, stand numbers, and wetland status. A discussion of each mapping unit is provided in the following sections. Both the table and the discussion are presented in order of the community descriptions in the Alaska Vegetation Classification system. Vegetation data forms for each observation point, including percent cover, are contained in Appendix D.

TABLE 3

VEGETATION TYPES AND WETLAND STATUS,

Vegetation Type	Vegetation Type	Map Unit	Stands	Wetland Status	
Overstory	Understory			UPL	WET
Forests					
Needleleaf Forests					
Open Needleleaf Forests					
Open white spruce		OWS			
	Ald	OWS/Ald	17, 20	X	
	BES	OWS/BES	15, 23, 37	X	
	ER	WS/ER	8, 14	X	
	Unidentified	OWS			
Open Black Spruce		OBS	28		X
Open Black Spruce White Spruce		OBSWS	11, 12		X
Black Spruce Woodland		BSWdl	9, 26		X
Black Spruce Woodland (uplands)		BSWdl2	7, 33	X	
White Spruce Woodland		WSWdl	6,	X	
Broadleaf Forest					
Closed Deciduous Forests					
Closed Paper Birch		CB	39	X	
Open Broadleaf Forests					
Open Mixed Assoc.		OMA	38	X	
Mixed Needleleaf-Broadleaf Forests					
Open Mixed Forests					
Open White Spruce – Paper Birch					
	Alder	OSB/Ald	21, 34	X	
	Ericaceous	OSB/Er	36, 35	X	

TABLE 3 (Continued)

VEGETATION TYPES AND AREAL EXTENT,

Vegetation Type Overstory	Vegetation Type Understory	Map Unit	Stands	Wetland Status	
				UPL	WET
Scrub					
Dwarf Tree					
Dwarf Tree Woodland Scrub					
Black Spruce		BSDS	10, 16,		X
Tall Scrub					
Closed Tall Scrub					
Alder		Ald	13, 18, 19, 22, 25	X	
Low Scrub					
Open Low Scrub					
Birch-Ericaceous Shrub Bog		BESB	1, 2,31		X
Birch-Ericaceous Shrub Tundra		BES	3, 30, 32, 29	X	
Willow Shrub/Graminoid Bog		WSGB	4, 5, 24, 27		X
Other Map Units					
Gravel Bars		Grv			
Slides/Disturbed Areas		TD			
Streams		Riv			

4.1 OPEN NEEDLE LEAF FOREST (I.A.2)

4.1.1 Mapping Unit OWS/Ald (White Spruce Forest/Alder Understory)

Sampling points JDRC-017 and JDRC-020 were used to characterize this mapping unit. Moss (*Hylocomium splendens.*) cover provides 58 percent of the ground cover with lichen and bare spots providing the remainder of the ground cover. The herbaceous canopy provides 25 percent cover. Important herbaceous species include *Festuca altaica*, *Equisetum sylvaticum*, *Epilobium angustifolium*, *Linnaea borealis*, and *Calamagrostis canadensis*. The dwarf shrub canopy provides less than 10 percent cover. Important dwarf shrubs include *Arctostaphylos rubra.* The low shrub canopy provides 10 percent cover. Important low shrubs include *Rosa acicularis, Ribes triste. Viburnum edule*. Low shrubs have a density between 5,500 and 6,000 stems per hectare. Tall shrubs provide less than 10 percent cover. Important tall shrubs include *Alnus viridis* spp. *sinuata* with a density of 2,000 stems per hectare. Trees provide between 58 percent cover. Important tree species are limited to *Picea glauca* at a density between 700 and 900 stems

per hectare with an average DBH of 28.4 centimeters and scattered *Betula neoalaskana* with a density of less than 400 stems per hectare with an average DBH of 6.7 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryorthents). These areas generally have low micro-relief and are bisected by well-developed gullies. Soils typically are excessively drained.

Mapping Unit OWS/Ald consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on steep east and south facing slopes within the Jumbo Dome Road Corridor.

4.1.2 Mapping Unit OWS/BES (White Spruce Forest/Birch Ericaceous Shrub Understory)

Sampling points JDRC-015 and JDRC-023 were used to characterize this mapping unit. Lichen (*Cladonia* spp./*Cladina* spp.) cover provides between 75 percent of the ground cover with moss and bare spots providing the remainder of the ground cover. The herbaceous canopy provides less than 10 percent cover. Important herbaceous species include *Carex bigelowii*, and *Calamagrostis canadensis*. The dwarf shrub canopy provides between 23 and 60 percent cover. Important dwarf shrubs include *Ledum palustre* spp. *decumbens*, *Ledum groenlandicum*, *Vaccinium vitis-idea*, *Empetrum nigrum*, *Ledum groenlandicum*, and *Vaccinium uliginosum*. The low shrub canopy provides 28 percent cover. Important low shrubs include *Betula nana* and *Salix glauca*. Low shrubs have a density of between 7,500 and 24,000 stems per hectare. Tall shrubs are generally absent. Trees provide between 13 and 35 percent cover. Important tree species are limited to *Picea glauca* at a density of 400 stems per hectare with an average DBH less than 24 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryorthent, Typic Dystrocrept). These areas generally have low micro-relief and are bisected by weakly developed rills. Soils are typically well to excessively drained.

Mapping Unit WS/BES consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on southeast facing slopes near tree line within the Jumbo Dome Road Corridor.

4.1.3 Mapping Unit WS/ER (White Spruce Forest/Ericaceous Shrub Understory)

Sampling points JDRC-008, JDRC-014, and JDRC-037 were used to characterize this mapping unit. Lichen (*Cladonia* spp./*Cladina* spp.) cover provides between 28 and 75 percent of the ground cover with moss (*Hylocomium splendens*) and bare spots providing the remainder of the ground cover. The herbaceous canopy provides less than 10 percent cover. Important herbaceous species include *Carex bigelowii*, and *Calamagrostis canadensis*. The dwarf shrub canopy provides between 23 and 58 percent cover. Important dwarf shrubs include *Ledum palustre* spp. *decumbens*, *Vaccinium vitis-idea*, *Empetrum nigrum*, *Ledum groenlandicum*, and *Vaccinium uliginosum*. The low shrub canopy provides between 10 and 13 percent cover. Important low shrubs include *Betula nana*. Low shrubs have a density of between 3,500 and 7,500 stems per hectare. Tall shrubs are generally absent. Trees provide between 13 and 35

percent cover. Important tree species are limited to *Picea glauca* at a density of 800 stems per hectare with an average DBH less than 15.9 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryorthents and Aquic Cryopsamments). These areas generally have low micro-relief and are bisected by weakly developed rills. Soils are typically well drained.

Mapping Unit WS/ER consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on south and east facing slopes near tree line within the Jumbo Dome Road Corridor.

4.1.4 Mapping Unit OBS (Open Black Spruce Forest)

Sampling points JDRC-028 was used to characterize this mapping unit. Moss cover (*Sphagnum* spp.) provides 77 percent of the ground cover with lichen (*Cladonia* spp./*Cladina* spp.) and bare spots providing the remainder of the ground cover. The herbaceous canopy provides less than 10 percent cover. Herbaceous species include *Rubus chamaemorus*. The dwarf shrub canopy provides 25 percent cover. Important dwarf shrubs include *Empetrum nigrum*, *Vaccinium uliginosum*, *Ledum palustre* spp. decumbens, and *Vaccinium vitis-idea*. The low shrub canopy provides 58 percent cover. Important low shrubs include *Betula nana*, *Picea glauca*, and *Betula glandulosa*. Low shrubs have a density of 37,000 stems per hectare. Tall shrubs provide 150 percent cover. Tall shrubs include *Picea mariana* at a density of 1,000 stems per hectare with an average diameter less than 2.8 centimeters. Trees provide 25 percent cover. Important tree species include *Picea mariana* at a density of 500 stems per hectare with an average DBH less than 5.6 centimeters and *Picea glauca* at a density of 100 stems per hectare with an average DBH less than 7.6 centimeters.

Despite having an aquic moisture regime, the soils underlying these sites are not hydric soils (Histic Cryaquepts). Evidence of hydrology was observed in the field and the aquic conditions are related to saturation during the growing season. These areas generally have high micro-relief and are often bisected by weakly developed rills and gullies. Soils are generally moderately well drained.

Mapping Unit OBS consists of jurisdictional wetlands that connect to other Waters of the United States, including wetlands, via natural surface water conveyances. These jurisdictional wetlands have not been disturbed have an HGM rating of 1.00.

4.1.5 Mapping Unit OBWS (Open Black Spruce-White Spruce Forest)

Sampling points JDRC-011 and JDRC-012 were used to characterize this mapping unit. Moss cover (*Sphagnum* spp.) provides between 83 and 97 percent of the ground cover with lichen (*Cladonia* spp./*Cladina* spp.) and bare spots providing the remainder of the ground cover. The herbaceous canopy provides between 18 and 33 percent cover. Herbaceous species include *Rubus chamaemorus*, and *Carex bigelowii*. The dwarf shrub canopy provides 38 percent cover. Important dwarf shrubs include *Ledum groenlandicum*, *Empetrum nigrum*, *Vaccinium uliginosum*, *Ledum palustre* spp. *decumbens*, and *Vaccinium vitis-idea*. The low shrub canopy

provides between 58 and 73 percent cover. Important low shrubs include *Betula nana, Salix glauca,* and *Betula glandulosa.* Low shrubs have a density between 8,000 and 14,000 stems per hectare. Tall shrubs provide 20 percent cover. Tall shrubs include *Picea mariana* at a density between 500 and 1,250 stems per hectare with a diameter less than 2.8 centimeters and *Picea glauca* at a density between 250 and 1,500 stems per hectare with an average DBH of less than 3.0 centimeters. Trees provide 40 percent cover. Important tree species include *Picea mariana* at a density between 400 and 900 stems per hectare with an average DBH less than 8.3 centimeters and *Picea glauca* at a density between 600 and 700 stems per hectare with an average DBH less than 9.4 centimeters.

Soils underlying these sites are hydric soils (Typic Cryaquepts, Histic Cryaquepts). These areas generally have high micro-relief and are often bisected by weakly developed rills and gullies. Soils generally have moderately well to well developed organic horizons above a gleyed B-horizon.

Mapping Unit OBWS consists of jurisdictional wetlands that connect to other Waters of the United States, including wetlands, via natural surface water conveyances. These jurisdictional wetlands have not been disturbed and have an HGM rating of 1.00. These areas are found near tree line on stream terraces within the Jumbo Dome Road Corridor.

4.2 NEEDLE LEAF WOODLAND

4.2.1 Mapping Unit BSWdl (Black Spruce Woodland)

Sampling points JDRC-009 and JDRC-026 were used to characterize this mapping unit. Moss cover (*Sphagnum* spp.) provides 75 to 95 percent of the ground cover with lichen (*Cladonia* spp./*Cladina* spp.) and bare spots providing the remainder of the ground cover. The herbaceous canopy provides between three and eight percent cover. Herbaceous species include *Rubus chamaemorus, Calamagrostis Canadensis,* and *Carex bigelowii.* The dwarf shrub canopy provides between 30 and 55 percent cover. Important dwarf shrubs include *Ledum groenlandicum, Empetrum nigrum,* and *Vaccinium vitis-idea, Vaccinium uliginosum.* The low shrub canopy provides between 30 and 78 percent cover. Important low shrubs include *Vaccinium uliginosum, Picea marina, Betula nana,* and *Salix pulchra.* Low shrubs have a density of between 17,500 and 33,000 stems per hectare. Tall shrubs and trees provide less than 25 percent cover. Important tree species are limited to *Picea mariana* at a density less than 1,000 stems per hectare with an average DBH of 10.9 centimeters.

Soils underlying these sites are hydric soils (Histic Cryaquepts, Typic Cryaquepts). These areas have generally high micro-relief and are often bisected by weakly developed rills and gullies between moss mounds. Soils are generally poorly drained.

Mapping Unit BSWdl consists of jurisdictional wetlands that connect to other Waters of the United States, including wetlands, via natural surface water conveyances. These jurisdictional wetlands have not been disturbed have an HGM rating of 1.00. These areas are found on low to flat areas on stream terraces near tree line within the Jumbo Dome Road Corridor.

4.2.2 Mapping Unit BSWdl2 (Black Spruce Forest/Ericaceous Shrub Understory)

Sampling points JDRC-033 and JDRC-033 were used to characterize this mapping unit. Moss (*Hylocomium splendens*) provides 98 percent of the ground cover with lichen and bare spots providing the remainder of the ground cover. The herbaceous canopy provides more than 50 percent cover. Important herbaceous species include *Carex bigelowii* and *Calamagrostis canadensis*. The dwarf shrub canopy provides between 15 percent cover. Important dwarf shrubs include *Vaccinium vitis-idea.* The low shrub canopy provides 43 percent cover. Important low shrubs include *Betula nana* and *Picea mariana.* Low shrubs have a density of 25,500 stems per hectare. Tall shrubs are generally absent. Trees provide 10 percent cover. Important tree species are limited to *Picea mariana* at a density of 100 stems per hectare with an average DBH less than 10.7 centimeters.

Soils underlying these sites are not hydric soils a (Typic Dystrocryepts). These areas have generally low micro-relief and are bisected by weakly developed rills. Soils are generally well drained.

Mapping Unit BSWdl2 consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on south and west facing slopes near tree line within the Jumbo Dome Road Corridor.

4.2.3 Mapping Unit WSWdl (White Spruce Woodland)

Sampling points JDRC-006 has been used to characterize this mapping unit. Moss (*Hylocomium splendens* spp.) cover provide between 85 and 80 percent of the ground cover with lichen (*Cladonia* spp./*Cladina* spp.) and bare spots providing the remainder of the ground cover. Important herbaceous species include *Pyrola grandiflora*, *Carex bigelowii*, and *Cornus canadensis*. The dwarf shrub canopy provides 40 percent cover. Important dwarf shrubs include *Potentilla fruiticosa, Ledum palustre* spp. *decumbens* , *Arctostaphylos uva-ursa,* and *Vaccinium uliginosum.* The low shrub canopy provides 65 percent cover. Important low shrubs include *Betula nana* and *Salix glauca*. Low shrubs have a density of 9,000 stems per hectare. Tall shrubs are generally absent. Trees provide 15 percent cover. Important tree species are limited to *Picea glauca* at a density of 800 stems per hectare with an average DBH of 7.8 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryorthents). These areas generally have low micro-relief and bisected by weakly developed rills. Soils are generally moderately well drained.

Mapping Unit WSWdl consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on topographic rises on the tread of stream terraces near tree line within the Jumbo Dome Road Corridor.

4.3 CLOSED BROADLEAF FOREST

4.3.1 Mapping Unit CB (Closed Birch Forest)

Sampling points JDRC-039 has been used to characterize this mapping unit. Moss cover provides between less than 25 percent of the ground cover with lichen and bare spots providing the remainder of the ground cover. The herbaceous canopy provides 90 percent cover. Important herbaceous species include *Equisetum arvense* and *Calamagrostis canadensis*. The dwarf shrub canopy provides 45 percent cover. Important dwarf shrubs include *Rosa acicularis, Ribes triste,* and *Arctostaphylos uva-ursa.* The low shrub canopy provides 3 percent cover. Important low shrubs include *Picea glauca.* Low shrubs have a density of 2,000 stems per hectare. Tall shrubs are generally absent. Trees provide 65 percent cover. Important tree species include *Betula neoalaskana* at a density of 1,200 stems per hectare with an average DBH less than 15 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryopsamments). These areas generally have low micro-relief and are bisected by shallow gullies. Soils are generally well drained.

Mapping Unit OSB consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on steep east and south facing slopes within the Jumbo Dome Road Corridor.

4.3.2 Mapping Unit OMA (Closed Mixed Forest)

Sampling points JDRC-038 has been used to characterize this mapping unit. Moss cover provides between 60 percent of the ground cover with lichen and bare spots providing the remainder of the ground cover. The herbaceous canopy provides 44 percent cover. Important herbaceous species include *Equisetum arvense, Calamagrostis canadensis, Linnaea borealis,* and *Pyrola grandiflora.* The dwarf shrub canopy provides 43 percent cover. Important dwarf shrubs include *Rosa acicularis* and *Ribes triste.* The low shrub canopy provides 8 percent cover. Important low shrubs include *Picea glauca, Populus tremuloides,* and *Populus balsamifera.* Low shrubs have a density of 3,000 stems per hectare. Tall shrubs are generally absent. Trees provide 93 percent cover. Important tree species include *Betula neoalaskana* at a density of 1,000 stems per hectare with an average DBH of 17 centimeters, *Populus balsamifera* at a density of 900 stems per hectare with an average DBH of 14.8 centimeters, and *Picea glauca* at a density of 100 stems per hectare with an average DBH of 17 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryopsamments). These areas generally have low micro-relief and are bisected by shallow gullies. Soils are generally well drained.

Mapping Unit OSB consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on gently sloping east facing slopes within the Jumbo Dome Road Corridor.

4.4 MIXED FORESTS

4.4.1 Mapping Unit OSB/Ald (Open White spruce-Paper Birch Forest/Alder understory)

Sampling points JDRC-021 and JDRC-034 were used to characterize this mapping unit. Lichen (*Hylocomium splendens.*) cover provides 58 percent of the ground cover with moss and bare spots providing the remainder of the ground cover. The herbaceous canopy provides 30 percent cover. Important herbaceous species include *Calamagrostis canadensis*. The dwarf shrub canopy provides less than 10 percent cover. Important dwarf shrubs include *Arctostaphylos rubra.* The low shrub canopy provides 10 percent cover. Important low shrubs include *Betula neoalaskana.* Low shrubs have a density of 1,000 stems per hectare. Tall shrubs provide 23 percent cover. Important tall shrubs include *Alnus viridis* spp. *crispa* at a density of 2,000 stems per hectare, *Betula neoalaskana* at a density of 2,000 stems per hectare with an average DBH of 4.4 centimeters, and *Picea glauca* at a density of 250 stems per hectare with an average DBH of 2.5 centimeters. Trees provide 55 percent cover. Important tree species include *Picea glauca* at a density of 500 stems per hectare with an average DBH of 26.0 centimeters and *Betula neoalaskana* at a density of less than 200 stems per hectare with an average DBH of 6.0 centimeters.

Soils underlying these sites are not hydric soils (Typic Cryorthent). These areas generally have low micro-relief and are bisected by well developed gullies. Soils are generally excessively drained.

Mapping Unit OSB/Ald consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on steep east and south facing slopes within the Jumbo Dome Road Corridor.

4.4.2 Mapping Unit OSB/ER (OSB White spruce-Paper Birch Forest)

Sampling points JDRC-035 and JDRC-036 were used to characterize this mapping unit. Moss cover provides between 30 and 80 percent of the ground cover with lichen and bare spots providing the remainder of the ground cover. The herbaceous canopy provides between 8 and 50 percent cover. Important herbaceous species include *Festuca altaica, Equisetum sylvaticum, Linnaea borealis*, and *Calamagrostis canadensis*. The dwarf shrub canopy provides between 73 and 80 percent cover. Important dwarf shrubs include *Rosa acicularis, Vaccinium spp. Ledum groenlandicum,* and *Empetrum nigrum.* The low shrub canopy provides 3 percent cover. Important low shrubs include *Betula neoalaskana and Picea glauca.* Low shrubs have a density of between 250 and 500 stems per hectare. Tall shrubs provide between 18 and 28 percent cover. Important tall shrubs include *Alnus viridis* spp. *sinuata* at a density of 750 and 1,500 stems per hectare with a DBH less than 11.4 centimeters, *Betula neoalaskana* at a density between 300 and 700 stems per hectare with an average DBH less than 15 centimeters, and *Picea glauca* at a density of 250 stems per hectare with an average DBH of 2.5 centimeters. Trees provide between 45 and 60 percent cover. Important tree species include *Picea glauca* at a density between 200 and 400 stems per hectare with an average DBH of less than 42.0 centimeters and *Betula neoalaskana* at a density of between 300 and 700 stems per hectare with an average DBH less than 15 centimeters.

Soils underlying these sites are not hydric soils a (Typic Cryopsamments and Typic Dystrocryepts). These areas generally have low micro-relief and are bisected by gullies. Soils are generally well to excessively well drained.

Mapping Unit OSB consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on steep east and south facing slopes within the Jumbo Dome Road Corridor.

4.5 Open Dwarf Tree Scrub

4.5.1 Mapping Unit BSDS (Black Spruce Dwarf Scrub)

Sampling points JDRC-010 and JDRC-0016 were used to characterize this mapping unit. Moss cover (*Pleurozium* spp. and *Sphagnum* spp.) provides between 75 and 97 percent of the ground cover with lichen (*Cladonia* spp./*Cladina* spp.) and bare spots providing the remainder of the ground cover. The herbaceous canopy provides between 5 and 33 percent cover. Herbaceous species include *Rubus chamaemorus, Calamagrostis canadensis*, and *Carex bigelowii.* The dwarf shrub canopy provides between 42 and 55 percent cover. Important dwarf shrubs include *Ledum groenlandicum, Vaccinium uliginosum, Ledum palustre* spp. *decumbens, Empetrum nigrum*, and *Vaccinium vitis-idea.* The low shrub canopy provides between 30 and 78 percent cover. Important low shrubs include *Betula nana, Salix glauca, Picea* mariana, and *Betula glandulosa.* Low shrubs have a density of between 32,000 and 35,500 stems per hectare. Tall shrubs and trees provide less than 25 percent cover. Important tree species include *Picea mariana* at a density less than 500 stems per hectare with an average DBH of 3.3 centimeters and *Picea glauca* at a density of less than 500 stems per hectare with an average DBH between 2.5 and 15.1 centimeters.

Soils underlying these sites are hydric soils (Histic Cryaquepts). These areas generally have high micro-relief and are often bisected by weakly developed rills and gullies. Soils are generally poorly to very poorly drained.

Mapping Unit BSDS consists of jurisdictional wetlands that connect to other Waters of the United States, including wetlands, via natural surface water conveyances. These jurisdictional wetlands have not been disturbed have an HGM rating of 1.00. These areas are found on low to flat areas near tree line on stream terraces within the Jumbo Dome Road Corridor.

4.6 OPEN TALL SCRUB

4.6.1 Mapping Unit Ald1 (Closed Alder Tall Scrub)

Sampling points JDRC-013 has been used to characterize this mapping unit. Moss cover provides 18 percent of the ground cover with bare spots providing the remainder of the ground cover. The herbaceous canopy provides 75 percent cover. Important herbaceous species include *Cornus canadensis, Rubus ideaus, Potentilla fruiticosa*, and *Calamagrostis canadensis.* The

dwarf shrub canopy is absent. The low shrub canopy provides 23 percent cover. Important low shrubs include *Ribes triste* and *Salix glauca*. Low shrubs have a density of 4,500 stems per hectare. Tall shrubs provide 95 percent cover. Important tall shrubs include *Alnus incana* spp. *tenuifolia* at a density of 14,000 stems per hectare with an average DBH of 3.5 centimeters and *Picea glauca* at a density of 1,500 stems per hectare with an average DBH of 3.3 centimeters. The tree canopy is absent.

Soils underlying these sites are not hydric soils a (Typic Cryofluvents). These areas generally have low micro-relief and are bisected by weakly developed rills. Soils are generally well drained.

Mapping Unit Ald1 consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on gravel bars along Marguerite Creek near tree line within the Jumbo Dome Road Corridor.

4.6.2 Mapping Unit Ald2 (Open Alder Tall Scrub)

Sampling points JDRC-018 has been used to characterize this mapping unit. Bare ground provides 60 percent of the ground cover with moss providing the remainder of the ground cover. The herbaceous canopy provides 55 percent cover. Important herbaceous species include *Linnaea borealis Epilobium angustifolium,* and *Calamagrostis canadensis.* The dwarf shrub canopy is absent. The low shrub canopy provides 23 percent cover. Important low shrubs include *Ribes triste* and *Salix glauca*. Low shrubs have a density of 4,500 stems per hectare. Tall shrubs provide 95 percent cover. Important tall shrubs include *Alnus viridis* spp. *crispa* with a density of 250 stems per hectare with an average DBH of 2.6 centimeters. The tree canopy provides less than 10 percent cover. Important tree species include *Betula neoalaskana* at a density of 900 stems per hectare with an average DBH of 28.4 centimeters.

Soils underlying these sites are not hydric soils a (Typic cryorthent). These areas generally have low micro-relief and are bisected by weakly developed rills. Soils are generally well drained.

Mapping Unit Ald2 consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on slide areas on the upper slopes within the Jumbo Dome Road Corridor.

4.6.3 Mapping Unit Ald3 (Closed Alder Tall Scrub)

Sampling points JDRC-019 has been used to characterize this mapping unit. Moss cover provides 5 percent of the ground cover with bare spots providing the remainder of the ground cover. The herbaceous canopy provides 60 percent cover. Important herbaceous species include Epilobium angustifolium, *Rubus ideaus, Cystopteris fragilis,* and *Calamagrostis canadensis.* The dwarf shrub canopy is absent. The low shrub canopy provides 23 percent cover. Important low shrubs include *Rosa acicularis, Ribes triste,* and *Viburnum edule*. Low shrubs have a density of 4,000 stems per hectare. Tall shrubs provide 55 percent cover. Important tall shrubs include *Alnus incana* spp. *crispa* at a density of 1,250 stems per hectare with an average DBH of 5.2 centimeters. The tree canopy provides less than 5 percent cover. Important tree species

include *Picea glauca* at a density of 1,500 stems per hectare with an average DBH of 3.3 centimeters. The tree canopy is absent.

Soils underlying these sites are not hydric soils a (Typic Cryofluvents). These areas generally have low micro-relief and are bisected by weakly developed rills. Soils are generally well drained.

Mapping Unit Ald3 consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found in headwater of small drainages on steep slopes within the Jumbo Dome Road Corridor.

4.6.4 Mapping Unit Ald4 (Closed Alder Tall Scrub)

Sampling points JDRC-022 and JDRC-025 were used to characterize this mapping unit. Moss cover provides 25 percent of the ground cover with bare spots providing the remainder of the ground cover. The herbaceous canopy provides between 33 and 48 percent cover. Important herbaceous species include *Equisetum sylvaticum, Equisetum pretense,* and *Calamagrostis Canadensis*. The dwarf shrub canopy provides between 23 and 28 percent cover. Important low shrubs include *Arctostaphylos rubra, Rubus ideaus, Empetrum nigrum*, and *Ribes triste.* The low shrub canopy provides 23 percent cover. Important low shrubs include *Betula glandulosa* and *Rosa acicularis*. Low shrubs have a density of 10,000 stems per hectare. Tall shrubs provide 58 percent cover. Important tall shrubs include *Alnus viridis* spp. sinuata at a density of 4,000 stems per hectare with an average DBH of 3.3 centimeters. The tree canopy provides less than 5 percent cover. Important tree species include *Picea glauca* at a density of 100 stems per hectare with an average DBH of 19.0 centimeters.

Soils underlying these sites are not hydric soils a (Typic Cryorthents and Typic Cryopsamments). These areas generally have low micro-relief and are bisected by weakly developed rills. Soils are generally well drained.

Mapping Unit Ald4 consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on lower slopes within the Jumbo Dome Road Corridor.

4.7 OPEN LOW SCRUB

4.7.1 Mapping Unit BESB (Shrub Birch – Ericaceous Shrub Bog)

Sampling points JDRC-001, JDRC-002, JDRC-031 were used to characterize this mapping unit. Moss cover (*Sphagnum* spp.) provide between 80 and 100 percent of the ground cover with bare spots due to surface water ponding providing the remainder of the ground cover. The herbaceous canopy includes of *Rubus chamaemorus* and *Carex bigelowii.* In general, sedges (*Carex* spp.) tended to dominate the herbaceous canopy on wetter sites. The dwarf shrub canopy provides between 65 and 75 percent cover. Important dwarf shrubs include *Ledum palustre* spp. *decumbens*, *Vaccinium vitis-idea*, and *Empetrum nigrum.* The low shrub canopy provides between 63 and 65 percent cover. Important low shrubs include *Betula* spp. (*nana, glandulosa,* and their hybrids). On wetter sites, clumps of *Salix* spp. Low shrubs have a density of of

between 28,500 and 40,500 stems per hectare. Tall shrubs and trees provide less than 10 percent cover. Important tree species are limited to *Picea mariana* at a density less than 500 stems per hectare with an average DBH less than 2.4 centimeters.

Soils underlying these sites are hydric soils a (Typic Cryaquepts). These areas generally have high micro-relief and are often bisected by weakly developed rills and gullies between Sphagnum mounds. Soils are generally poorly to very poorly drained.

Mapping Unit BESB consists of jurisdictional wetlands that connect to other Waters of the United States, including wetlands, via natural surface water conveyances. These jurisdictional wetlands have not been disturbed have an HGM rating of 1.00. These areas are found on terraces and depressions within the Jumbo Dome Road Corridor.

4.7.2 Mapping Units BES1 and BES (Shrub Birch – Ericaceous Shrub)

Sampling points JDRC-003, JDRC-029, JDRC-030, and JDRC-032 were used to characterize this mapping unit. Lichen (*Cladonia* spp./*Cladina* spp.) cover provide between 75 and 80 percent of the ground cover with moss (*Hylocomium splendens* spp.) and bare spots providing the remainder of the ground cover. The herbaceous canopy includes *Rubus chamaemorus, Lupinus arcticus,* and *Carex bigelowii.* The dwarf shrub canopy provides 60 percent cover. Important dwarf shrubs include *Ledum palustre* spp. *decumbens*, *Arctostaphylos uva-ursa, Vaccinium vitis-idea,* and *Vaccinium uliginosum*). The low shrub canopy provides 65 percent cover. Important low shrubs include *Betula, glandulosa.* Low shrubs have a density of 9,000 stems per hectare. Tall shrubs and trees provide less than 10 percent cover. Important tree species are limited to *Picea glauca* at a density of 400 stems per hectare with an average DBH of 16.5 centimeters.

Soils underlying these sites are not hydric soils a (Typic Cryorthods). These areas generally have low micro-relief and are bisected by weakly developed rills and minor gullies. Soils generally had an E horizon organic horizon above Bs-horizons.

Mapping Unit BES1 consists of uplands that are not subject to the provisions of the Clean Water Act. These areas are found on the tread riser of stream terraces within the Jumbo Dome Road Corridor.

4.7.3 Mapping unit WSGB (Willow – Graminoid Shrub Bog)

Sampling points JDRC-003, JDRC-004, JDRC-024, and JDRC-027 were used to characterize this mapping unit. Moss cover (*Sphagnum* spp.) provide between 25 and 30 percent of the ground cover with bare spots due to surface water ponding providing the remainder of the ground cover. The herbaceous canopy provides between 30 and 50 percent cover. Important herbaceous species include *Equisetum* spp., *Carex utriculata*, and *Calamagrostis canadensis.* The dwarf shrub canopy provides approximately 33 percent cover. Important dwarf shrubs include *Ledum groenlandicum*, and *Vaccinium uliginosum.* The low shrub canopy provides between 73 and 75 percent cover. Important low shrubs include *Betula glandulosa* and *Salix pulchra*). Low shrubs have a density of between 16,500 and 26,000 stems per hectare. Tall

shrubs and trees provide less than 10 percent cover. Important tree species are limited to *Picea mariana* at a density less than 500 stems per hectare with an average DBH less than 2.3 centimeters.

Soils underlying these sites are hydric soils a (Typic Cryaquepts and Typic Cryaquents). These areas generally have high micro-relief and are often bisected by weakly developed rills and gullies between shrubs and herbaceous vegetation. Soils are generally poorly drained.

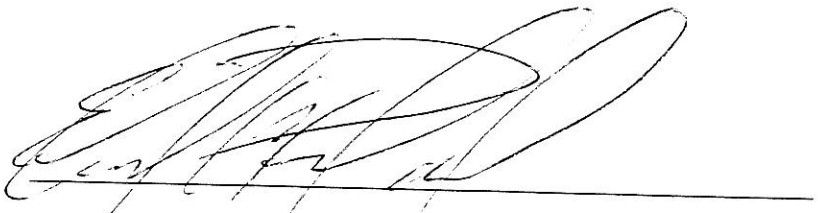
Mapping Unit WSGB consists of jurisdictional wetlands that connect to other Waters of the United States, including wetlands, via natural surface water conveyances. These jurisdictional wetlands have not been disturbed have an HGM rating of 1.00. These areas are found within stream channels and drainage ways within the Jumbo Dome Road Corridor. At lower elevations, the dwarf shrub canopy is absent.

5.0 CONCLUSIONS AND RECOMMENDATIONS

At the time of investigations, the site was within the growing season as defined in the U.S. Army Corps of Engineers, Alaska District. Vegetation Mapping Units OBS, OBWS, BSDS, BESB, and WSGB consist of jurisdictional wetlands that are subject to Clean Water Act Jurisdiction. Jurisdictional wetlands account for approximately 30 percent of the Jumbo Dome Road Corridor. Soil disturbing activities within these mapping units, including mechanized land clearing, will require a Section 404 wetland permit from the U.S. Army Corps of Engineers.

6.0 PROFESSIONAL CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



Date: 15 DEC 2005

Edmond C. Packee, Jr. Ph.D
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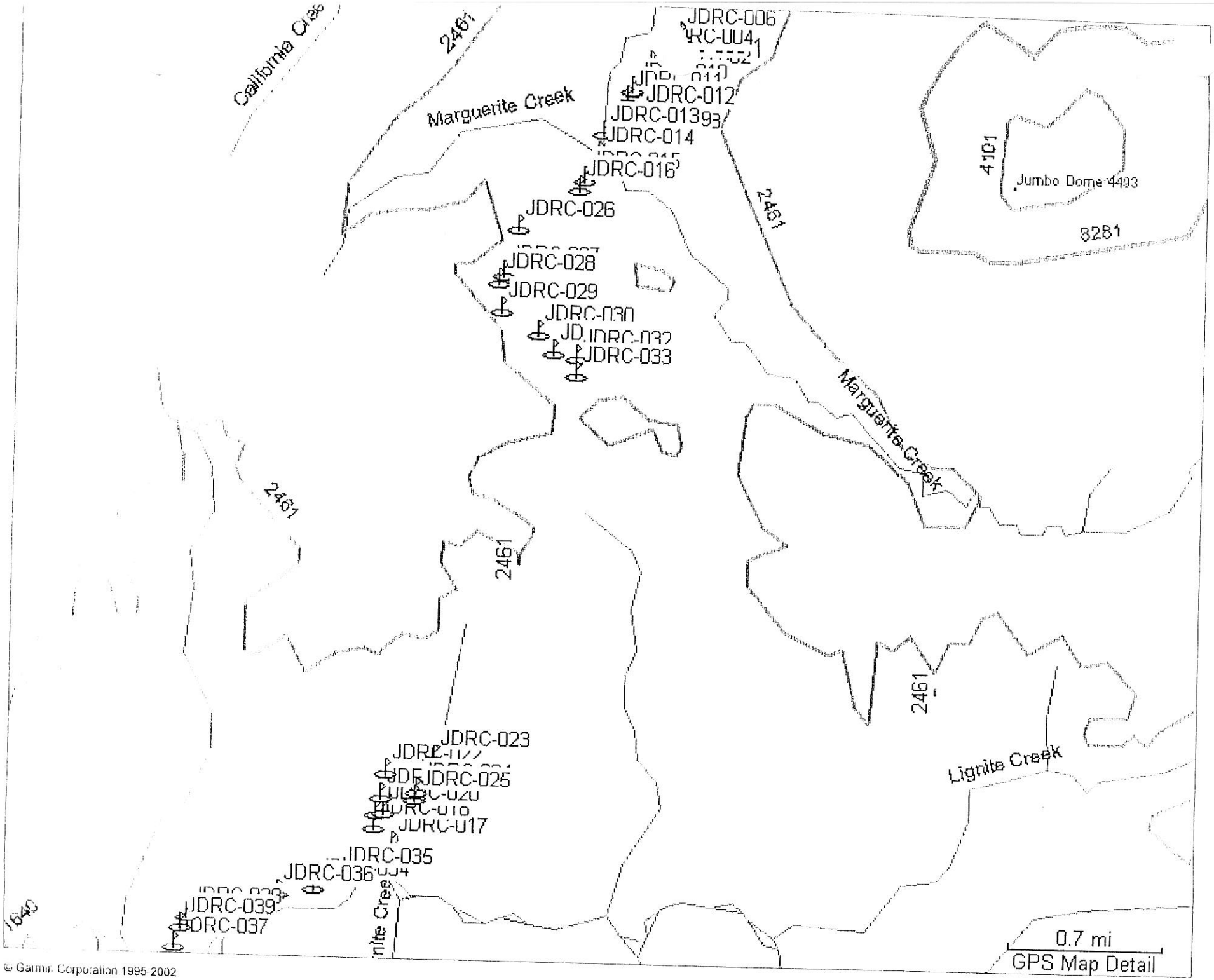
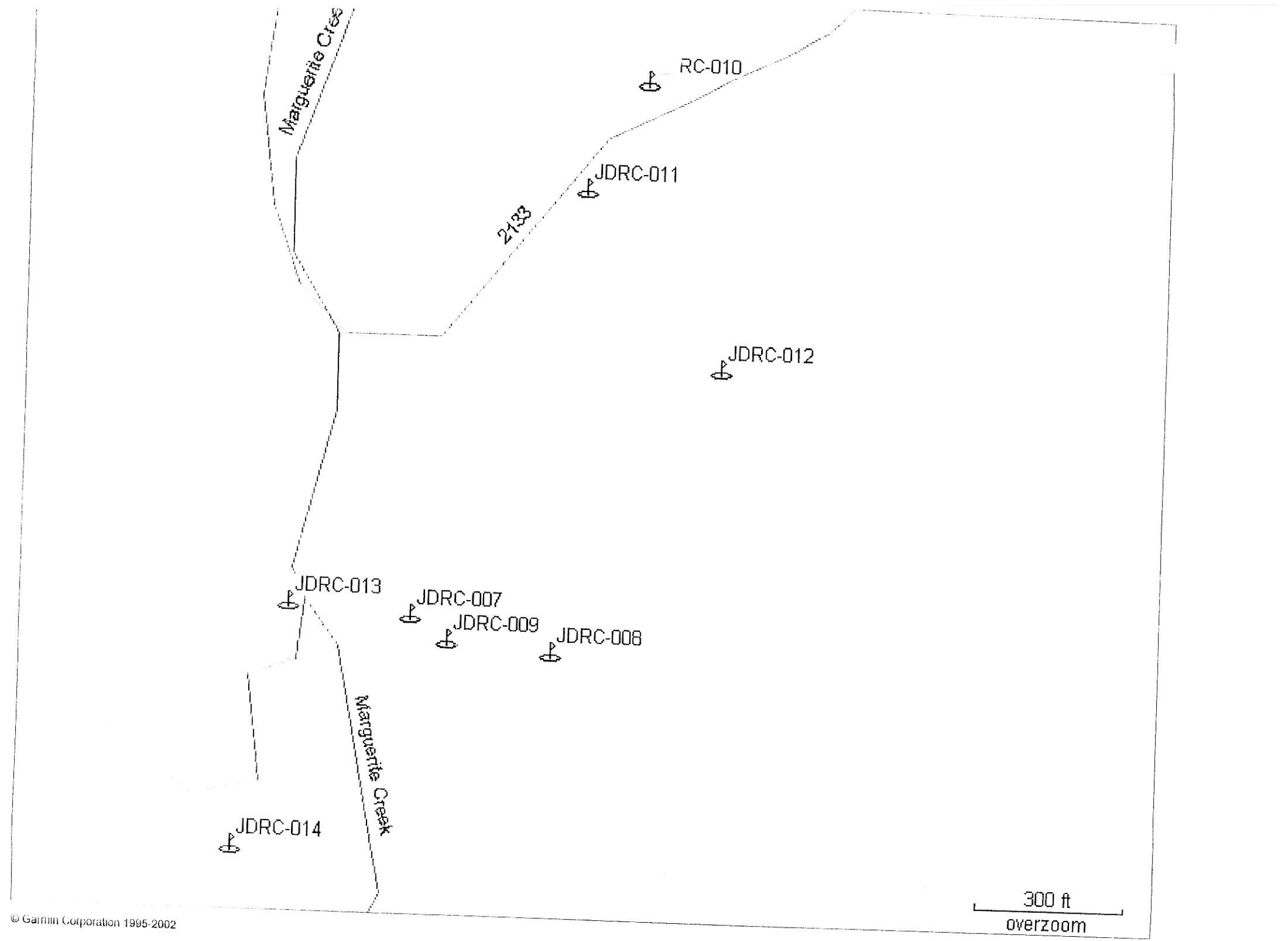
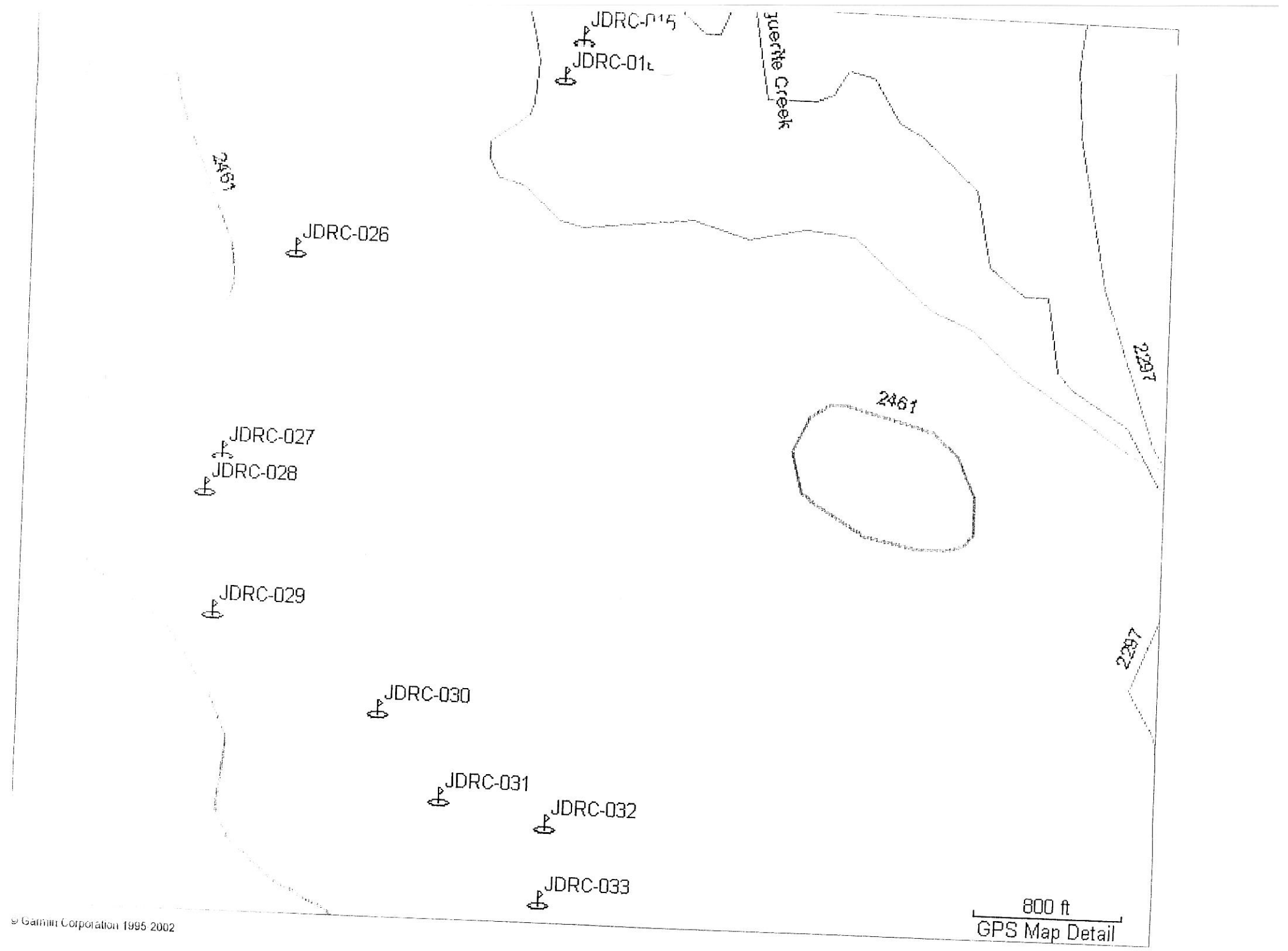
Certified Professional Soil Scientist., No. 28100.
Certified Professional in Erosion and Sediment Control. No. 2337.

APPENDIX A

TRANSECT LOCATION AND SAMPLING POINTS



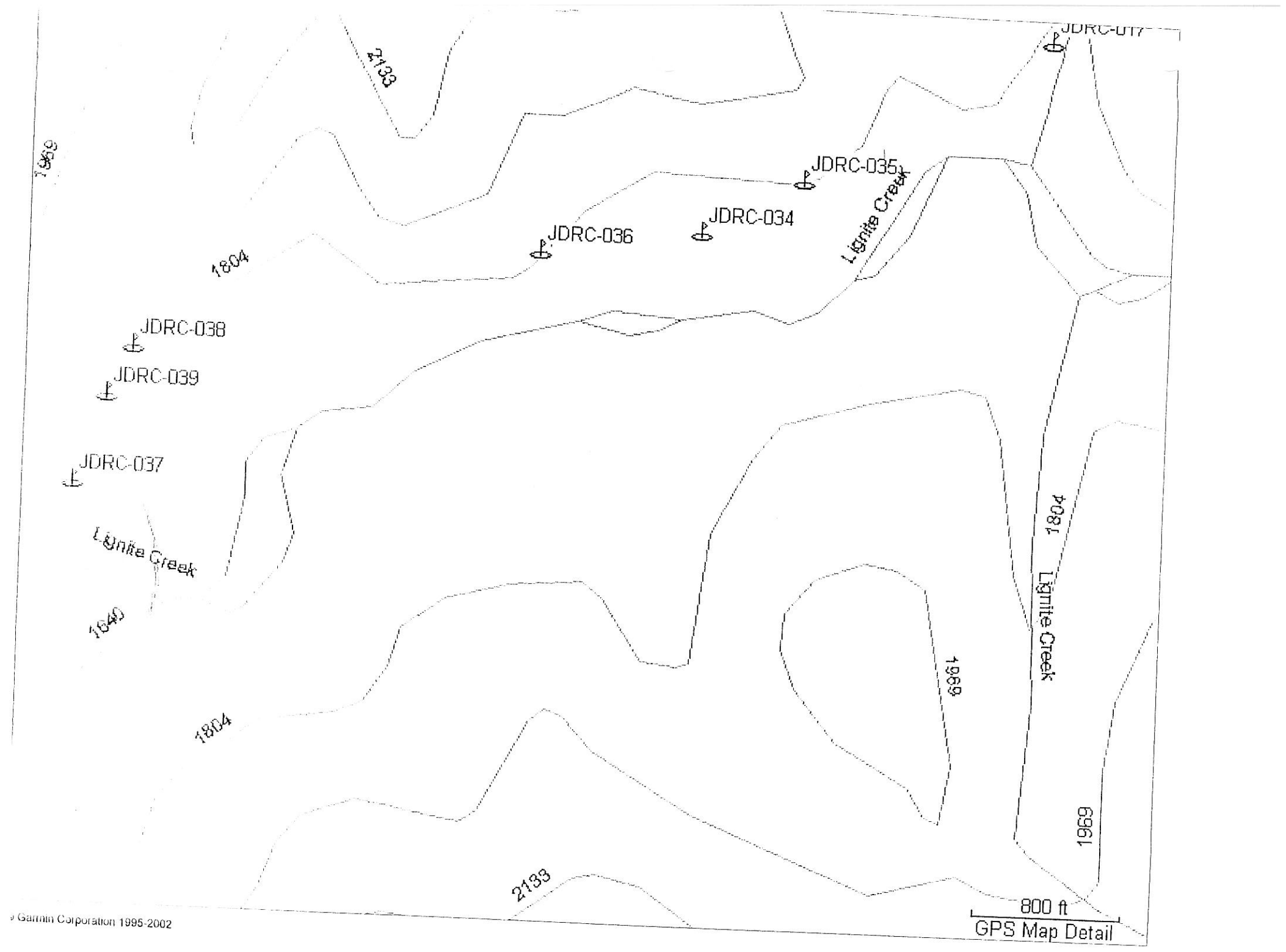




APPENDIX B

ROUTINE WETLAND DETERMINATION WORKSHEETS

AVAILABLE UPON REQUEST



APPENDIX D

VEGETATION DATA SUMMARY

AVAILABLE UPON REQUEST

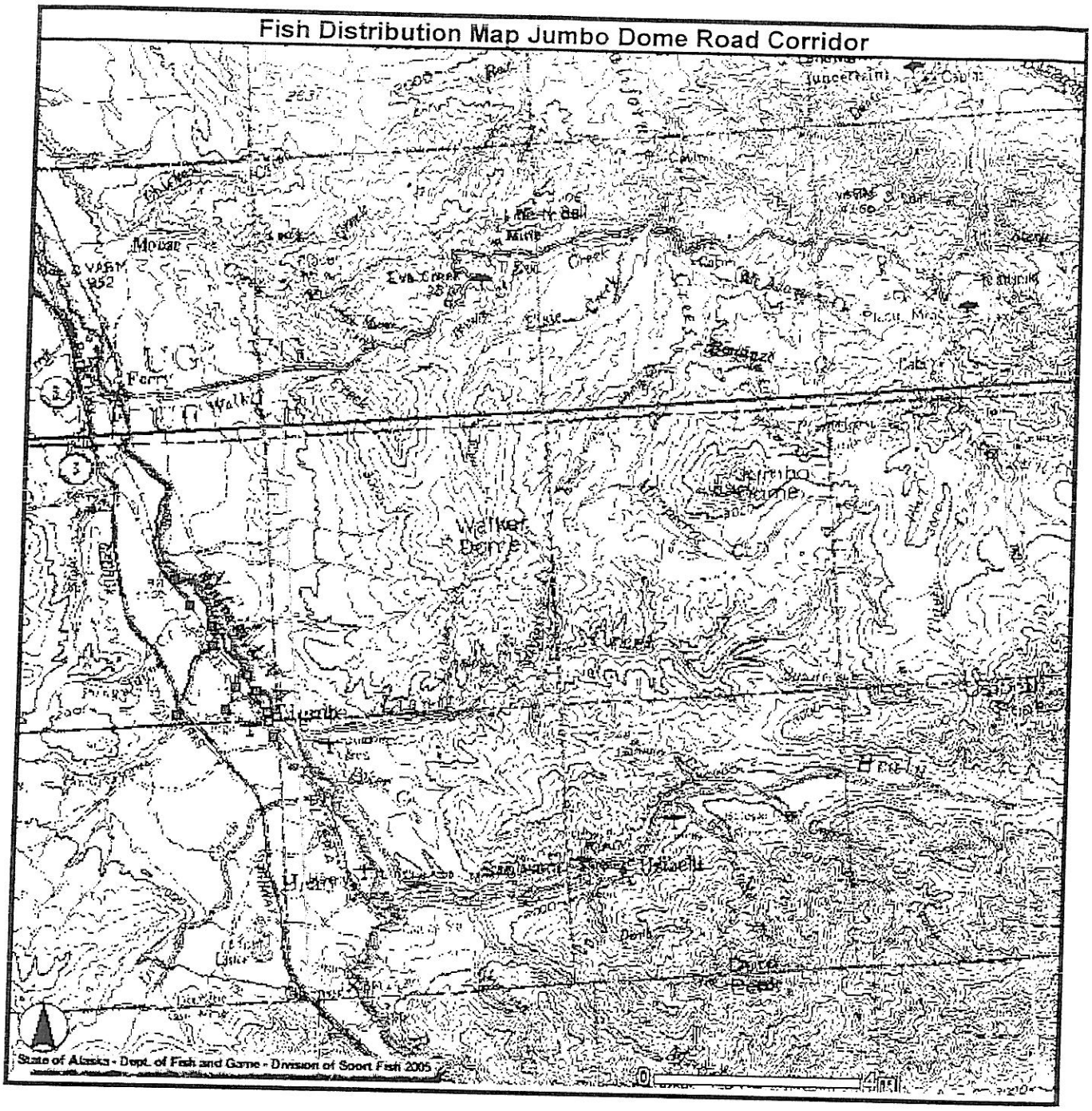
APPENDIX E

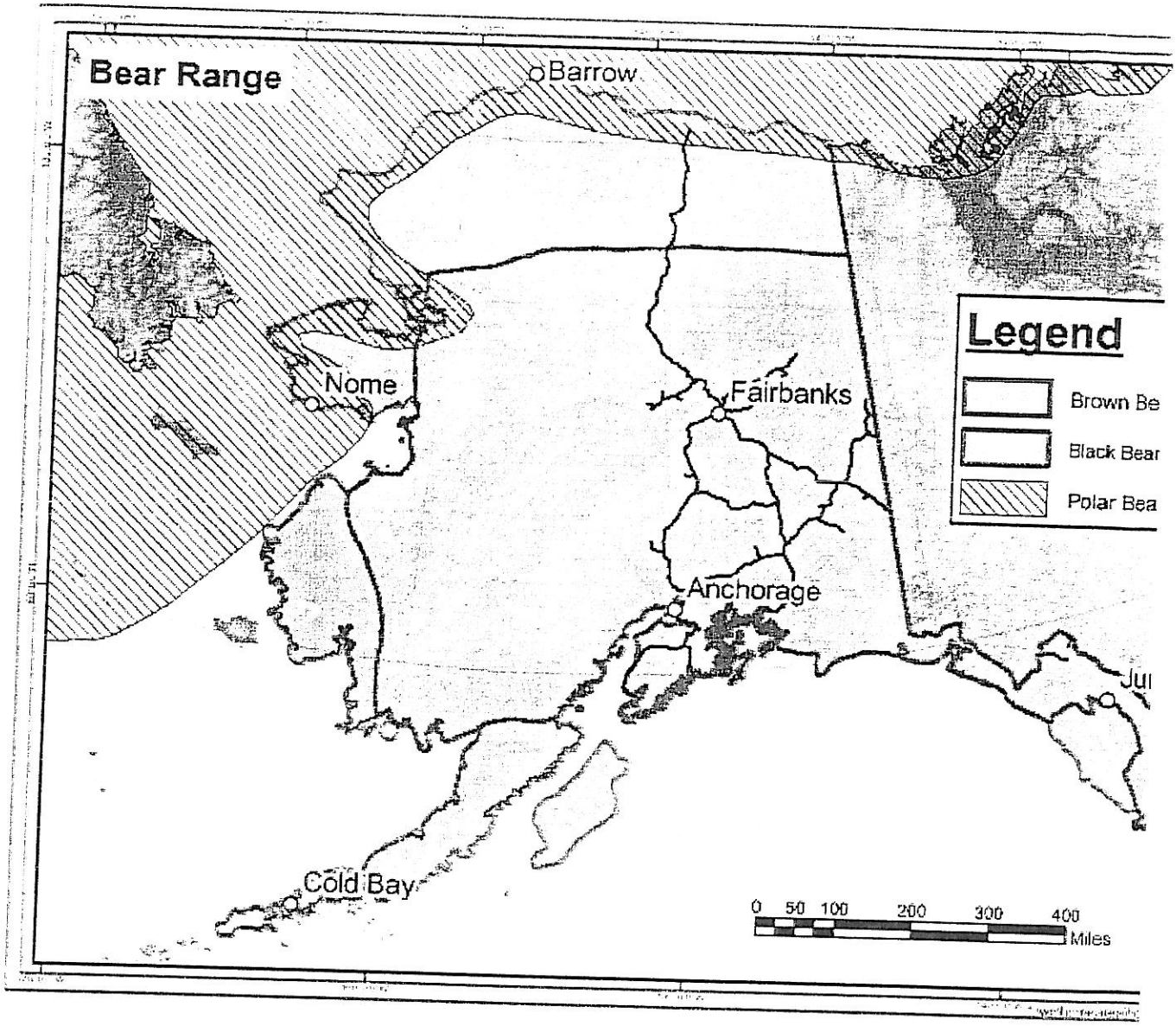
HGM WETLAND FUNCTIONAL ASSESSMENT WORKSHEETS

AVAILABLE UPON REQUEST

APPENDIX F

ADF&G SPECIES DISTRIBUTION MAPS


Fish Distribution Map Jumbo Dome Road Corridor
Walker Dome
State of Alaska - Dept. of Fish and Game - Division of Sport Fish 2005



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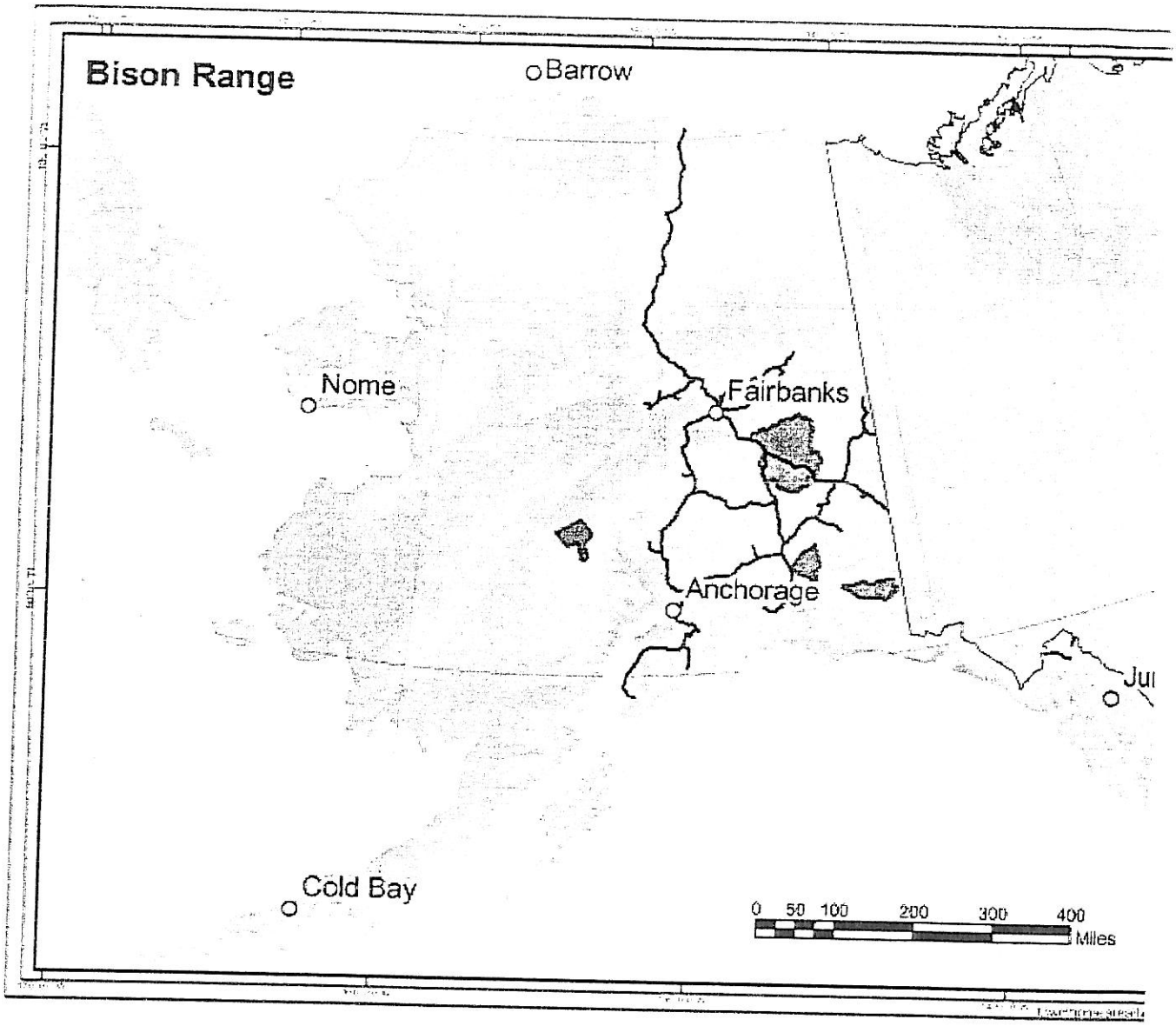

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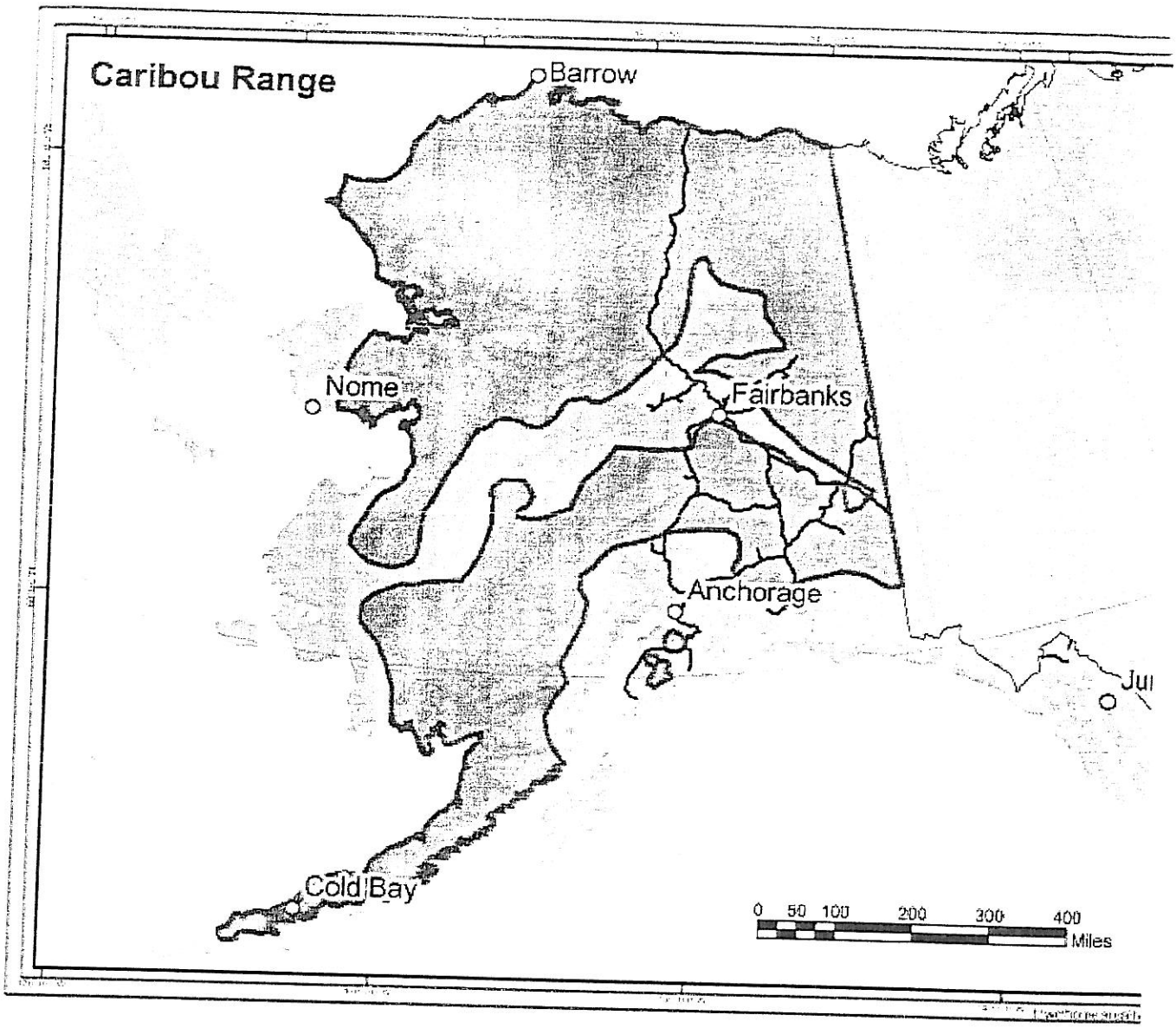

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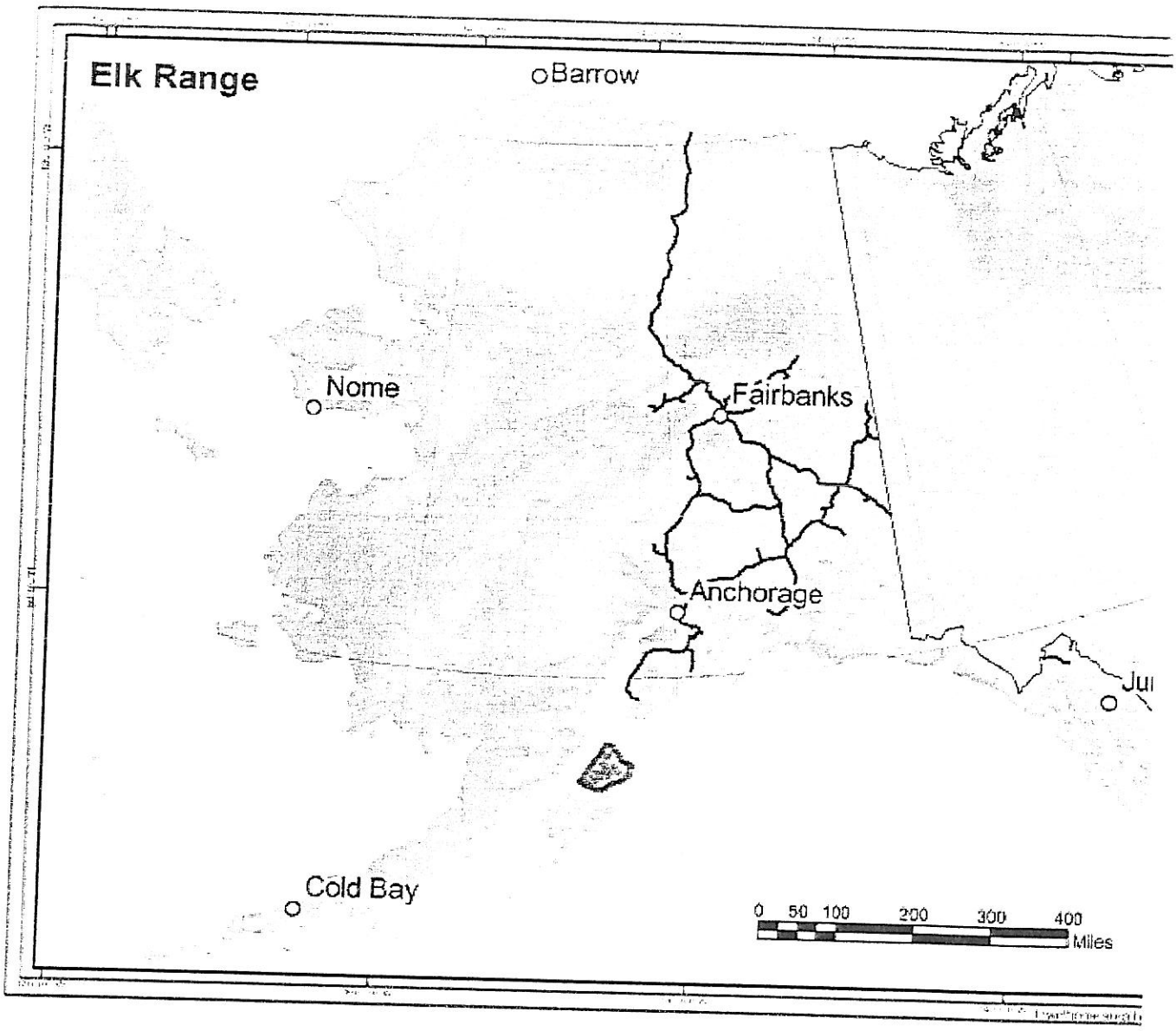

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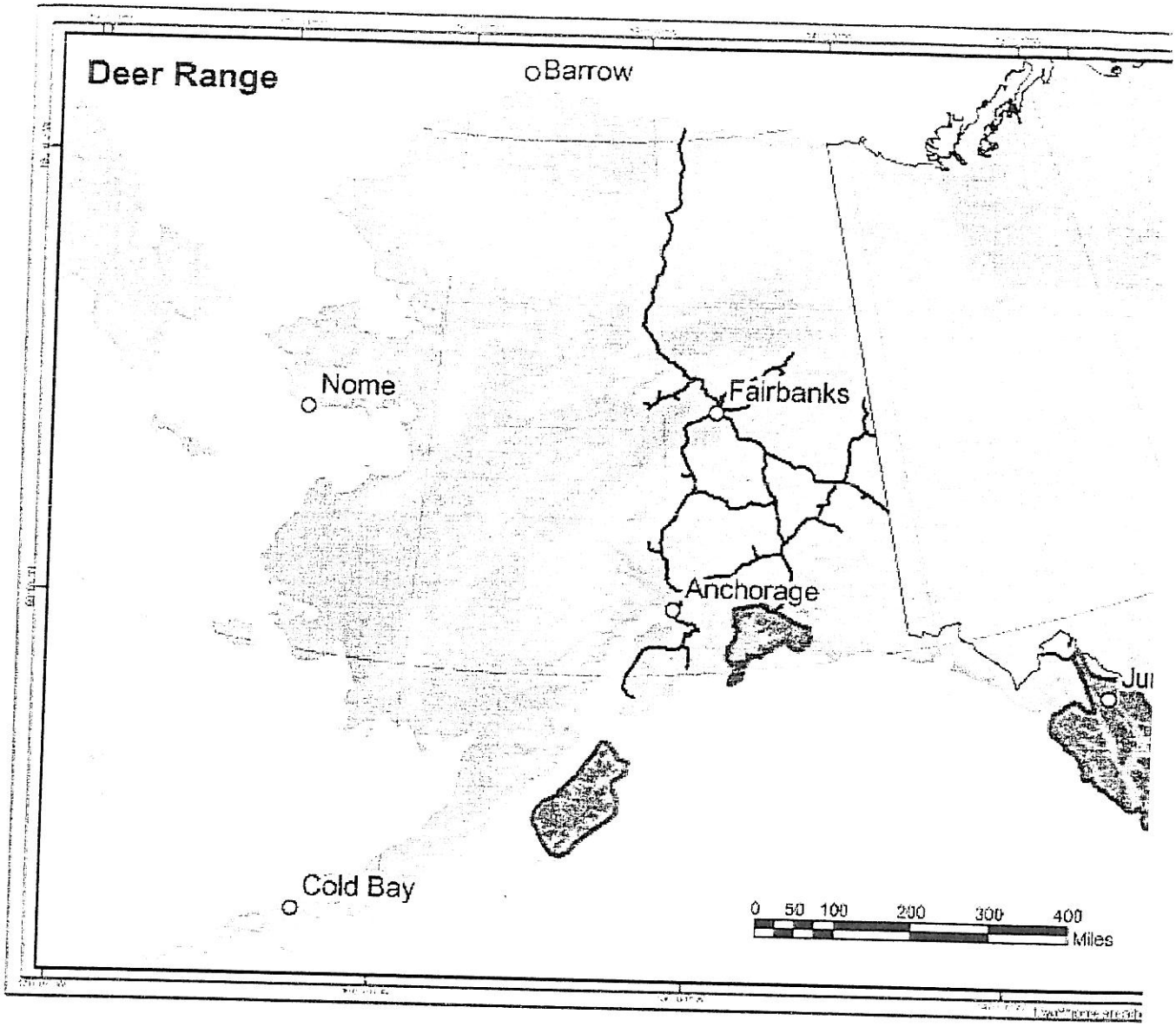

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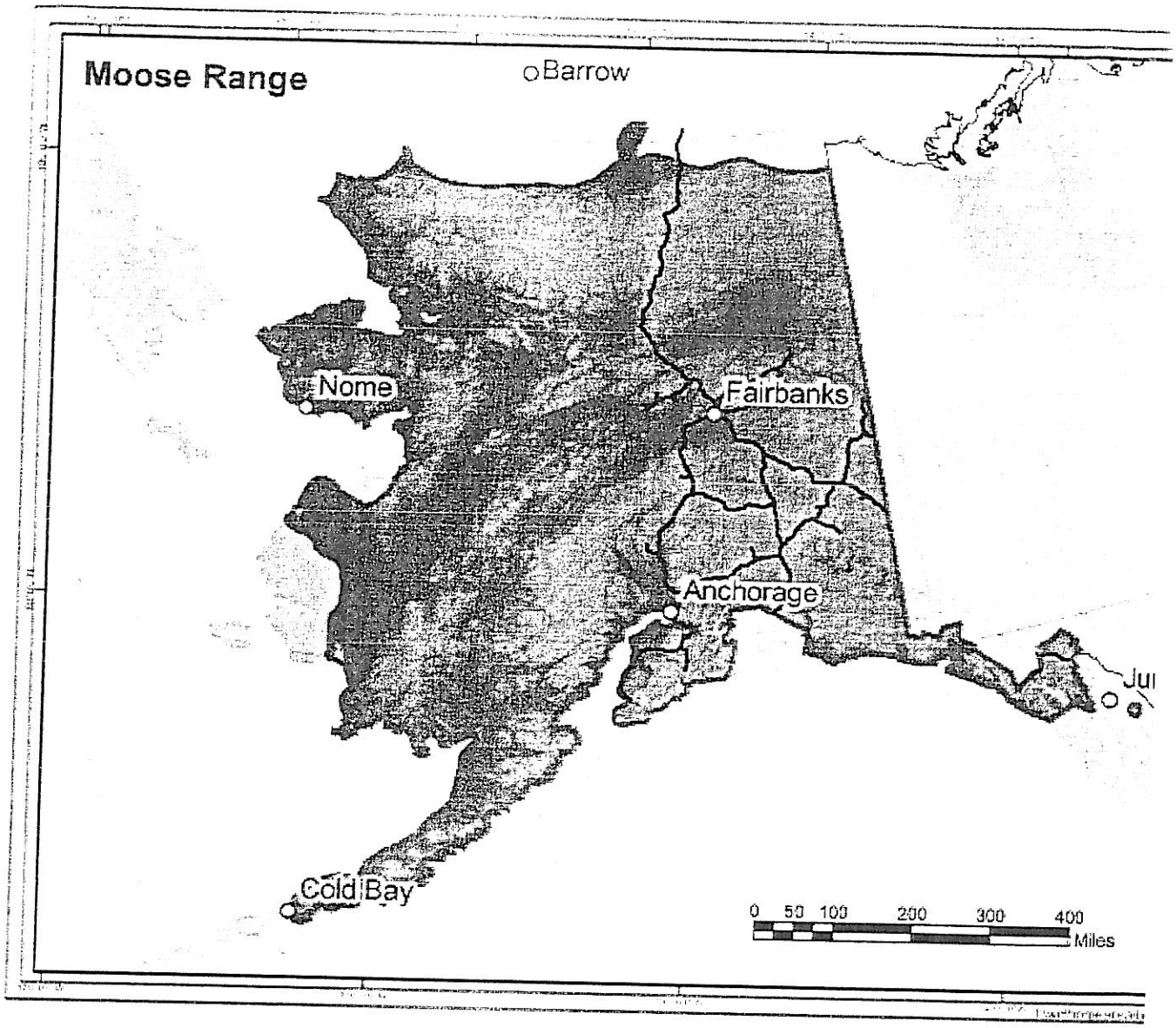

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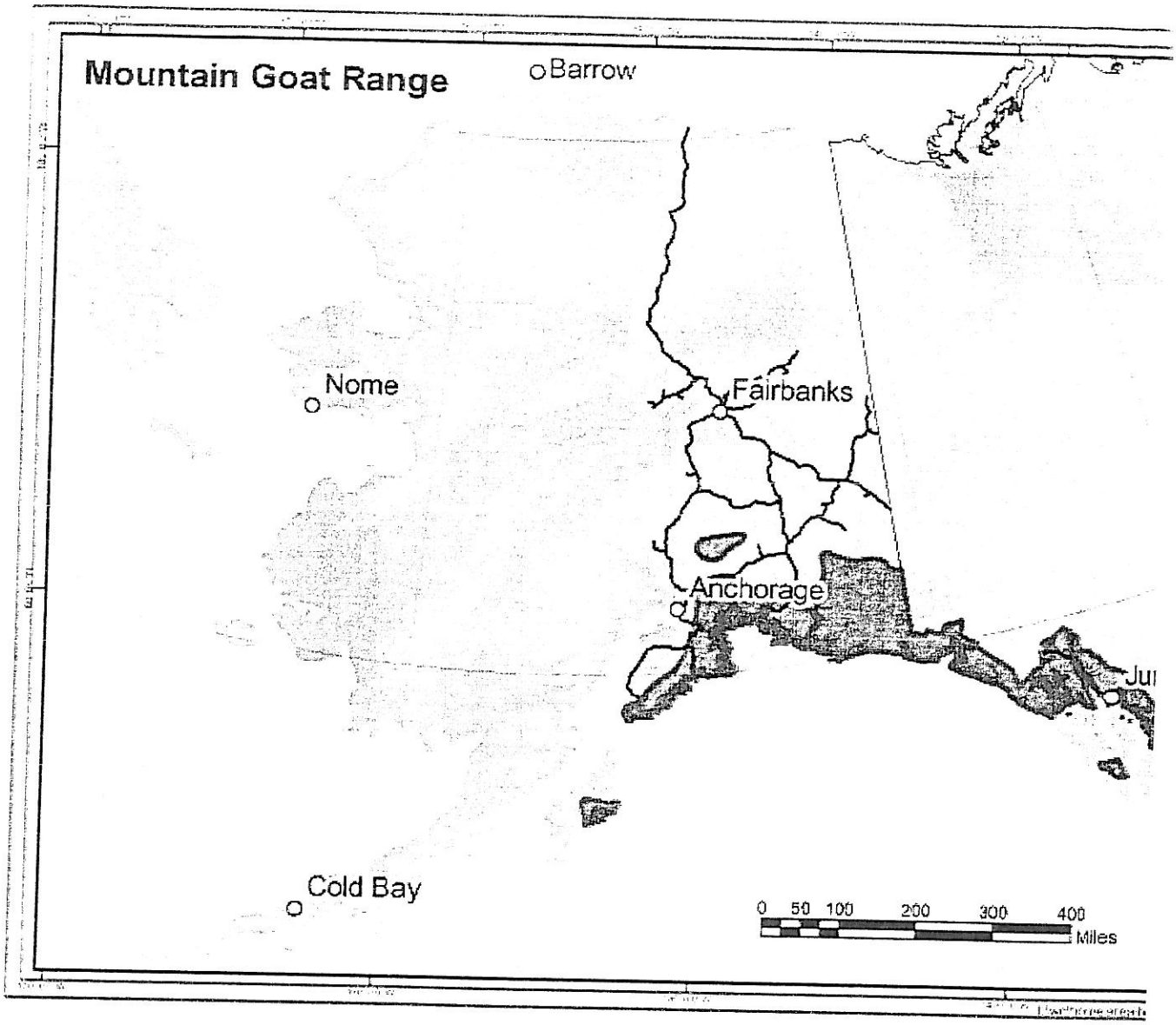

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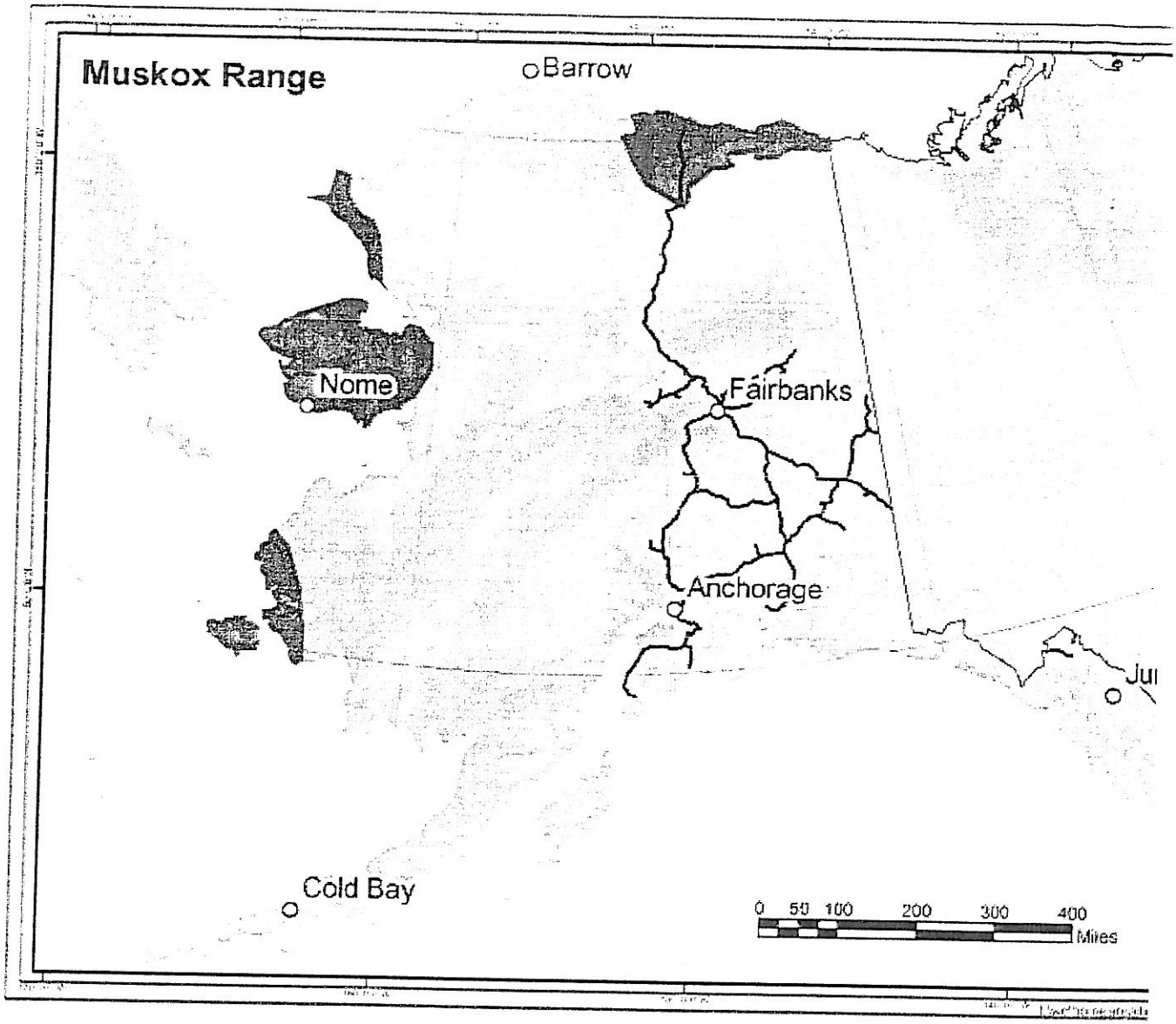
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Barrow
Nome
Fairbanks
Anchorage
Cold Bay
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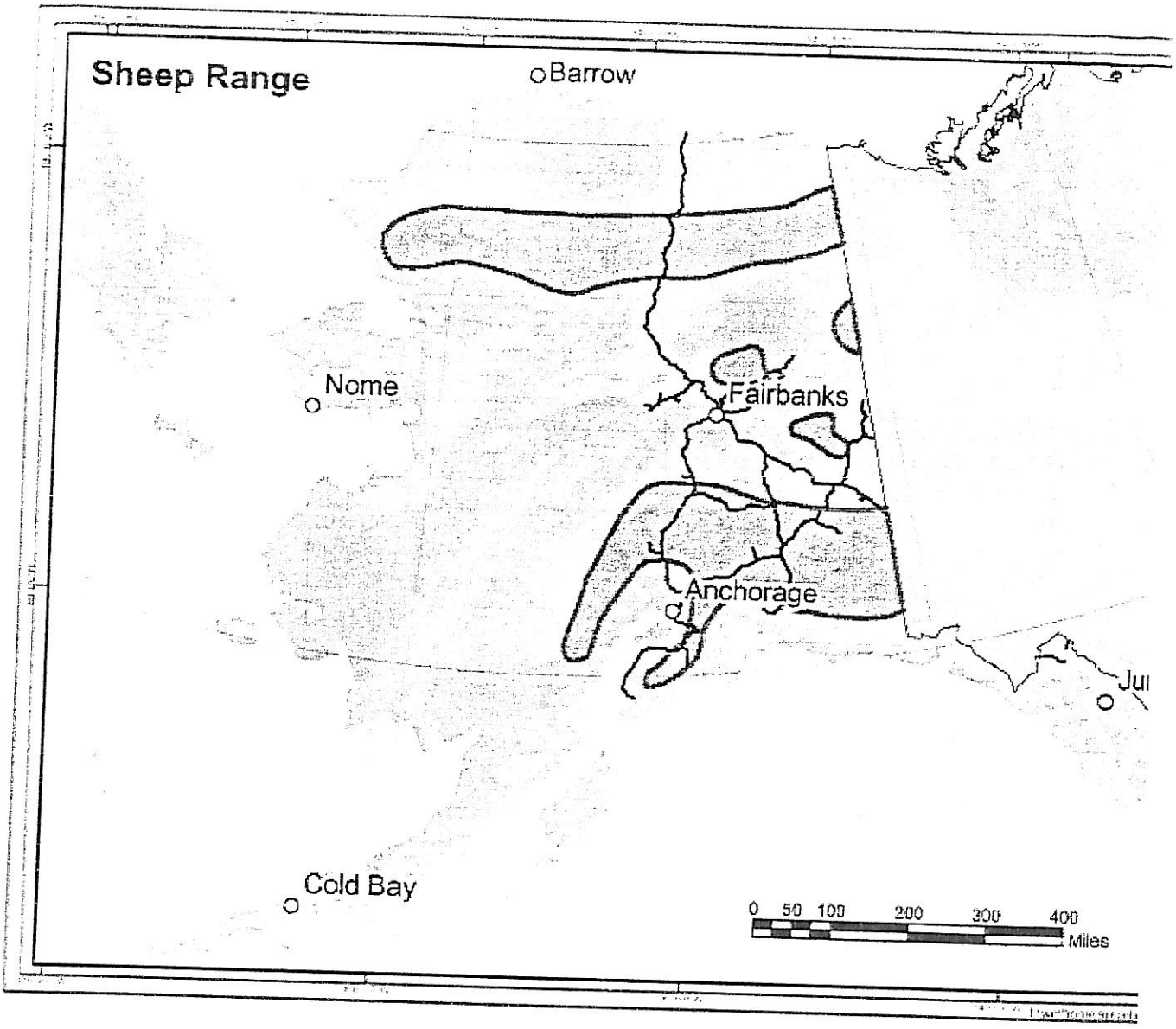
Miles



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12/6/2005

VEGETATION LEGEND

AId	CB	OWS/AId
AId 1	Grv	OWS/BES
AId 3	OBS	TD
AId 4	OBSWS	WGSB
BES	OMA	WSWdL
BES 1	OSB	
BESB	OSB/AId	
BSDS	OSB/Er	
BSWdl	OWB/Er-OWS	
BSWdl 2	OWS	

Sec.36
Sec.32
Sec.33
Sec.34
Sec.1
Sec.6
Sec.5
Sec.4
Sec.3
Sec.12
Sec.7
Sec.8
Sec.9
Sec.10
Sec.13
Sec.18
Sec.17
Sec.16
Sec.15
Sec.24
Sec.19
Sec.20
Sec.21
Sec.22
Sec.25
Sec.30
Sec.29
Sec.28
Sec.27

STATE LAND
UNIVERSITY LAND
ILO-LANDS
STATE LAND
SCHOOL LAND

JUMBO DOME MINING AREA
75,000,000 TONS
OVERALL RATIO @ 2:1

4-Seam Sample Site
3-Seam Sample Site

JUMBO DOME HAUL ROAD
(PROPOSED CENTERLINE)
5.5± Miles To Mining Area

CUT~4,661,000 Bank Cu.Yds.
FILL~4,776,000 Cu.Yds.

MID CUT
404,000 TONS @ 3.2:1 RATIO
(6-SEAM @ 23,000 TONS)
(4-SEAM @ 381,000 TONS)

EAST CUT
205,000 TONS @ 4.6:1 RATIO
(6-SEAM)

WEST CUT
510,000 TONS @ 2:1 RATIO
(4-SEAM @ 236,000 TONS)
(3-SEAM @ 274,000 TONS)

Bridge-5

Sec.36

Sec.31

Sec.32

Sec.33

Sec.34

STATE LAND

UNIVERSITY LAND

JUMBO DOME MINING AREA

75,000,000 TONS

OVERALL RATIO @ 2:1

4-Seam Sample Site

3-Seam Sample Site

Sec.1

Sec.6

Sec.5

Sec.4

Sec.3

TLO-LANDS

STATE LAND

Sec.12

Sec.7

Sec.8

Sec.9

Sec.10

Sec.13

Sec.18

Sec.17

JUMBO DOME HAUL ROAD

(PROPOSED CENTERLINE)

5.5± Miles To Mining Area

CUT~4,661,000 Bank Cu.Yds.

FILL~4,776,000 Cu.Yds.

Sec.16

Sec.15

Sec.24

Sec.19

Sec.20

Sec.21

Sec.22

Sec.25

Sec.30

Sec.29

Sec.28

Sec.27

MID CUT

404,000 TONS @ 3.2:1 RATIO

(6-SEAM @ 23,000 TONS)

(4-SEAM @ 381,000 TONS)

EAST CUT

205,000 TONS @ 4.6:1 RATIO

(6-SEAM)

WEST CUT

510,000 TONS @ 2:1 RATIO

(4-SEAM @ 236,000 TONS)

(3-SEAM @ 274,000 TONS)

Bridge-5

SCHOOL LAND

APPENDIX CVIII-2

JUMBO DOME ACCESS ROAD WETLAND MAPPING REVISIONS

Jumbo Dome Access Road
Wetland Mapping Revisions
March 2010

Prepared for: Usibelli Coal Mine, Inc.; PO Box 1000; Healy, Alaska 99743
Prepared by: HDR Alaska, Inc.; 2525 C Street, Suite 305; Anchorage, Alaska 99503

HDR Alaska, Inc (HDR) has completed a Wetland Report (HDR 2010a) and Vegetation Report (HDR 2010b) for the proposed Jumbo Dome Mine impact area, covering approximately 1,200 acres. A proposed mine access road corridor has been identified connecting the mine area to Healy Spur Road to the south. Travis/Peterson Environmental Consulting, Inc. (TPECI) performed a preliminary wetland delineation and vegetation survey of the road corridor in 2005 (TPECI 2005). The attached "2005 Wetland Mapping" figure shows the extent of the TPECI wetland mapping.

After completion of the HDR wetland and vegetation mapping in 2010, the wetland boundaries were compared to the TPECI wetland boundaries in the small section where they overlap. This resulted in a discovery of several discrepancies between the two studies. The HDR reports were completed in 2010 using recent aerial photography, topography, and the 2007 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Regional Supplement; USACE 2007). Therefore, the HDR wetland and vegetation boundaries are determined to supersede the previous mapping effort.

Since inconsistencies surfaced during the comparison of the two mapping studies, HDR wetland scientists mapped the remainder of the road corridor using the new aerial photography, topography, and field data collected using the Regional Supplement. This effort led to revisions to TPECI's wetland mapping in the mile long extent south of the Jumbo Dome Mine area. The purpose of this memorandum is to address these areas and provide wetland mapping revisions to the road corridor previously mapped by TPECI. The attached figures show the previous TPECI wetland mapping and the revisions done in 2011.

TPECI collected data at 7 locations in the area (Table 1). The majority of the data agrees with the HDR mapping revisions. Three of the TPECI data points (JDRC-027, JDRC-028, and JDRC-031) occur in wetland areas adjacent to 2 stream channels. These areas are both mapped as wetland by TPECI and HDR. However, the boundaries are slightly different. This can be attributed to the newer aerial photography and the contour lines which allow for a clear distinction between upland and wetland areas.

Table 1. TPECI Data Points

Plot No.	Wetland Status	Agree with HDR Mapping Revisions
JDRC-015	Upland	Yes
JDRC-016	Wetland	No
JDRC-026	Wetland	No
JDRC-027	Wetland	Yes
JDRC-028	Wetland	Yes
JDRC-029	Upland	Yes
JDRC-031	Wetland	Yes

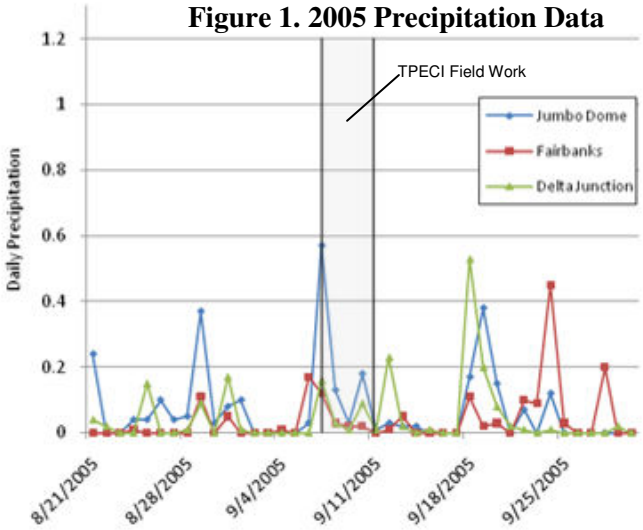
The two upland field data plots collected by TPECI (JDRC-015 and JDRC-029) also agree with the HDR revised mapping.

The remaining two plots, JDRC-016 and JDRC-026 do not agree with the HDR revised road corridor mapping. These data forms are included as an attachment to this memorandum.

Plot JDRC-016 is located on steep topography and is likely the result of GPS uncertainty. Due to the steep topography of the valley, it is likely that the point is actually located on a flat area on the top of the hillside in a wetland approximately 140 feet to the west. TPECI has mapped the entire west side of the Marguerite Creek tributary Valley as wetland, which HDR is revising to upland. The edges of the valley are very steep (averaging a 40% slope) and bare ground is visible in the aerial photography. This makes it highly unlikely to be wetland. There is also a road through the delineated wetland that has substantial cut and fill slopes visible on the aerial photography.

The plot JDRC-016 data form was completed using the 1987 Corps of Engineers Manual and is marked as having hydrophytic vegetation, wetland hydrology, and hydric soils. The data form was revaluated using the Regional Supplement. It was confirmed to meet both the dominance test (83%) and prevalence index (2.8) for hydrophytic vegetation. There was saturation at 3.5 inches (9 cm) meeting the wetland hydrology criteria. It is important to note that there was substantial rainfall (0.6 inches) on the day before they collected the JDRC-016 data. Figure 1 shows the daily precipitation from the Jumbo Dome rain gage as well as precipitation data from Farbanks and Delta Junction for the fieldwork timeframe. The soil indicators marked were "Histosol" and "Gleyed or Low-Chromo Colors". According to the soil profile description, the soil was composed of 7.5 inches (19 cm) of organic material. This would not meet the criteria for histosol and is a marginal histic epipedon, which requires accumulation of at least 8 inches of organics. The soil does meet the 1987 requirements for gleyed or low-chroma colors, however there is no corresponding indicator in the Regional Supplement. Technically, the soil does not meet any indicator in the Regional Supplement. However, it is assumed that this plot is likely on or near a wetland boundary because the accumulation of organic material is very close to 8 inches. The fact that this plot is likely on or near a wetland boundary and is located in an area of steep topography has led to the conclusion that wetlands exist on a flatter area upslope.

Figure 1. 2005 Precipitation Data



The other plot that disagrees with the revised wetland boundaries is JDRC-026. This plot is on a 15% slope (documented by TPECI and verified with existing contours) between the road and a tributary to Marguerite Creek. The 1987 data form completed by TPECI shows the area as having hydrophytic vegetation, wetland hydrology, and hydric soils. The vegetation is hydrophytic according to both the dominance test (75%) and the prevalence index (2.7). The plot was marked as saturated in the upper 12 inches; however the actual depth of saturation was not recorded. Rainfall records show that 0.2 inches of rain fell on the same day as this data was collected. The hydric soil indicators marked are "Aquic Moisture Regime" and "Gleyed or Low-Chroma Colors". As the soil horizons are described on the data sheet, no hydric soil indicators are met for the Regional Supplement. The 1987 indicator "Aquic Moisture Regime does not occur in the 2007 Regional Supplement and no other hydric soil indicaor applies. The soil horizons described do not actually meet the 1987 criteria for "Gleyed or Low-Chroma Colors". This indicator requires the soil to be on the gley page or have a chroma below 2. All of the horizons have a chroma of 3 or higher and none of them are on the gley page. In fact, most of the layers are brightly colored. Since this plot is located on a steep slope, has no hydric soil indicators (according to the Regional Supplement) and was collected during a period of high rainfall, the plot is determined to be upland. This revises the area of wetland previously mapped by TPECI, changing the wetland status of the entire south slope of the Marguerite Valley tributary. See attached figures for example of the mapping differences.

The two attached figures show the 2005 wetland mapping and the revisions made by HDR in 2011. The total road corridor mapping area, not counting area mapped by HDR in 2010 is 709.4. The mapping revisions have reduced wetland area by 49.6 acres. The table below shows the difference in wetland and upland acreage between the mapping done with 1987 Corps Manual and the Regional Supplement.

Table 2. Mapping Area Revisions

Mapped Type	2011 HDR Mapping	2005 TPECI Mapping
Wetland	39.7	89.3
Upland	669.7	620.1

References

HDR Alaska, Inc. 2010a. SMCRA Permit Application Chapter XI. Wetland Report. Prepared for Usibelli Coal Mine, Inc. December 2010.

HDR Alaska, Inc. 2010b. SMCRA Permit Application Chapter VIII. Vegetation Report. Prepared for Usibelli Coal Mine, Inc. December 2010.

Travis/Peterson Environmental Consulting, Inc. 2005. Jumbo Dome Road Corridor Preliminary Wetland Delineation and Vegetation Survey. Prepared for Usibelli Coal Mine, Inc. December 2005.

U.S Army Corps of Engineers (USACE). 2007. Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Alaska Region. Vicksburg, MS.

U.S. Army Corps of Engineers Environmental Laboratory (USACE) 1995. Corps of Engineers Wetlands Delineation Manual. Vicksburg, MS.

LEGEND

- 2010 HDR Field Data Points
- 2005 T/P Field Data Points
- Jumbo Dome Mine Mapping Area
- Access Road Mapping Area
- Proposed Access Road Footprint
- 2005 Mapped Wetland

500 250 0 500 1,000 1,500 2,000 Ft.

N

SUBJECT REVISIONS

REV.	DATE:	BY:	DESCRIPTION
1	02/11	JSS	ORIGINAL SUBMITTAL

DESIGN BY:

DRAWN BY: J. Schively, HDR

CHECK BY:

DWG FILE:

DATE DRAWN: FEB. 21, 2011

JUMBO DOME MINE

PERMIT NUMBER

ACCESS ROAD
2005 WETLAND MAPPING

JUMBO DOME MINE

USIBELLI COAL MINE, INC.
P.O. BOX 1000, HEALY, ALASKA 99743
(907) 683-2226

PLATE No. XXX

SHEET No. 1 OF 1

REV. 1

MAPPING CODE | **DESCRIPTION**

PEM1A	Temporarily Flooded Emergent Wetland
PEM1C	Semi-Permanently Flooded Emergent Wetland
PEM1F	Semi-Permanently Flooded Emergent Wetland
PSS1A	Temporarily Flooded Broadleaf Scrub-Shrub Wetland
PSS1B	Saturated Broadleaf Scrub-Shrub Wetland
PSS1C	Seasonally Flooded Broadleaf Scrub-Shrub Wetland
PSS1/4B	Saturated Broadleaf/Needleleaf Scrub-Shrub Wetland
PSS1/EM1B	Saturated Broadleaf Scrub-Shrub/Emergent Wetland
PSS1/EM1C	Seasonally Flooded Broadleaf Scrub-Shrub/Emergent Wetland
PSS3/4B	Saturated Broadleaf/Needleleaf Evergreen Scrub-Shrub Wetland
PSS4/EM1B	Saturated Needleleaf Scrub-Shrub/Emergent Wetland
R3UBH	Open Water (Stream)

LEGEND

- 2010 HDR Field Data Points
- 2005 T/P Field Data Points
- Jumbo Dome Mine Mapping Area
- Access Road Mapping Area
- Proposed Access Road Footprint
- Wetlands
- Water Bodies

MAP NOTES:

1. Wetland Mapping prepared by HDR Alaska, Inc. using field data from earlier Usibelli studies, aerial photograph interpretation, and a HDR field visit during September 2010.

500 250 0 500 1,000 1,500 2,000 Ft.

N

SUBJECT REVISIONS

REV.	DATE:	BY:	DESCRIPTION
1	02/11	JSS	ORIGINAL SUBMITTAL

DESIGN BY:

DRAWN BY: J. Schively, HDR

CHECK BY:

DWG FILE:

DATE DRAWN: FEB. 21, 2011

JUMBO DOME MINE

PERMIT NUMBER

USIBELLI COAL MINE, INC.

ACCESS ROAD REVISED WETLAND MAPPING

JUMBO DOME MINE

USIBELLI COAL MINE, INC.
P.O. BOX 1000, HEALY, ALASKA 99743
(907) 683-2226

PLATE No. XXX

SHEET No. 1 OF 1

REV. 1

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Jumbo Dome Road Corridor Applicant/Owner: Usibelli Coal Mine Investigator: E.C. Packee Jr PhD C.L. Ping PhD	Date: 8 SEPT 05 County: State: AK
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: BSDS Transect ID: JDRC Plot ID: 016

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Carex bigelowii	H	FAC	9. Picea mariana	T	FACW
2. Ledum groenland	H	FACW	10. Picea glauca	T	FACU
3. Vaccinium uliginosum	H	FAC	11.		
4. Vaccinium vitis-idea	H	FAC	12.		
5. Empetrum nigrum	H	FAC	13.		
6. Ledum pal. decumb.	H	FACW	14.		
7. Betula nana	S	FAC	15.		
8. Salix glauca	S	FAC	16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 90%

Remarks: Hydrophytic vegetation indicated

HYDROLOGY

___ Recorded Data (Describe in Remarks): ___ Stream, Lake, or Tide Gauge ___ Aerial Photographs ___ Other X No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: X Inundated X Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands Secondary Indicators (2 or more required): ___ Oxidized Root Channels in Upper 12 Inches ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Field Observations: Depth of Surface Water: 0-1 (in.) Depth to Free Water in Pit: _____ (in.) Depth to Saturated Soil: 9cm ~~(in.)~~	

Remarks: ~~Hydrophytic~~ WETLAND Hydrology indicated

SOILS

Map Unit Name (Series and Phase): Histic Cryaquept

Drainage Class: poor

Taxonomy (Subgroup): _____

Field Observations Confirm Mapped Type? Yes No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
cm					
0-9	Oe	7.5YR 3/2			peaty muck
9-19	Oa	7.5YR 2.5/1			muck
19-45	Bw	10YR 4/3			muck
45-70	Bg	2.5YR 4/1	10YR 4/4	common p	fine sandy loam
70-100	C				gravelly sandy loam

Hydric Soil Indicators:

- [X] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Aquic Moisture Regime
- [ ] Reducing Conditions
- [X] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic Content in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (Explain in Remarks)

Remarks: Hydric soils indicated

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Jumbo Dome Road Corridor Applicant/Owner: USIBELLI COAL MINE Investigator: E.C. Packee Jr. PhD C.L. Ping PhD	Date: 10 SEP 05 County: _____ State: AK
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: BSwdC Transect ID: JDRC. Plot ID: S26

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Ledum palustre decum	H	FACW	9. Picea glauca	S	FACU
2. Vaccinium uliginosum	H	FAC	10.		
3. Vaccinium vitis-idea	H	FAC	11.		
4. Empetrum nigrum	H	FAC	12.		
5. Betula nana	S	FAC	13.		
6. Salix pulchra	S	FACW	14.		
7. Picea mariana	T	FACW	15.		
8. Picea glauca	T	FACU	16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 47%

Remarks: Hydrophytic vegetation indicated

HYDROLOGY

___ Recorded Data (Describe in Remarks): ___ Stream, Lake, or Tide Gauge ___ Aerial Photographs ___ Other ✓ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated ✓ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands Secondary Indicators (2 or more required): ___ Oxidized Root Channels in Upper 12 Inches ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Field Observations: Depth of Surface Water: _____(in.) Depth to Free Water in Pit: _____(in.) Depth to Saturated Soil: _____(in.)	

Remarks: Wetland hydrology indicated.

SOILS

Map Unit Name (Series and Phase): _____ Drainage Class: somewhat poor

Taxonomy (Subgroup): Typic Cryaquept Field Observations Confirm Mapped Type? Yes No

Profile Description:

Depth (inches) cm	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	Oi	~~10YR~~			litter
2-6	Oa	10YR 2/2			muck
6-19	Bw	10YR 5/4	10YR 5/6	30%	sandy loam
19-23	~~Bw~~	10YR 3/3			sandy loam
23-55	~~Bw~~	10YR 4/6			
55-82	BC	2.5Y 6/4			
82-105	Ab	10YR 4/3			

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- X Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: Hydric Soils indicated Soil Pit U-28

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

Is this Sampling Point Within a Wetland? (Circle) (Yes) No

Remarks:

Approved by HQUSACE 3/92

APPENDIX CVIII-3

WETLAND FUNCTIONAL ASSESSMENT, JUMBO DOME MINE ACCESS ROAD

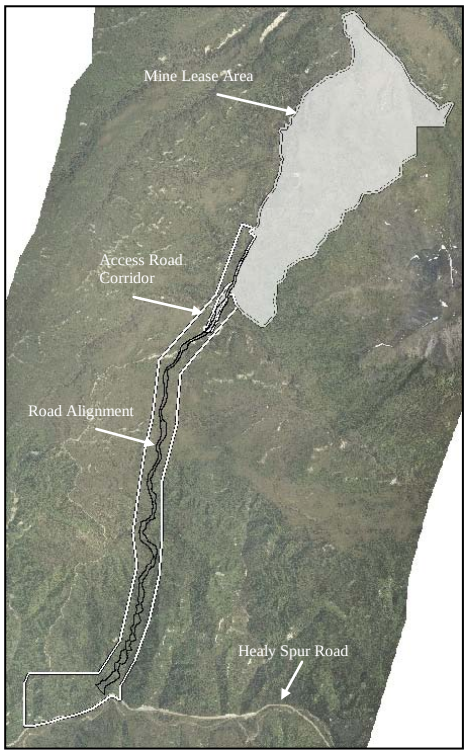
Wetland Functional Assessment
Jumbo Dome Mine Access Road
Healy, AK

March 2011

Usibelli Coal Mine, Inc.
100 Cushman St, Suite 210
Fairbanks, Alaska 99701

1.0 INTRODUCTION AND PURPOSE

The purpose of this document is to describe the primary hydrologic and ecological functions of wetlands and waters mapped within the proposed Usibelli Coal Mine (UCM) Jumbo Dome Mine Access Road Corridor (road corridor) near Healy, Alaska. The road corridor encompasses approximately 654 acres and will provide access from Healy Spur Road, north to the Jumbo Dome Mine lease area (Inset 1).



Initial wetland and stream mapping with field data collection was produced for the road corridor in 2005 by Travis/Peterson Environmental Consulting, Inc. A review of the mapping was conducted in 2011 by HDR Alaska, Inc. The findings of the review were discussed in a meeting with the U.S. Army Corps of Engineers (USACE) and it was determined that the mapping needed revision. HDR Alaska, Inc., produced revised office-based wetland and stream mapping and described the conclusions in a memorandum dated February 25, 2011. The wetland types within the road corridor are similar to those present within the mine lease area, which are described in further detail in the Wetland Delineation Report (Chapter XI) prepared for UCM's Surface Mining Control and Reclamation Act (SMCRA) permit application. This wetland functional assessment is intended to support the Section 404 permit review process by providing information regarding the physical and ecological functions of wetlands and waters within the road corridor.

Wetland functions are defined as the chemical, physical, and biological processes or attributes that contribute to the self-maintenance of a wetland and relate to the ecological significance of wetland properties without regard to subjective human values (American Society for Testing and Materials 1999). Not all wetlands perform all functions, nor do they perform all functions to the same extent. For example, a wetland's geographic location may determine its habitat functions, and the location of a wetland within a watershed may determine its hydrologic or water quality functions. The principal factors that determine how a wetland performs these functions are climatic conditions, quantity and quality of water entering and leaving the wetland, and disturbances or alteration within the wetland or the surrounding ecosystem (Novitzki et al. 1997). This report is a qualitative assessment of how the road corridor wetlands perform a set of ecological functions, and is intended to support the permitting process.

2.0 METHODS

In accordance with the 2009 USACE Regulatory Guidance Letter (RGL) No. 09-01, wetlands and waters were assessed to determine potential functional capacity for ten functions. The following functions were evaluated:

- Flood Flow Alteration
- Sediment Removal
- Nutrient and Toxicant Removal
- Erosion Control and Shoreline Stabilization
- Production of Organic Matter and its Export
- General Habitat Suitability
- General Fish Habitat
- Native Plant Richness
- Educational or Scientific Value
- Uniqueness and Heritage

The revised mapping provided with the 2011 memorandum served as the basis for this assessment. The purpose of the revised mapping was to delineate and describe the extent and types of wetlands and waters under USACE jurisdiction found within the road corridor. Project design, alternatives, wetland functions, and impacts were not discussed. The revised mapping was an office-based effort, but also considered the information presented in the 2005 wetland delineation report for the road corridor and the 2010 wetland delineation report for the adjacent mine area. Mapped wetlands were assigned National Wetland Inventory (NWI) mapping codes based on the U.S. Fish and Wildlife Service Classification of Wetlands and Waterbodies (Cowardin et al. 1979).

For this functional assessment, wetland scientists used mapping for the road corridor and data from the other reports to identify physical features that contribute to the performance of certain functions, and others that indicate certain functions do not occur. Examples of such indicators include the wetland's location relative to streams, the wetland's vegetation type, the amount of open water present, and the wetland's topographic position and location in the watershed. For each wetland type, scientists then subjectively considered these indicators and observations in specific wetlands to complete the "Wetland Function Data Form – Alaska Regulatory Best Professional Judgment Characterization" questionnaire included in the USACE RGL No. 09-01.

Wetland data sheets, site photographs, GIS data layers, and other project-related studies were used to help fill out each function data form and identify indicators of wetland function. The completed data forms are included in Appendix A. To further support the wetland permitting process, and as described in USACE RGL No. 09-01, wetlands and waters were then categorized into the following categories: Category I, II, III, and IV. Figure 1, also included in Appendix A, shows the location and categories of the identified wetlands and waters.

Category I – High functioning wetlands
These wetlands are the "cream of the crop". Generally, these wetlands are less common. These are wetlands that: 1) provide a life support function for threatened or endangered species that has been documented; 2) represent a high quality example of a rare wetland type; 3) are rare within a given region; or 4) are undisturbed and contain ecological attributes that are impossible or difficult to replace within a human lifetime, if at all. Examples of the latter are mature forested wetlands that may take a century to develop, and certain bogs and fens with their special plant populations that have taken centuries to develop. The position of the wetland in the landscape plays an integral role in overall watershed health.

Category II – High to moderate functioning wetlands
These wetlands are those that: 1) provide habitat for very sensitive or important wildlife or plants; 2) are either difficult to replace (such as bogs); or 3) provide very high functions, particularly for wildlife habitat. These wetlands occur more commonly than Category I wetlands, but still need a high level of protection.

Category III –Moderate to low functioning wetlands
These wetlands can provide important functions and values. They can be important for a variety of wildlife species and can provide watershed protection functions depending on where they are located. Generally these wetlands will be smaller and/or less diverse in the landscape than Category II wetlands. These wetlands usually have experienced some form of degradation, but to a lesser degree than Category IV wetlands.

Category IV – Degraded and low functioning wetlands
These wetlands are the smallest, most isolated, have the least diverse vegetation, may contain invasive species, and have been degraded by humankind. These are wetlands that we should be able to replace and, in some cases, be able to improve from a habitat standpoint. These wetlands can provide important habitat functions and values, and should to some degree be protected depending on where they are located in the watershed and the condition of that watershed (urban vs. rural). In some areas, these wetlands may be providing groundwater recharge and water pollution prevention functions and, therefore, may be more important from a local point of view. Thus, regional differences may call for a more narrow definition of this category.

3.0 SUMMARY OF WETLAND FUNCTIONS

Vegetation type, knowledge of hydrological inputs and outputs, wildlife information, and topographic settings were used to complete the Wetlands Functions Data Forms and assess functions for each wetland type. The following sections describe the scores that each received. Completed data forms are included in Appendix A. The "Score" column of each table below shows the number of indicators the wetland type has relative to the total number of possible indicators.

3.1 Deciduous Scrub-Shrub Wetlands

Deciduous scrub-shrub wetlands are the most common wetland type in the road corridor, covering approximately 38.7 acres. Their general lack of significant hydrological features prevented them from otherwise scoring higher, but functional capacities may be higher in limited areas with more active hydrology. However, scrub-shrub deciduous wetlands within the road corridor still play important roles in the local ecosystem, as seen in the "Moderate" scores for six of the functions. Table 1 shows the scores that deciduous scrub-shrub wetlands received for each function.

Table 1. Estimated Wetland Functions for Deciduous Scrub-Shrub Wetlands

Function	Score	Estimated Capacity for Performing Function
Flood Flow Alteration	4 (of 7)	Moderate
Sediment Removal	1 (of 6)	Moderate
Nutrient and Toxicant Removal	2 (of 5)	Moderate
Erosion Control and Shoreline Stabilization	0 (of 3)	Low
Production of Organic Matter and its Export	3 (of 6)	Moderate
General Habitat Suitability	4 (of 7)	Moderate
General Fish Habitat	0 (of 6)	Low
Native Plant Richness	2 (of 4)	Moderate
Educational or Scientific Value	0 (of 3)	Low
Uniqueness and Heritage	0 (of 5)	Low

3.2 Streams and Adjacent Wetlands

There are approximately 20,938 linear feet (4.0 miles) of ephemeral streams in the project area. These streams are fed largely by groundwater discharge into wetlands as well as by surface water from precipitation and snowmelt. The wetlands adjacent to these streams filter water as it enters these streams, likely removing sediments and toxicants; while the streams themselves carry nutrients further down in the

watershed. Using guidance from the U.S. Fish and Wildlife Service developed for Interior Alaska, it was determined that these processes generally occur in a buffer zone of 15-20 meters around streams. As such, all wetlands within 20 meters of streams were considered "adjacent wetlands" and included in this category. All streams and their adjacent wetlands scored "Moderate" to "High" in all but one of the functions. Marguerite Creek, a perennial stream located at the northern end of the road corridor, would be crossed by the proposed road to the mine. As such, approximately 2.81 acres of open water is present within the mapped area. Marguerite Creek is not listed as an anadromous water in the Alaska Department of Fish and Game Anadromous Waters Catalogue, but is reported to have resident fish such as sculpin (*Cottus sp.*) and arctic grayling (*Thymallus arcticus*). Table 2 shows the scores that these areas received for each function.

Table 2. Estimated Wetland Functions for Streams and Adjacent Wetlands

Function	Score	Estimated Capacity for Performing Function
Flood Flow Alteration	3 (of 7)	Moderate
Sediment Removal	4 (of 6)	High
Nutrient and Toxicant Removal	3 (of 5)	High
Erosion Control and Shoreline Stabilization	3 (of 3)	High
Production of Organic Matter and its Export	5 (of 6)	High
General Habitat Suitability	5 (of 7)	High
General Fish Habitat	2 (of 6)	Moderate
Native Plant Richness	3 (of 4)	High
Educational or Scientific Value	0 (of 3)	Low
Uniqueness and Heritage	1 (of 5)	Moderate

4.0 RESULTS

A total of 38.7 acres of scrub-shrub deciduous wetlands were evaluated for their contributions to the ecosystem of the Jumbo Dome Mine area. These wetlands fell into one general National Wetland Inventory (NWI) type that was evaluated for its potential capacity to perform wetland functions. Non-wetland areas within the bed of ephemeral streams (using an average stream width of 18 inches) totaling approximately 0.7 acres and 2.8 acres of open water of Marguerite Creek were also added to the evaluation. Table 3 shows the estimated acreages and categories of wetlands and waters within the road corridor.

As outlined in the USACE Alaska District RGL No. 09-01, the functional assessment scores (Tables 1 and 2) were used to support assigning the wetlands into the following categories:

Category I – High functioning wetlands
There are no Category I wetlands within the road corridor. All wetlands found within the road corridor are relatively common.

Category II – High to moderate functioning wetlands
The following wetlands within the road corridor are classified as Category II wetlands.

1) All wetlands within 20 meters of streams: Wetlands near drainage features are recommended for Category II because of their connectivity to the larger watershed and the stream-related functions they perform.

2) All ephemeral streams and open water. This includes the open water of Marguerite Creek and an estimated 18 inch bed width within all mapped ephemeral streams.

Approximately 15.6 acres of Category II wetlands adjacent to streams occur in the road corridor. An additional 3.5 acres of non-wetland, unvegetated ephemeral streams and open water of Marguerite Creek would also fall under Category II. See Table 4 for a breakdown of impacts to Category II wetlands from development of the current road alignment within the corridor.

Category III –Moderate to low functioning wetlands
All other wetlands identified are widespread throughout the road corridor and common in Interior Alaska. Therefore all wetlands that do not meet the requirements of Category II wetlands are recommended for inclusion in Category III.

Approximately 23.0 acres of Category III wetlands occur in the road corridor. See Table 4 for a breakdown of impacts to Category III wetlands from development of the current road alignment within the corridor.

Category IV – Degraded and low functioning wetlands
All wetlands in the road corridor are connected to expanses of generally undisturbed lands; therefore no Category IV wetlands were identified within the project area.

Table 3. Wetland and Stream Categories within Access Road Corridor

Category II Wetlands Adjacent to Streams (acres)	Category III Wetlands (acres)	Category II Ephemeral Streams (linear feet)	Category II Ephemeral Streams (acres)	Category II Perennial Stream Marguerite Creek (acres)
15.6	23.0	20,938	0.7	2.8

Summary of Impacts
In total, the development of the current road alignment within the Jumbo Dome Mine road corridor would impact approximately 3.0 acres of Category II and III wetlands, including 3,219 linear feet (0.6 miles) of ephemeral streams and 0.1 acre of Marguerite Creek. Approximately 2.1 acres of the affected wetlands or waters are Category II, which are high to moderate functioning. These include areas adjacent to streams and the streams themselves that perform important hydrologic and ecological functions. All other project area wetlands are undisturbed and types common throughout Interior Alaska, and are classified as Category III. The impact calculations also include impacts to areas of wetlands and streams that were delineated and assessed as part of the mine lease area that fall within the road alignment. Table 4 shows the impacts of the development of the current road alignment on both categories of wetlands and waters.

Table 4. Impacts to Wetlands and Stream Categories Based on Current Road Alignment

Category II Wetlands Adjacent to Streams (acres)	Category III Wetlands (acres)	Category II Ephemeral Streams (linear feet)	Category II Ephemeral Streams (acres)	Category II Perennial Stream Marguerite Creek (acres)
1.9	0.9	3,219	0.1	0.1

5.0 MITIGATION RATIO ANALYSIS

It is estimated that impacted wetlands would have both an overall "Low to Moderate" (Category III) and "Moderate to High" (Category II) functional capacity (Table 4). As such, per Alaska District RGL No. 09-01, the suggested mitigation ratio for preservation of wetlands would be 1.5:1 for Category III wetlands and 2:1 for Category II wetlands.

If UCM chooses to provide mitigation in the form of preservation for wetland impacts, either through an in-lieu fee provider or through permittee responsible mitigation, this would require 4.2 credits for Category II impacts (covering 2.1 acres of actual impact) and 1.4 credits for Category III impacts (covering 0.9 acres of actual impact). If UCM chooses to compensate for wetland impacts by restoring or enhancing existing wetlands (instead of preserving wetlands), then the required mitigation ratio would be 1:1 for both Category II and III wetlands for a total of 3.0 credits needed. See Table 5 for a breakdown of mitigation needs based on the type of mitigation performed.

Table 5. Mitigation Credits Needed by Mitigation Type

Mitigation Through Preservation			
Wetland/Water Impact Category	**Mitigation Ratio**	**Acres of Impact**	**Total Credits Needed**
Category II	2 to 1	2.1	4.2
Category III	1.5 to 1	0.9	1.4
Total		**3.0**	**5.6**
Mitigation Through Restoration/Enhancement			
Wetland/Water Impact Category	**Mitigation Ratio**	**Acres of Impact**	**Total Credits Needed**
Category II	1 to 1	2.1	2.1
Category III	1 to 1	0.9	0.9
Total		**3.0**	**3.0**

6.0 REFERENCES

2005. Jumbo Dome Road Corridor Preliminary Wetland Delineation and Vegetation Survey. Prepared by Travis Peterson Environmental Consulting, Inc. Fairbanks, Alaska. Prepared for Usibelli Coal Mine, Inc. Fairbanks, Alaska.

2009. U.S. Army Corps of Engineers Alaska District. Alaska District Regulatory Guidance Letter RGL ID No. 09-01.

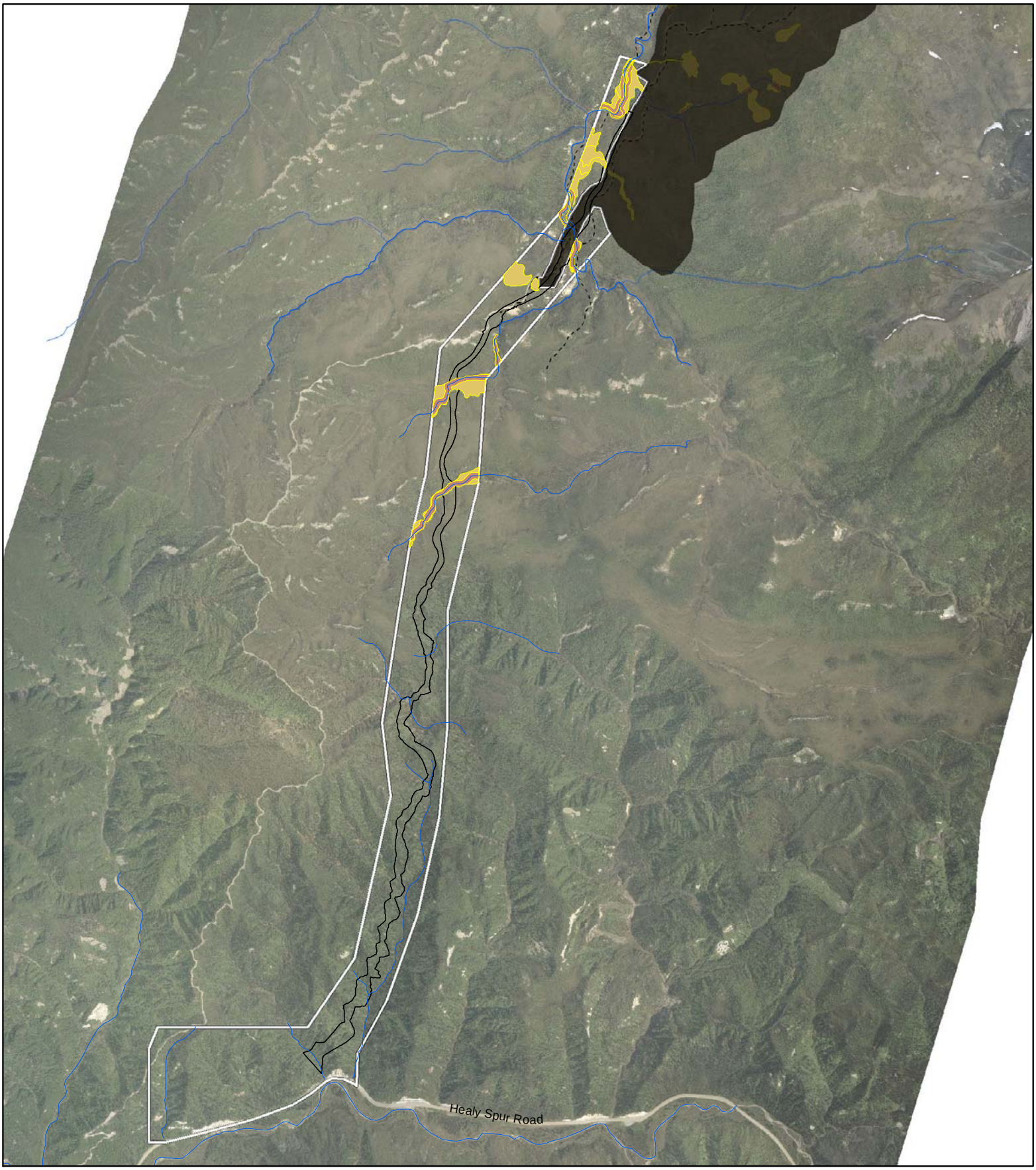
2010. Jumbo Dome Mine Wetland Delineation Report. Usibelli Coal Mine. Fairbanks, Alaska.

2011. Jumbo Dome Road Mapping Revision Memorandum. Prepared by HDR Alaska, Inc. Anchorage, Alaska. Prepared for Usibelli Coal Mine, Inc. Fairbanks, Alaska.

2011. Alaska Department of Fish and Game Anadromous Waters Catalogue. http://www.adfg.alaska.gov/index.cfm?adfg=maps.interactive

APPENDIX A

FIGURE 1 AND WETLAND FUNCTION DATA FORMS



Wetland Functional Categories

MAP NOTES:

1. Functional Categories were assigned to wetlands using guidance from the U.S. Army Corps of Engineers Alaska District Regulatory Guidance Letter ID No. 09-01.
2. Wetland mapping prepared by HDR Alaska, Inc. using field data from earlier Usibelli studies, aerial photograph interpretation, and a HDR field visit to the Mine Area during September 2010.

N

Feet

0 1,000 2,000 3,000

Legend

- Previous Mine Lease Area Wetland Mapping and Functional Assessment Area
- Current Road Alignment
- Road Corridor Mapping and Functional Assessment Area
- Streams

Wetland Functional Category

- II
- III

Jumbo Dome Mine Access Road Corridor
Usibelli Coal Mine, Inc.
March 2011

Wetland Functions Data Form-Alaska Regulatory Best Professional Judgment Characterization
*****This is an example. Best professional judgment should be used on each specific site*****

File #: Jumbo Dome Access Road Date: 03-11-2011

Wetland Name: Broadleaf scrub/shrub wetlands (PSS1) PM/RS: FA conducted by Zachary Halstead, HDR

A. Flood Flow Alteration (Storage and Desynchronization)	Likely or not likely to Provide (Y or N)
1. Wetland occurs in the upper portion of its watershed. 2. Wetland is relatively flat area and is capable of retaining higher volumes of water during storm events, than under normal rainfall conditions. 3. Wetland is a closed (depressional) system. 4. If flowthrough, wetland has constricted outlet with signs of fluctuating water levels, algal mats, and/or lodged debris. 5. Wetland has dense woody vegetation 6. Wetland receives floodwater from an adjacent water course 7. Floodwaters come as sheet flow rather than channel flow.	1. Yes 2. Yes, but marginal 3. No - generally open systems connected to non-RPW's & RPW 4. Yes - Seasonally flooded hydro regimes indicate fluctuating H_2O. 5. No 6. No 7. Yes - from snowmelt & precipitation from surrounding slopes 5 – 7 (Y) – High Function 1 – 4 (Y) – Moderate Function None - Low Function (4) Moderate
B. Sediment Removal	Likely or not likely to Provide (Y or N)
1. Sources of excess sediment (from tillage, mining or construction) are present upgradient of the wetland. 2. Slow-moving water and/or a deepwater habitat are present in the wetland. 3. Dense herbaceous vegetation is present. 4. Interspersion of vegetation and water is high in wetland. 5. Ponding of water occurs in the wetland. 6. Sediment deposits are present in wetland (observation or noted in application materials).	1. No 2. No 3. No - Dominated by shrubs. 4. No 5. Yes 6. No - Based on observations in mine area. 4 – 6 (Y) – High Function 1 - 3 (Y) – Moderate Function None – Low Function (1) Moderate

Note: e.g., for Flood Flow Alteration, answering yes to at least ~~3~~ 5 out of 7 attributes would rate the wetlands as high functioning; answering yes to 1, 2, 3, or 4 out of the 7 attributes would rate the wetland as moderate; and not answering yes to any of the 7 attributes would rate the wetland low for Flood Flow Alteration function.

(PSS1)

C. Nutrient and Toxicant Removal (important with high adjacent land use/industrial areas) 1. Sources of excess nutrients (fertilizers) and toxicants (pesticides and heavy metals) are present upgradient of the wetland. 2. Wetland is inundated or has indicators that flooding is a seasonal event during the growing season. 3. Wetland provides long duration for water detention. 4. Wetland has at least 30% aerial cover of live dense herbaceous vegetation. 5. Fine grained mineral or organic materials are present for the wetland (in wetland report).	Likely or not likely to Provide (Y or N) 1. No 2. Yes 3. Yes 4. No - Dominated by shrubs 5. No - Based on observations in mine area soil pits. 3 – 5 (Y) – High Function 1 - 2 (Y) – Moderate Function None – Low Function (2) Moderate
D. Erosion Control and Shoreline Stabilization *If associated with watercourse or shoreline* 1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion. 2. A herbaceous layer is part of this dense vegetation. 3. Trees and shrubs able to withstand erosive flood events are also part of this dense vegetation.	Likely or not likely to Provide (Y or N) 1. No - Areas along streams assessed seperately. 2. No - See above 3. No - See above 1-3 (Y) – High Function None – Low Function (None) Low
E. Production of Organic Matter and its Export 1. Wetland has at least 30% aerial cover of dense herbaceous vegetation. 2. Woody plants in wetland are mostly deciduous. 3. High degree of plant community structure, vegetation density, and species richness present. 4. Interspersion of vegetation and water is high in wetland. 5. Wetland is inundated or has indicators that flooding is a seasonal event during the growing season. 6. Wetland has outlet from which organic matter is flushed.**	Likely or not likely to Provide (Y or N) 1. No - Dominated by shrubs 2. Yes 3. No 4. No - Not that would export OM 5. Yes 6. Yes - most likely in a few locations 4 – 6 (Y) – High Function 1 - 3 (Y) – Moderate Function None – Low Function **If 6 is N, then automatically low function (3) Moderate
F. General Habitat Suitability 1. Wetland is not fragmented by development. 2. Upland surrounding wetland is undeveloped. 3. Wetland has connectivity with other habitat types. 4. Diversity of plant species is high. 5. Wetland has more than one Cowardin Class (i.e., PFO, PSS, PEM, POW, etc.) 6. Has high degree of Cowardin Class interspersion. 7. Evidence of wildlife use, e.g., tracks, scat, gnawed stumps, etc., is present.	Likely or not likely to Provide (Y or N) 1. Yes 2. Yes 3. Yes 4. No 5. Yes - generally 6. No 7. No - based on observations in mine area 5 – 7 (Y) – High Function 1 – 4 (Y) – Moderate Function None - Low Function (4) Moderate

(PSS1)

G. General Fish Habitat *Must be associated with a fish-bearing water* 1. Wetland has perennial or intermittent surface-water connection to a fish-bearing water body. 2. Wetland has sufficient size and depth of open water so as not to freeze completely during winter. 3. Observation of fish. 4. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter. 5. Spawning areas are present (aquatic vegetation and/or gravel beds.) 6. Juvenile rest areas	Likely or not likely to Provide (Y or N) 1. No 2. No 3. No – Based on mine area observations. 4. No 5. No 6. No 4 – 5 (Y) – High Function 1 - 3 (Y) – Moderate Function None – Low Function None Low
H. Native Plant Richness 1. Dominant and codominant plants are native. 2. Wetland contains two or more Cowardin Classes. 3. Wetland has three or more strata of vegetation. 4. Wetland has mature trees.	Likely or not likely to Provide (Y or N) 1. Yes 2. Yes - generally 3. No 4. No 3 - 4 (Y) – High Function 1 - 2 (Y) – Moderate Function None – Low Function 2 Moderate
I. Educational or Scientific Value 1. Site has documented scientific or educational use. 2. Wetland is in public ownership. 3. Accessible trails available.	Likely or not likely to Provide (Y or N) 1. No 2. No - controlled access 3. No - controlled access 2 - 3 (Y) – High Function 1 (Y) – Moderate Function None – Low Function
J. Uniqueness and Heritage 1. Wetland contains documented occurrence of a state or federally listed threatened or endangered species. 2. Wetland contains documented critical habitat, high quality ecosystems, or priority species respectively designated by the U.S. Fish and Wildlife Service 3. Wetland has biological, geological, or other features that are determined rare 4. Wetland has been determined significant because it provides functions scarce for the area. 5. Wetland is part of: an estuary, bog, or a mature forest.	Likely or not likely to Provide (Y or N) 1. No 2. No 3. No 4. No 5. No 3 – 5 (Y) – High Function 1 – 2 (Y) – Moderate Function None – Low Function None Low

Wetland Functions Data Form-Alaska Regulatory Best Professional Judgment Characterization
*****This is an example. Best professional judgment should be used on each specific site*****

File #: Jumbo Dome Access Road Date: 3-11-2011

Wetland Name: Wetlands w/in 20m (65') of ephemeral or perennial streams. PM/RS: FA conducted by Zachary Halstead, HDR

A. Flood Flow Alteration (Storage and Desynchronization)	Likely or not likely to Provide (Y or N)
1. Wetland occurs in the upper portion of its watershed. 2. Wetland is relatively flat area and is capable of retaining higher volumes of water during storm events, than under normal rainfall conditions. 3. Wetland is a closed (depressional) system. 4. If flowthrough, wetland has constricted outlet with signs of fluctuating water levels, algal mats, and/or lodged debris. 5. Wetland has dense woody vegetation 6. Wetland receives floodwater from an adjacent water course 7. Floodwaters come as sheet flow rather than channel flow.	1. Yes 2. No 3. No 4. No - outlets not constricted. 5. Yes - PSS dominated. 6. Yes 7. No - channeled flow 5 – 7 (Y) – High Function 1 – 4 (Y) – Moderate Function None - Low Function (3) Moderate
B. Sediment Removal	Likely or not likely to Provide (Y or N)
1. Sources of excess sediment (from tillage, mining or construction) are present upgradient of the wetland. 2. Slow-moving water and/or a deepwater habitat are present in the wetland. 3. Dense herbaceous vegetation is present. 4. Interspersion of vegetation and water is high in wetland. 5. Ponding of water occurs in the wetland. 6. Sediment deposits are present in wetland (observation or noted in application materials).	1. Yes - erosion forces of streams. 2. Yes - during flooding 3. No - dominated by shrubs. 4. No. 5. Yes - during flooding. 6. Yes - based on observations in mine area. 4 – 6 (Y) – High Function 1 - 3 (Y) – Moderate Function None – Low Function (4) High

Note: e.g., for Flood Flow Alteration, answering yes to at least 3 out of 7 attributes would rate the wetlands as high functioning; answering yes to 1, 2, 3, or 4 out of the 7 attributes would rate the wetland as moderate; and not answering yes to any of the 7 attributes would rate the wetland low for Flood Flow Alteration function.

(Streams and Nearby Wetlands)

C. Nutrient and Toxicant Removal (important with high adjacent land use/industrial areas) 1. Sources of excess nutrients (fertilizers) and toxicants (pesticides and heavy metals) are present upgradient of the wetland. 2. Wetland is inundated or has indicators that flooding is a seasonal event during the growing season. 3. Wetland provides long duration for water detention. 4. Wetland has at least 30% aerial cover of live dense herbaceous vegetation. 5. Fine grained mineral or organic materials are present for the wetland (in wetland report).	Likely or not likely to Provide (Y or N) 1. No 2. Yes - seasonal or temporarily flooded hydro regimes 3. Yes - in some areas 4. No - dominated by shrubs 5. Yes - based on observations in the mine area. 3 – 5 (Y) – High Function 1 - 2 (Y) – Moderate Function None – Low Function (3) High
D. Erosion Control and Shoreline Stabilization *If associated with watercourse or shoreline* 1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion. 2. A herbaceous layer is part of this dense vegetation. 3. Trees and shrubs able to withstand erosive flood events are also part of this dense vegetation.	Likely or not likely to Provide (Y or N) 1. Yes 2. Yes - in most locations 3. Yes - shrubs (3) 1-3 (Y) – High Function None – Low Function High
E. Production of Organic Matter and its Export 1. Wetland has at least 30% aerial cover of dense herbaceous vegetation. 2. Woody plants in wetland are mostly deciduous. 3. High degree of plant community structure, vegetation density, and species richness present. 4. Interspersion of vegetation and water is high in wetland. 5. Wetland is inundated or has indicators that flooding is a seasonal event during the growing season. 6. Wetland has outlet from which organic matter is flushed.**	Likely or not likely to Provide (Y or N) 1. Yes - most likely directly adjacent to streams 2. Yes - PSS1 3. Yes - most often varied along/adjacent to streams 4. No 5. Yes 6. Yes (5) 4 – 6 (Y) – High Function 1 - 3 (Y) – Moderate Function None – Low Function **If 6 is N, then automatically low function High
F. General Habitat Suitability 1. Wetland is not fragmented by development. 2. Upland surrounding wetland is undeveloped. 3. Wetland has connectivity with other habitat types. 4. Diversity of plant species is high. 5. Wetland has more than one Cowardin Class (i.e., PFO, PSS, PEM, POW, etc.) 6. Has high degree of Cowardin Class interspersion. 7. Evidence of wildlife use, e.g., tracks, scat, gnawed stumps, etc., is present.	Likely or not likely to Provide (Y or N) 1. Yes 2. Yes 3. Yes 4. Yes - most likely along/adjacent to streams 5. Yes - generally 6. No 7. No - based on observations in mine area (5) 5 – 7 (Y) – High Function 1 – 4 (Y) – Moderate Function None - Low Function High

(Streams & Nearby Wetlands)

G. General Fish Habitat *Must be associated with a fish-bearing water* 1. Wetland has perennial or intermittent surface-water connection to a fish-bearing water body. 2. Wetland has sufficient size and depth of open water so as not to freeze completely during winter. 3. Observation of fish. 4. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter. 5. Spawning areas are present (aquatic vegetation and/or gravel beds.) 6. Juvenile rest areas	Likely or not likely to Provide (Y or N) 1. Yes - flows into Marguarette Creek 2. No 3. No - based on observations in mine area 4. Yes - in PSS1A 5. No 6. No > based on observations in mine area 4 – 5 (Y) – High Function 1 - 3 (Y) – Moderate Function None – Low Function (2) Moderate
H. Native Plant Richness 1. Dominant and codominant plants are native. 2. Wetland contains two or more Cowardin Classes. 3. Wetland has three or more strata of vegetation. 4. Wetland has mature trees.	Likely or not likely to Provide (Y or N) 1. Yes 2. Yes - 3. Yes - most likely low + tall shrubs + emergents adjacent to streams. 4. No 3 - 4 (Y) – High Function 1 - 2 (Y) – Moderate Function None – Low Function (3) High
I. Educational or Scientific Value 1. Site has documented scientific or educational use. 2. Wetland is in public ownership. 3. Accessible trails available.	Likely or not likely to Provide (Y or N) 1. No 2. No - Controlled access 3. No Controlled access 2 - 3 (Y) – High Function 1 (Y) – Moderate Function None – Low Function None Low
J. Uniqueness and Heritage 1. Wetland contains documented occurrence of a state or federally listed threatened or endangered species. 2. Wetland contains documented critical habitat, high quality ecosystems, or priority species respectively designated by the U.S. Fish and Wildlife Service 3. Wetland has biological, geological, or other features that are determined rare 4. Wetland has been determined significant because it provides functions scarce for the area. 5. Wetland is part of: an estuary, bog, or a mature forest.	Likely or not likely to Provide (Y or N) 1. No 2. No 3. No 4. Yes - streams 5. No 3 – 5 (Y) – High Function 1 – 2 (Y) – Moderate Function None – Low Function (1) Moderate

CHAPTER IX

FISH AND WILDLIFE INFORMATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF EXHIBITS

1.0 INTRODUCTION

Fish and wildlife resources within the Hoseanna Creek basin have been inventoried and assessed in two separate studies. These studies were designed to evaluate the effects of development activities in the local area and are directly applicable to the proposed Jumbo Mine Road Corridor Project. They are entitled "Biological Studies of a Proposed Power Plant Site Near Healy, Alaska" and "Wildlife Food Habits and Habitat Use on Revegetated Stripmine Land in Alaska." The first study was completed in February, 1979 by Woodward-Clyde Consultants for the Golden Valley Electric Association. The second study is a thesis that was prepared and published by Chuck Elliott in 1984. Copies of these studies are included in Usibelli Coal Mine, Inc.'s surface coal mining permit application for the Poker Flats mine which is on file with the Division of Mining and Water Management in Anchorage.

The field survey work for the studies included aquatic sampling of Hoseanna Creek which adjoins the permit area for the Jumbo Mine Road Corridor. Study results indicated that there are low numbers of small mammals, furbearers, and large mammals and low to moderate numbers of songbirds, waterfowl, and raptors within the area. The following sections provide a brief discussion on the avifauna and mammals that were inventoried.

2.0 FAUNA

2.1 AVIFAUNA

Approximately 150 species of birds inhabit the Tanana and Nenana river Valleys (ADF&G, 1985) and many of these same species are common throughout the interior region of Alaska. Field observations of avifauna species occurring on the study areas were made in 1978, 1980, 1981, and 1982. A total of 69 species were observed. Table CIX-1 presents a composite list of the observations and includes passerines, waterfowl, and raptors.

TABLE CIX-1
BIRD SPECIES OBSERVED DURING
1978 AND 1980-1982

Common Name	Scientific Name
Violet-green Swallow	Tachycineta thalassina
Tree Swallow	Iridoprocne bicolor
Bank Swallow	Riparia riparia
Barn Swallow	Hirundo rustica
Cliff Swallow	Petrochelidon pyrrhonota
Gray Jay	Perisoreus canadensis
Black-billed Magpie	Pica pica
Rusty Blackbird	Euphagus carolinus
Common Raven	Corvus corax
Boreal Chickadee	Parus hudsonicus
American Robin	Turdus migratorius
Swainson's Thrush	Catharus ustulatus
Orange-crowned Warbler	Vermivora celata
Yellow Warbler	Dendroica petechia
Common Redpoll	Carduelis flammea
Savannah Sparrow	Passerculus sandwichensis
White-crowned Sparrow	Zontrichia leucophrys
Lapland Longspur	Calcarius lapponicus
Dark-eyed Junco	Junco hyemalis
Mallard	Anas platyrhynchos
Green-winged Teal	Anas crecca
Canvasback	Aythya valisineria
Bufflehead	Bucephala albeola
Surf Scoter	Melanitta perspicillata
Red-tailed Hawk	Buteo jamaicensis

TABLE CIX-1 (CONTINUED)
BIRD SPECIES OBSERVED DURING
1978 AND 1980-1982

Common Name	Scientific Name
Golden Eagle	Aquila chrysaetos
Goshawk	Accipiter gentilis
Sharp-shinned Hawk	Accipiter striatus
Marsh Hawk	Circus cyaneus
Merlin	Falco columbarius
American Kestrel	Falco sparverius
Ruffed Grouse	Bonasa umbellus
Willow Ptarmigan	Lagopus lagopus
Sandhill Crane	Grus canadensis
Upland Sandpiper	Bartramia longicauda
Lesser Yellowlegs	Tringa flavipes
Solitary Sandpiper	Tringa solitaria
Spotted Sandpiper	Actitis macularia
Common Snipe	Gallinago gallinago
Western Sandpiper	Calidris mauri
Least Sandpiper	Calidris minutilla
Mew Gull	Larus canus
Hawk Owl	Surnia ulula
Boreal Owl	Aegolius funereus
Short-eared Owl	Asio flammeus
Belted Kingfisher	Megaceryle alcyon
Common Flicker	Colaptes auratus
Hairy Woodpecker	Picoides villosus
Rock Dove	Columba livia

2.2 MAMMALS

The occurrence and distribution of small mammals within the study areas was documented with trapping methods. Live traps, spaced along randomly located transects, were used to determine densities and habitat utilization patterns for mice, shrews, and ground squirrels. Large mammals were documented by direct observation of tracks and sign. The five species of particular importance, because of subsistence, recreational, or ecological values, included black bear, brown bear, caribou, Dall sheep, and moose. Table CIX-2 presents the composite list of the mammal species that were either trapped or observed in the study areas.

Big game animals that have been identified on the Jumbo Road Corridor site through direct observation by UCM personnel include moose, brown bear, and black bear. Smaller mammals observed include:

Porcupine (Erethizon Dorsatum)
Beaver (Castor Canadensis)
Snowshoe Hare (Lepus Americanus)
Red Squirrel (Tamiasciuvus Hudsonicus)
Red Fox (Vulpes Vulpes)
Lynx (Felis Canadensis)
Wolf (Canis Lupus)

TABLE CIX-2
MAMMAL SPECIES OBSERVED OR TRAPPED
DURING 1978 AND 1980-1982

Common Name	Scientific Name
Tundra Vole	Microtus oeconomus
Red-backed Vole	Clethrionomys rutilus
Masked Shrew	Sorex cinereus
Pygmy Shrew	Sorex hoyi
Arctic Shrew	Sorex tundrensis
Water Shrew	Sorex palustris
Northern Jumping Mouse	Zapus hudsonicus
Porcupine	Erethizon dorsatum
Least Weasel	Mustela rixosa
Beaver	Castor canadensis
Marten	Martes americana
Short-tailed Weasel	Mustela erminea
Mink	Mustela vison
Dall sheep	Ovis dalli
Caribou	Rangifer tarandus
Moose	Alces alces
Coyote	Canis latrans
Snowshoe Hare	Lepus americanus
Red Squirrel	Tamiasciurus hudsonicus
Northern Flying Squirrel	Glaucomys sabrinus
Arctic Ground Squirrel	Spermophilus parryii
Black Bear	Ursus americanus
Grizzly Bear	Ursus arctos
Red Fox	Vulpes vulpes
Wolf	Canis lupus
Lynx	Lynx canadensis

3.0 THREATENED OR ENDANGERED SPECIES

The State and Federal lists for threatened and endangered species in Alaska are identical and include the following species:

- Short-tailed albatross
- Eskimo curlew

Neither of the studies referenced above located any of these species. In addition, the U.S. Fish and Wildlife Service has previously stated that no proposed or listed threatened or endangered species are known to occur in the vicinity of the proposed mine site (See Exhibit CIX-1).

4.0 FISH AND WILDLIFE MANAGEMENT

The Jumbo Road Corridor project falls within subunit D-4 of subregion 4 for the Tanana Basin Area Plan. One of the primary management goals for subsurface resources within the subregion is to contribute to Alaska's economy by making subsurface resources available for development. For subunit D-4, the principal management objectives focus on development of subsurface coal and hardrock minerals, while protecting fish and wildlife habitat and recreation values to the extent feasible. The entire subunit is open to mineral entry with minerals and wildlife habitat as the primary land use designations. Forestry and public recreation are listed as secondary land use designations. According to the Alaska Department of Fish and Game (ADF&G), there is no critical wildlife habitat in the vicinity of the Two Bull Ridge mine project.

The proposed Jumbo Road Corridor site is located within ADF&G's Game Management Unit 20A. Within this unit, ADF&G has established restricted areas to further maintain management objectives. The entire Hoseanna Creek drainage, including the area as far south as Healy Creek, is situated within the ADF&G's Healy-Lignite Management Area. In this management area, ADF&G has established special restrictions which include hunting by bow and arrow only.

~~EXHIBIT CIX-1~~

~~LETTER FROM THE U.S. FISH AND WILDLIFE SERVICE~~

EXHIBIT CIX-1

LETTER FROM THE U.S. FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE

NORTHERN ALASKA ECOLOGICAL SERVICES
101 12th Ave. Box 19, Room 110
Fairbanks, AK 99701

June 13, 1997

Alan E. Renshaw
Manager, Permitting and Regulatory Compliance
Usibelli Coal Mine, Inc.
P.O. Box 1000
Healy, AK 99743

Dear Mr. Renshaw:

This responds to your 16 May 1997 request for information concerning the occurrence of threatened or endangered species in the vicinity of T11 and 12 S, R6 and 7W, Fairbanks Meridian. To our knowledge, no endangered or threatened species occur in this area, although American peregrine falcons, which are endangered, could pass through the area during migration. Therefore, mining operations in this area are not likely to adversely affect any threatened or endangered species.

You also requested a list of Alaska's State and Federally listed threatened and endangered species. The Federal list includes the following species:

American peregrine falcon
Aleutian Canada goose
Short-tailed albatross
Eskimo curlew
Spectacled eider
Steller's eider
Aleutian shield fern

Of these, the Eskimo curlew and short-tailed albatross are on the Alaska State endangered species list. The American peregrine falcon, Aleutian Canada goose, and spectacled eider are classified by the State as "species of special concern." The State of Alaska does not list plant species; therefore the Aleutian shield fern is not recognized.

Thank you for your interest in endangered species.

Sincerely,

Patrick Sousa

Patrick Sousa
Field Supervisor

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6.0 RESPONSIBLE PARTIES

This chapter was prepared by Usibelli Coal Mine, Inc.

CHAPTER X

SOIL RESOURCES

SOIL RESOURCES OF JUMBO DOME ROAD CORRIDOR
USIBELLI COAL MINE, HEALY, ALASKA

8 DECEMBER, 2005

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF PLATES

LIST OF APPENDICES

1.0 INTRODUCTION

The soil resources of the Jumbo Dome road access area were surveyed in September 7 to 11, 2005 for inventory and general planning purposes. During the 4.5 day a total of 45 soil pits were excavated and described. The soil profile descriptions are presented as Appendix and morphological properties were summarized in tabulated form as part of the results.

2.0 METHODOLOGY

2.1 SURVEY AREA

The soil survey area is located north of the Hoseanna Creek and east of Bridge No. 5. The survey area included 500 feet on both side of the road corridor to Jumbo Dome. It covers SE and NE corner Sec. 30, NW corner sec. 29, W1/2 Sec. 20, SE corner sec. 18, W1/2 Sec. 17, and SE corner Sec. 8, T11S, R6W, F. M.

2.2 SOIL SURVEY

The ground truthing was completed by studying the morphological properties of the soils and their relationships to vegetation communities and landforms along an elevation transacts following the road corridor. The soil morphological properties were studied according to USDA National Soil Survey Center standard (Schoeneberger et al., 2002). In the field the soils were described according to genetic horizons with thickness and arrangement of each horizon recorded. The parameters used to define each soil horizon including Munsell color, presence and abundance of redoximorphic features, including Fe concentration and depletion and mottles, field texture, structure, moist and wet consistency, root distribution, water table at the time of description, and other associated landscape features such as % slope, slope shape, parent materials, landscape position, drainage, vegetation communities, coarse fragment and surface stones. The ground truthing was conducted in September 7 to 11, 2005. There were 45 soils pits excavated and the locations of the pits are marked on the soil map (see Plate 1). Each pit was assigned to a appropriate map unit (Table 1) and the map units are

described in the following section. Detailed soil profile descriptions are listed in Appendix A and relevant soil properties are presented in Table 2.

2.3 SOIL MAPPING

Soil map unit was established based on soils, vegetation and landforms according to Soil Survey Manual (Soil Survey Division Staff, 1994). Consociation map units are those map units with only one taxonomic unit. This kind of map unit contains less than 15% of soils of contrasting nature but may contain up to 40% of soils with similar nature which have the same land use interpretations. The complex map units are those units containing soils of contrasting nature of more than 15%. Soil boundaries were established by identifying representative soil profiles in the landform unit and then correlating the landform with vegetation communities, drainage and other surface features. Soil pits were classified according to Keys to Soil Taxonomy (Soil Survey Staff, 2003) and used to define the map unit. The map (Plate 1) was compiled by plotting soil boundaries on 1:400 aerial photo maps with the aid of topographic map and paired color aerial photographs. Ground checking was used to verify the boundaries. Soils of each map unit are described in the following section and the soil profile descriptions are list in Appendix A.

3.0 RESULTS AND DISCUSSION

3.1 SOIL MAP UNIT DESCRIPTION

The mapping units are based on ground truthing; excavated pits. Map unit symbols are expressed in numbers as marked on Plate 1. Map Unit Legend is presented in Table 1. All soil pits were classified to the family level according to Keys to Soil Taxonomy (Soil Survey Staff, 2003) and are presented in Appendix B.

3.1.1 Miscellaneous Land Types

3 – River channels and sand bars

4 - Escarpments

This unit includes landslides with precipitous slopes and without vegetation cover, coal seams exposures, and escarpments along terrace breaks and steep hill slopes.

6 – Roads or Disturbed Area

This unit is limited to the road corridor and side casts.

3.1.2 Entisols

Entisols are soils formed recently with minimum horizon development.

3.1.2.1 Cryofluvents

Cryofluvents are cold Entisols having irregular decrease of organic matter contents at depth from 10 to 50 inches. They occur in valley floors, stream banks, and toe slopes adjacent to streams or drainages.

13 -- Typic Cryofluvents– Typic Cryaquents complex, 0-8% slopes

The Typic Cryofluvents are deep, moderately well drained soils occur on nearly level to gently sloping river terraces and flood plains. They formed in stratified sandy to medium-coarse-textured alluvial material. Vegetation includes willow, white spruce, and alder. In a representative profile, (Pedon 21), one inch of peat overlies a 7 inches of dark-brown sand. The stratified substratum consists of sand, silt loam and loamy sand extending to more than 30 inches depth. This unit also contains 20% Typic Cryaquents that have loamy textured top soils over gravelly outwash. In a representative profile (Pedon 14) there is a one inch of peat over 9 inches of brown loamy subsurface over 23 inches of glayed sandy loam horizon. The substratum consists of gravelly sand extending to a depth of more than 40 inches.

3.1.2.2 Cryopsamments

14 – Aquic Cryopsamment, 0-15% slopes

The Aquic Cryopsamments formed in alluvial fans and are moderately well to somewhat poorly drained. Vegetation includes white spruce, alder, and grasses. In a representative profile (Pedon 39) a recently deposited sand layer of 5 inches overlies a one inch organic layer. The subsurface horizon consists of 12 inches of brown sand overlies stratified sand extending to a depth of more than 40 inches.

15 – Typic Cryopsamments, sandy, 25-50 % slopes

The Typic Cryopsamments formed in sandstone parent material on hill slopes, landslides and slumps at the foothills. They are well to excessively drained. In a representative profile (Pedon 27), a thin (< 1 inch) organic layer overlies a loamy A horizons of 2 inches. Below 4 inches of brown loamy sand subsurface horizon overlies sand and gravelly sand extending to a depth of more than 40 inches.

3.1.2.3 Cryorthents

These are excessively to well-drained loamy to coarse-textured Entisols formed in different parent material and are widely distributed over the permit area.

16. - Typic Cryorthents, sandy, 0-12% slopes

These moderately deep, excessively to well drained soils occur on alluvial fans. Vegetation on the Cryorthents is dominantly scattered white spruce, birch and thin shrubs. The Typic Cryorthents are represented by Pedon 36. It generally has a very thin (less than 1 inch) organic mat over a 4 inches of dark brown organic rich surface layer over recently deposited sand, about 7 inches thick. The buried subsoil includes a brown, very gravely silt loam over fractured coal seam at 22 inches.

17 --Typic Cryorthents, sandy, 25-50 % slopes

These well-drained soils formed in residuum and colluvium of sandstone material on terrace breaks, dissected foot slopes and toe slopes. The slopes range from plane to complex and have a flat to undulating topography. The vegetation is characterized by white spruce with scattered dense tall shrub understory. In a representative profile of Typical Cryorthents (Pedon 10), 8 inches of organic layer overlies one inch brown subsurface horizon. The substratum consists of sand and very cobbly sand to more than 40 inches. Stones and boulders are presented in some of the units.

18 – Typic Cryothents, sandy-Typic Dystrocryepts-Lithic Cryorthents, coarse-loamy complex, 45-90 % slopes

The well to excessively-drained Typic Cryothents formed in residuum and colluvium of sandstone material on back slopes and dissected foot slopes. The slopes range from plane to complex and have a flat to undulating topography. The vegetation is characterized by white spruce with scattered paper birch and tall shrub understory. In a representative profile of Typical Cryorthents (Pedon 7), 4 inches of organic layer overlies 8 inches dark brown surface horizon. The substratum consists of stratified very cobbly and very gravelly sand to more than 40 inches. This map unit includes 30% well-drained Typic Dystrocryepts (Pedon 16). These soils formed in materials weathered from sandstone mixed with loess due to slope movements and erosion. They are commonly found on saddle and bench slopes. In a representative profile, a 3 inch organic layer overlies 5 inches of a brown subsurface horizon. The substratum consists of light brown sandy loam to more than 40 inches. This map unit also includes about 15% Lithic Cryorthens (Pedon 15). These soils form in thin (< 10 inches) soils over sandstone bedrock or coal seams.

19 - Typic Cryothents, sandy, 45-90% slope

The well to excessively-drained Typic Cryothents formed in residuum and colluvium of sandstone material on ridge tops, shoulder slopes, back slopes and dissected foot slopes. The

slopes range from plane to complex and have a flat to undulating topography. The vegetation is characterized by white spruce with scattered paper birch, patches of alder, shrub and grass understory. In a representative profile of sandy Typical Cryorthents (Pedon 20), 2 inches of organic layer overlies 14 inches brown to dark grayish brown surface horizon. The substratum consists of a buried organic horizon of 4 inches thick over sandy substratum to more than 40 inches. This map unit includes 15 % Typic Dystrocryepts on some shoulder slopes and 3 % Typic Cryofluvents in the bottom of deep and narrow drainageways.

3.1.2.4 Cryaquents

These are poorly to very poorly drained loamy to coarse-textured Entisols formed in alluvium in lowlands including drainageways, depressions and low terraces along streams.

20 – Typic Cryaquents, sandy, 0-12% slopes

These deep, poorly-drained soils occur in basins and dissected drainageways with vegetation dominated by dense willow shrubs with scattered black spruce. At the time of surveying, free water at microlows and water table was within 25 cm to the surface of microhighs. In a representative profile (Pedon 26), a grayish brown surface horizon of 4 inches overlies 7 inches of a medium textured, gleyed subsurface horizon with abundant and distinct mottles to a depth of 13 inches. The substratum consists of gleyed loamy sand and sand with oxidized color to a depth of more than 40 inches.

3.1.3 Inceptisols

Inceptisols are young soils in which modifications of parent material by weathering are weak. They generally have a cambic horizon unless permafrost is present.

3.1.3.1 Cryaquepts

Aquepts are wet Inceptisols. Cryaquepts are Aquepts with mean annual soil temperature less than 50 degree F. These poorly drained soils occur mainly on terraces and toe slope slopes of the permit area.

21 -- Histic Cryaquepts, 0-3% slopes

These deep, somewhat poorly drained soils occur on terraces and floodplains in the northern part of the road corridor. They form in medium-textured alluvium. The slopes are plane and have a slightly undulating relief. Vegetation includes dwarf white spruce, dwarf birch, blueberry, sedges, willow, mosses (including sphagnum) and lichens. In a representative profile (Pedon 3), a thin organic layer, about 2 inches, overlies a brown sandy loam B horizon, about 5 inches thick. Next, there is a reduced and mottled silt loam and oxidized gravelly sandy loam subsoil over very gravelly sand to more than 40 inches deep. The water table was at 2 inches below the surface at the time of surveying. There are about 1 % of stones at the surface.

22 -- Typic Cryaquepts, 3-15% slopes

These deep, poorly-drained soils occur in fans and low terraces. The slopes are convex to concave. The vegetation is dominated by white spruce, ericaceous shrubs and grasses. In a representative profile (Pedon 2), a 5 inch organic layer overlies 2 inches of dark grayish brown, extremely cobbly silt loam. The subsurface horizon is strongly mottled gravelly sandy loam of 5 inches thick overlies stratified very to extremely gravelly sandy loam to a depth of more than 40 inches.

23 -- Typic Cryaquepts, 3-15% slopes

These poorly drained soils occur on drainageways and depressions along the streams. The vegetation consists of black spruce, bog birch, sedge, and Sphagnum moss. In a representative profile (Pedon 6), there is 4 inch thick peat layer overlying 10 inches of oxidized very cobbly sandy loam subsurface horizon. A gleyed substratum with medium texture, strong mottling at the lower boundary extends to 36 inches deep. The profile was

saturated with free water at 20 inches below the mineral surface. Rotten egg smell was detected when a fresh pit was open to less than 12 inches.

24 – Histic Cryaquepts-Typic Cryaquepts, 0-8 % slopes

These deep, somewhat poorly drained soils occur on terraces in the northern part of the road corridor. They form in medium-textured residual material from schist rocks. The slopes are plane and have a slightly undulating relief. Vegetation includes dwarf white spruce, dwarf birch, blueberry, sedges, willow, mosses (including sphagnum) and lichens. In a representative profile (Pedon 1), a dusky red mat of peat and mucky peat, about 9 inches, overlies a dark gray extremely channary silt loam subsurface horizon, about 7 inches thick. The mottled lower subsurface horizon consists of stratified sand and silt loam of 14 inches over a very gravelly silt loam to a depth of more than 40 inches deep.

25 -- Histic Cryaquepts, 8-25% slopes

These deep, poorly-drained soils formed in colluviuum and occur on concave to undulating toe slopes. The vegetation is dominated by black spruce, ericaceous shrubs sedges, grasses and mosses (Sphagnum and river moss). In a representative profile (Pedon 9), an 8 inch thick mucky peat overlies 9 inches of glayed sandy loam subsurface horizon. The second layer of subsurface has abundant and distinct mottles extending to more than 20 inches deep. Water flew through depressions and drainageways and water table in the pit was 4 inches below the surface of mineral horizon.

3.1.3.2 Dystrocryepts

Dystrocryepts are cold Inceptisols with brown to pale brown subsurface horizons (Bw) which indicate soil materials have been weakly oxidized and the base saturation is less than 60% due to weak leaching.

30 -- Aquic Dystrocryepts, 0-15% slopes

Aquic Dystrocryepts are Dystrocryepts with mottles or wet features associated with wetness within 25 inches of the surface. These deep, moderately well drained soils occur on terraces in the northern part of the road corridor. They formed in loess over river outwash. The vegetation includes white spruce, willows, bog birch, mosses, and lichens. In a representative profile (Pedon 30), a 3 inch peat layer overlies a thin (2 inches) mottled surface horizon (A). The upper subsurface horizon consists of 15 inches of brown to grayish brown sandy loam. The lower subsurface horizon consists of 10 inches of sand over a mottled sandy loam substratun of 10 inches thick. This map unit includes 15% of the soils with a very cobbly sandy loam substratum.

31 – Typic Dystrocryepts, loamy, 0-25% slopes

Dystrocryepts are Cryepts with base saturation less than 60% in the upper 30 inches of the soil. These soils form on flat to gently sloping broad terraces. The vegetation community is dominantly white spruce forest. In a representative profile (Pedon 25), a thin organic mat, about 3 inches, overlies a thin (1 inch) black mucky sandy A horizon, and 24 inch thick brown to grayish brown mottled sand and silty clay loam subsurface horizons (B and BC). Below the B and BC horizons, there is a gray sand substratum extending to a depth of more than 40 inches deep. Most of these soils show evidence of fire that resulted in a charcoal-rich surface layer and strongly mottled subsurface horizons.

32 – Typic Dystrocryepts, sandy, 0-25% slopes

These well drained soils formed on moderately sloping ridge tops, shoulder slopes and foothills of smooth, low hills weathered from sandstone. The vegetation community is dominantly white spruce forest. In a representative profile (Pedon 17), a dark brown organic layer of 5 inches overlies a light brown sandy loam subsurface horizon (Bw) of 7 inches thick. The substratum consists of pale yellow brown very cobbly sand extending to a depth of more than 40 inches deep.

33 – Humic Dystrocryepts, loamy, 0-15 % slopes

Humic Dystrocryepts are Dystrocryepts with a dark surface horizon (A). They formed in mixed parent material from colluvial and alluvial processes on well-drained upland terraces The slopes are plane with a slightly undulating surface. Vegetation includes white spruce, bog birch, ericaceous shrubs, mosses, and lichens. In a representative profile (Pedon 5), a 2 inches of organic horizon (O) horizon overlies 6 inches of dark brown surface horizon (A). The subsurface horizon (B) consists of 9 inches of dark grayish brown silt loam ovelying gravelly sand and sand to a depth of more than 40 inches.

3.1.4 Spodosols

In Spodosols humus and/or humus metal complexes are translocated from surface into subsurface horizons where they form a spodic horizon. This spodic horizon has reddish brown and dark reddish brown colors. The leached horizon above the spodic horizon has a bleached, grayish brown or gray color. Most Spodosols form in coarse-textured, mostly sandy parent material.

40 – Typic Haplocryods, 40-70 % slopes

Haplocryods are Spodosols formed in areas with cryic soil temperature regimes (mean annual temperature less than 50 degree F) and weakly developed spodic horizons. These soils formed in sandy material on moderately steep to steep terrace breaks. Vegetation includes scattered white spruce, dwarf birch, blueberry, and a thick lichen cover. In a representative profile (Pedon 4), a thin mat of peat, about 1 inch thick, overlies an 1.5 inch waekly leached grayish brown subsurface horizon (BE). The spodic horizons (Bs) below are reddish brown to yellowish brown very gravelly sandy loamy and sand, about 10 inches thick. The sandy substratum (C) extends to more than 40 inches in depth.

3.2 SOIL PROPERTIES

3.2.1 Morphological Properties

Morphological properties are summarized in Appendix C and also described in the Map Unit Description section.

3.2.2 Chemical Properties

The chemical property of the soils along the road corridor is limited to soil pH because it is the most useful index for other soil properties. Due the common bedrock geology and stratigraphy, soils in the surveyed area shared similar property with those from the Two Bull Ridge area which were studied in detail in the soil resources baseline report (Ping, 1992). In general, the soils are dominantly acidic in reaction. Based on field measurement in selected pits, the pH values in the organic horizons range from 3.6 to 6.4 with an average of 4.6. The pH values of the upper Bw horizons range from 3.8 to 4.7 with an average of 4.3. The values of the lower B horizons range from 5.3 to 6.7 with an average of 5.4. The values increases slightly in the C and the gravely 2C horizons. But wherever there is sandstone substratum C and 2C horizons), the pH values increase to 6.5 to 7.5.

3.2.3. Physical Properties

The common soil structure in the surveyed area is platy due to the action of seasonal frost. In some pits, weak medium subangular blocky structures were observed in the B horizons. Soil textures ranges from silt loam to extremely gravelly or cobbly sandy loam to sand. On terraces and floodplains, stratification of different textures was observed.

3.2 CRITERIA FOR SUITABILITY

The suitability of the soils for topsoil in the permitting area has been performed by reviewing the morphological, physical and chemical properties. Soils in the permitting area generally formed in residual material weathered from bedrock including sandstone in the southern part of the road corridor and Birch Creek schist in the northern part of the corridor, wind deposited material (loess), outwash gravel, and water laid sediments. These materials are not highly weathered and do not have properties adversary to plant growth (Ping and Kajia, 1989; Ping, 1992). Based on test plots conducted at the nearby Two Bull area that shares similar lithology, Helm (1996) has proved that the native soils in the area are suitable for revegetation. The criteria used to establish the suitablity of the topsoil are summarized in Table 3.

The criteria for suitability are selected based on suitability for plant growing medium.

(1). pH -- pH value is an index of soil acidity. Through out the permitting area, pH values for most soil horizons are more than 4.0. The lower values are found mostly in the organic horizons. But considering the fact that the bulk density of the organic horizon is only one fifths of the mineral horizons, (0.3 vs. 1.5 g/cm3, respectively), after stockpiling, the pH values of the mixed soils horizons would range from 5.0 to 5.6. Thus, pH is not a limiting factor of suitability in the permitting area.

(2). Soil texture -- medium to fine textured soil materials are suitable because they have better water and nutrients holding capacity for plant growth. The texture classes are considered suitable including sandy loam, fine sandy loam, silt, silt loam, loam, silty clay loam, muck sandy loam, mucky silt loam, mucky loam, peat, muck peat, peaty muck, and muck. Soils in the permitting area are dominantly coarse textured in the southern part due to the sandstine bedrock and medium textured in the northern part due to mixed alluvial and colluvial materials from the schist bedrock and eolian deposits. The wind blown materials were eroded and redeposited by water in low land and along the streams. No finer-textured soils such as clay loam, or clay are found in the permit areas, and silty clay loam was found in only in one horizon of one pit. Generally, regardless of texture, it is suitable for topsoil when the A and B horizons are mxied

with organic layers. But some of the substratum, the C or 2C horizons are derived from river outwash or flush flood which contains varying amount of rock fragments. When the gravel exceeds 35% by volume, the materials are not suitable for stockpiling. Some of the C and 2C horizons are sandy materials and are also not suitable for stockpiling.

(3). Coarse fragments -- Coarse fragments is defined as mineral fragments larger than 2 mm in diameter, and it serves as texture modifier. Excessive coarse fragments will decrease the water and nutrient holding capacities. Thus for suitable soil materials the content of rock fragment is best limited to 35% by volume or 50% by weight. In the USDA soil texture class, rock fragment over 35% by volume is designated as very gravely or very cobbly depending on the size of coarse fragments.

(4). Slope -- Slope is not a soil property but a map unit property. In the permitting area, the nature topographic break ranges from 40 to 45% slope depending on the map units. Generally, when slope is too steep, it hibit the ability of equipment to maneuver as required to collect the soil, especially under wet or frozen conditions. In addition, these soils are generally shallow with topsoil mixed with substratum materials, mostly sandstone materials or outwash gravel.

3.4 SALVAGE DEPTH

The salvage depth is defined as the depth of the soil material reaches a contrasting layer such as sand or very gravely layers, or to bedrock or the coal seam. The maximum salvage depth of each map unit is summarized in Table 4.

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5.0 RESPONSIBLE PARTIES

This report was prepared by Chien-Lu Ping, Ph.D., Certified Professional Soil Scientist of the American Registry of Certified Professional Agronomy, Crops and Soil Scientists, P.O. Box 2885, Palmer, Alaska, 99645

Sec.36 Sec.31 Sec.32 Sec.33 Sec.34

Sec.1 Sec.6 Sec.5 Sec.4 Sec.3

Sec.12 Sec.7 Sec.8 Sec.9 Sec.10

Sec.13 Sec.18 Sec.17 Sec.16 Sec.15

Sec.24 Sec.19 Sec.20 Sec.21 Sec.22

Sec.25 Sec.30 Sec.29

Sec.36 Sec.31 Sec.32

SOILS LEGEND

3	21
4	22
6	23
13	24
14	25
15	30
16	31
17	32
18	33
19	40
20	

7 Soil Pit Location

Soil Spot Check Location

Gravel Spot Check Location

Existing Exploration Trail

Bridge-5

REV	BY	DATE	DESCRIPTION
2	RCS	12/9/16	UPDATED W GRAVEL SITE A and NEW BOUNDARY
1	JTS	11/13	UPDATED BOUNDARY AND CENTERLINE FOR REVISION ORDER
0	MMAK	3/27/06	ORIGINAL SUBMITTAL

N W E S

1000' 0' 1000' 2000'

Contour Interval= 25'
UCM/Engineering~April 2004

DESIGNED BY: MAPMAKERS AK

COMPILED BY: MAPMAKERS AK

CHECK BY: RCS

DWG FILE: Plate CX-1 Dec 2016.dwg

DATE DRAWN: 11/06

JUMBO DOME ROAD CORRIDOR

USIBELLI COAL MINE INC. UCM

PERMIT NUMBER S-0605

SOILS MAP

JUMBO DOME ROAD CORRIDOR

USIBELLI COAL MINE, INC.
P.O. BOX 1000, HEALY, ALASKA 99743
(907) 683-2226

PLATE No. X-1

SHEET No. 1 OF 1

REV. 2

Table 1. Soil Map Unit Legend in the Jumbo Dome Road Access Corridor

Symbol	Map Unit Name	Pit #
3	River channels and sand bar	
4	Escarpments, rock outcrops	
6	Roads or disturbed areas, roads	
13	Typic Cryofluvents, sandy-Typic Cryaquepts, loamy complex, 0-15 % slopes	14, 21
14	Aquic Cryopsamment, 0-15% slopes	39,
15	Typic Cryopsamment, sandy, 25-60%	27, 40, 41, 37, 38
16	Typic Cryorthent, sandy, 0-12 % slopes	36
17	Typic Cryorthent, sandy, 25-50 % slopes	10,
18	Typic Cryorthent-Typic Dystrocryept-Lithic Cryorthents complex, coarse-loamy, 45-90 % slopes	7, 15, 16,
19	Typic Cryorthent, sandy, 45-90 % slopes	19, 20, 22, 23, 24,
20	Typic Cryaquent, sandy, 0-12 % slope	26, 29
21	Typic Cryaquept, 0-3 % slopes	3
22	Typic Cryaqupet, 3-15 % slopes	2, 28, 33
23	Typic Cryaquept, 15-45% slopes	6
24	Histic Cryaquept-Typic Cryaquepts complex, 0-8 % slopes	1, 11, 12, 18
25	Histic Cryaquept, 8-25 % slopes	9, 13,
30	Aquic Dystrocryept, 0-15 % slopes	8, 30,
31	Typic Dystrocryept, loamy, 0-25 % slopes	25, 31, 32, 34, 35,
32	Typic Dystrocryept, sandy, 0-25 % slopes	17
33	Humic Dystrocryept, loamy, 0-15 % slopes	5
40	Typic Haplocryod, 40-70% slopes	4

Table 2. Morphological Characteristics of pedons of Jumbo Dome Access Road

Pedon Horizon	Depth (inch)	Munsell color (moist)	Field Texture	Gravel (est) % vol	Saturation/ wetness	Roots	Water table " Limiting layer
Pedon 1							
Oe	0-2.5	7.5YR3/2	PT MK		M	3vf,f,2m	
Oa	2.5-9	7.5YR3/2	MK		M	3vf,f,2m	
Bg	9-16	2.5Y3/2, 10YR3/2 20%	CNXSIL	75	M	2f,1m	Excessive
BC	16-30	7.5YR4/4; 10YR3/2	55%S, 45%SIL		M		rock fragment
C	30-40	10YR2/2	VGSIL	50	M		
Pedon 2							
Oi	0-2.5	7.5YR3/3	PT		M	3vf, f, 2m	
Oa	2.5-5	7.5YR 3/2	MK		M	3vf, f, 2m	
A	5-7	10YR3/2	KXMKSIL	70	M	2fm, 1c	Excessive
Bg	7-12	50%2.5Y4/2; 7.5YR4/6	GSL	20	M		rock
BC	12-16	10YR3/3	KVSL	60	M		fragment
C	16-40	10YR3/3	KXSL	70	M		
Pedon 3							
Oe	0-2	7.5YR3/3	MK PT		W	3vf,f,2m	
Bw	2-7	10YR4/3	SL	10	SAT'D	3vf,f 1m	2" water
Bg1	7-12	2.5YR3/2, matrix	SIL	10	SAT'D	1vf,f	table
Bg2	12-20	7.5YR4/4	GSL	16	W		
2C	20-40	variegate	GVS	65	M		
Pedon 4							
Oi	0-1	7.5YR2.5/2	PT		M	1F2M	
AE	1-2.5	10YR4/2	FSL		M	2VF,F,3M1C	
Bs1	2.5-10	7.5YR4/4	GVSL	40	M	2F3M	
Bs2	10-12	7.5YR4/6	LS		M	2F3M	
BC	12-22	10YR5/4	S		M	1FM	
C	22-40	10YR5/3	S		M	1F	
Pedon 5							
Oe	0-2	7.5YR2.5/2	MKPT		M	3VF2M	
A	2-8	10YR2/2	KVSIL	40	M	3VF,F,2M	
Bw	8-17	10YR3/2	SIL		M	2VF,F,1M	
BC	17-28	7.5YR4/6	GS	18	M	1VF,F,M	
C	28-40	10YR3/2	S		M		
Pedon 6							
Oe	0-3	10YR2/1, 2/2	MKPT		M	3VF,1FM	
Oa	3-4	10YR2/2	MK		M	3VF,F,1M	
BE	4-10	10YR4/3	KVSL	40	M	3VF,F,1M	
Bs	10-14	7.5YR4/4;4/6	KVSL	50	W	2VF,F,1M	
Bg1	14-24	2.5Y4/1; 2/1(10%)	SIL		SAT	1F	
Bg2	24-36	10YR4/4;2.5Y4/2(40%)	SL		SAT		

Pedon 7							
Oi	0-4		PT		D	1m	
A1	4-12	10YR2/2	SIL		M	3vf,f,2m,1	
A2	12-22	10YR2/2	KXS	70	M	2vf,f,1m	
2AC	22-32	10YR3/2	GVS	45	M	1fm	
2C	32-40	2.5Y5/1	GS	20	M	1f	
Pedon 8							
Oi	0-2	7.5YR2.5/3	PT		M	3VF,F,2M	
A	2-3	10YR3/2	SIL		M	2VF,F,2M	
Bw	3-10	7.5YR4/6;2.5Y4/1;4/2(40%)	SIL		M	1VF,F	
2BC	10-13	10YR4/3, 2.5Y4/3(30%); 10YR4/6(10%)	KVSL	45	M	1VF,F	10” to very gravelly layer
2C	13-40	variegate	GXS	70	M		
Pedon 9							
Oi	0-4	7.5YR3/3	PT		M		
Oa	4-8	10YR2/	MK		SAT	2VF,F,1M	4” to water
Bg1	8-17	2.5Y4/2	SL		SAT	2VF,F,M	table
Bg2	17-20	10YR4/4;2.5Y4/2(40%)	SL		SAT	2VF,F,M	
Pedon 10							
Oi	0-4	7.5YR3/2	PT		M	2VF,F,M,1C	
Oe	4-5	7.5YR3/2	PTMK		M	3VF,F,M,1C	
Oa	5-8	7.5YR2.5/1	MK		M	3VF,F	
Bw	8-9	10YR4/4	SL		M	3VF,F, 1M	
2BC	9-18	10YR4/3	KVS	40	M	3VF,F, 1M	40” to very
3C	18-40	2.5Y4/3	S		M	1F,M	gravelly
Pedon 11							
Oe	0-3	5YR3/2	PTMK		M	3VF,F,M	
Oa	3-8	7.5YR3/3;5YR3/2	MKSIL		M	3VF,F,M	
Bg	8-16	2.5Y3/1;7.5YR4/6;7.5YR3/3	SIL		M	2VF,F	
BC	16-32	10YR4/1	SL		M	1VF,F	24” to water
C	32-40	10YR4/4	GSL	20	M	1F	table
Pedon 12							
Oi	0-3	7.5YR2.5/2	PT		M	3VF,F,2M	
A/O	3-6	10YR2/1; 5YR4/3	MKSIL		M	3VF,F,1M	
Bg	6-14	2.5Y4/1	SIL		M	2VF,F	
BC	14-32	7.5YR4/4; 2.5Y4/1(40%)	LS		M	1F	
C	32-40	variegated	GS	20	M		
Pedon 13							
Oe	0-2	7.5YR3/2	CHVPTMK	45	M	3VF,1F,M	
Oa	2-8	7.5YR2.5/2	MK		M	3VF,F,2M	
A	8-11	10YR3/2	SIL		M	3VF,F	
Oa’	11-14	7.5YR2.5/1	MK		M	3VF,F,M	
Bw1	14-17	10YR3/2	SL		M	2F,M	
Bw2	17-22	10YR4/2; 2.5Y3/2	SL		M	1F,M	
BC	22-36	2.5Y4/2;10YR4/4	SIL		M		
2C	36-40	10YR4/4	GLS	20	M		
Pedon 14							
Oi	0-1	7.5YR3/2	PT		M	3VF,F,2M,1C	
A	1-5	2.5Y4/2	SL		M	3VF,F,M,2C	
Bw	5-9	10YR4/4; 4/6;2.5Y4/1	LS; SIL		M	3VF,F,1M	
Bg	9-32	2.5Y4/1	SL		M	1F,M	
C	32-40	variegated	GS	20	M		

Pedon 15							
Oi	0-2	10YR2/2	PT		M	3VF,F,M	
Bw	2-5	10YR5/6	GSL	30	M		5” to bedrock
R	5+	10YR4/3					
Pedon 16							
Oe	0-3	7.5YR2.5/2	PTMK		M	3VF,F,M	
Bw	3-8	10YR5/3	GSL	20	M	2VF,F,M	
C1	8-24	10YR6/4	SL	10	M	21VF,F,2M	
C2	24-40	10YR6/4	SL	10	M		
Pedon 17							
Oi	0-3	7.5YR2.5/2	PT		M	2VF,F,M	
Oe	3-4	10YR2/2	PTMK		M	3VF,F,M	
Oa	4-5	10YR2/2	MKSL		M	3VF,F,M	
Bw	5-12	10YR5/6;4/4	SL	5	M	2F,M	
2BC	12-20	10YR4/3	KVS	70	M	1F,M	
2C	20-40	10YR4/2	KVS	70	M		
Pedon 18							
Oe	0-4	7.5YR3/2	PTMK		M	3VF,1F,2M	
Oa	4-8	7.5YR2.5/1	MK		M	3VF,F,1M	
Bw	8-17	10YR4/3; 2.5Y4/1 (10%)	FSL		M	2VF,F,1M	
Bg	17-28	2.5Y4/1;10YR4/4	FSL	10	SAT’D	1F	
C	28-40	10YR4/4	GSL		SAT’D		
Pedon 19							
Oi	0-4	10YR2/2	PT		M	3VF,1F,2M	Sandy texture
A	4-16	10YR3/4	LS	10	M	3VF,F,M,1C	
AC	16-24	2.5Y3/3; 10YR2/1	GS	20	M	2VF,F,M	
C	24-48+	2.yY4/2	S		M	1F,M	
Pedon 20							
Oe	0-2	10YR3/3	MKPT		M	3VF,2F,M	
A	2-11	7.5YR2.5/3	S		M	3VF,F,1M	Sandy texture
B&A	11-16	10YR4/4;7.5YR2.5/2 (30%)	S		M	3VF,F	
Oa’	16-18	7.5YR2.5/2	MKS		M	2VF,F,1M	
ACb	18-24	2.5Y4/3	S		M	2F, 1M	
C	24-40	2.5Y4/2	S		M	1VF,F,M	
Pedon 21							
Oi	0-1	10YR2/2	PT		M	2F,M	
A	1-8	10YR3/3;20%10YR2/2	S		M	2VF,F,3M	
Ab	8-10	10YR3/3	SIL		M	2VF,F,1M	
C1	10-12	2.5Y4/3	S		M	2VF,F	
Ab’	12-15	10YR4/2	LCoS		M	2VF,F	
A&C2	15-40	10YR3/3;4/3	LS		M	1VF,F	
Pedon 22							
Oi	0-1		PT		M	3VF,F,M,1C	
Oa	1-8	10YR2/2	MKS		M	3VF,F,2M,1C	
A	8-12	10YR4/3	LFS		M	2VF,F,1M	
AC	12-20	10YR5/4	SL		M	2VF,F	
C1	20-30	10YR4/3	FS		M	2VF,F	
C2	30-48	10YR4/3	S		M		

Pedon 23							
Oi	0-1		PT		M		
Oa	1-4	7.5YR2.5/3	MKS		M	2VF,F,3M	
A	4-10	10YR4/4	S		M	2VF,F,M,1C	Sandy texture
AC	10-24	10YR4/3	S		M	1VF,F,2M	
Ab	24-25	10YR2/2	MKS		M	1VF,F,M	
C	25-40	2.5Y4/3	S		M	1VF	
Pedon 24							
Oi	0-2		PT	10	M	3VF,F,2M	
Oe	2-4	10YR3/3;2/2	SMKPT	12	M	3VF,F,1M	
AC	4-11	10YR4/4	S	20	M	3VF,F,1M	
Ab	11-14	10YR4/3; 2/2	S		M	3VF,F,2M	
C1	14-21	10YR4/2	LS		M	1VF,F	
2C2	21-40	2.5Y4/2	SIL		M		
Pedon 25							
Oe	0-3	10YR2/1	PTMK		M	2VF,F,M	
O/A	3-4	10YR2/1	MKS		M	3VF,F,2M,1C	
Bw	4-8	10YR3/4; 7.5YR3/3	S		M	3VF,F,2M	
BC	8-28	2.5Y5/3;4/3	SICL		M	1VF,F,2M	
C	28-40	2.5Y4/1	S		M	1F,M	
Pedon 26							
A	0-4	2.5Y4/3	LCoS		M	3Vf,F	
Bg	4-13	5Y4/1;35%2.5Y4/2; 30%7.5YR3/3	SIL		M M	3VF,2F	
C1	13-24	7.5YR4/4; 40%2.5Y4/1	LS		M	1F	sandy
C2	24-40	10YR3/3	S		M	1F	
Pedon 27							
Oi/Oe	0-1	10YR2/2	MKPT		M	3VF,1F	
A	1-3	10YR3/2	SL		M	3VF,F	
Bw	3-7	2.5Y4/3	LS		M	3VF,F	
BC	7-15	2.5Y4/2	S		M	2VF,F	sandy
C1	15-29	2.5Y3/2;4/3	S		M	1VF,F	
C2	29-40	2.5Y4/2	GS	20	M		
Pedon 28							
Oi	0-1		PT		M		
Oa	1-2	10YR2/2	MK		M	3VF,F,2M	
Bw	2-8	10YR5/4;5/6;20%5Y6/1	SL		M	3VF,F,1M	
Ab	8-9	10YR3/3	SL	20	M	3VF,F	
Bwb	9-22	10YR4/6;8/1; 20%2.5Y5/2	GSL	30	M	2VF,1F	
BC	22-33	2.5Y6/4	GSL		M	1F	
Ab’	33-42	10YR4/3	LS		M	1VF,F	
Pedon 29							
Oe	0-2	7.5YR2.5/1	PTMK		M	3VF,F,1M	
Oa	2-4	7.5YR3/1	MK		M	3VF,F,2M	
Bg1	4-6	10YR3/2;20%2.5Y3/2; 7.5YR4/4	S		M	3VF,F	
Oa’	6-12	10YR2/1	MK		M		
Bg2	12-16	5Y3/1	STVS	40	M	3VF,F	12” to stony
C	16-24	variegated	KXS	70	M		sand

Pedon 30						
Oi	0-3	7.5YR2.5/2	PT		M	3VF,F,2M
A	3-5	10YR2/2;20%2.5Y4/1; 10YR4/4	SL		M	3VF,F,M
Bw1	5-16	10YR3/4	SL		M	2VF,F,M
Bw2	16-20	2.5Y4/4	FSL		M	1VF,F
BC	20-30	10YR4/4;4/3	S		M	
C	30-40	7.5YR5/8;2.5Y4/3	SL		M	
Pedon 31						
Oe	0-3	7.5YR2.5/2	MKPT		M	3VF,F,M
Oa	3-6	10YR2/2	MK		M	3VF,F,1M
A1	6-12	10YR2/2	SIL		M	3VF,F,1M
A2	12-14	10YR2/1	SIL		M	3VF,F,1M
A3	14-20	10YR2/2	SIL		M	2F
A&B	20-34	10YR2/2;3/2 (40%)	SIL		M	1F
C	34-40	10YR4/6	LFS		M	
Pedon 32						
Oe	0-4	10YR2/1	PTMK		M	3VF,1F,2M
A	4-6	10YR2/2	SIL		M	2VF,F,M
E	6-7	10YR5/2	SIL		M	3VF,F,1M
Bw	7-16	10YR4/4;4/6	VFSL		M	2VF,F,1M
Ab	16-17	10YR2/2	SIL		M	1VF,F
Bwb	17-31	10YR4/4;20%2.5Y4/1;10% 5YR4/6;20%10YR2/1	SL		M	1VF,F
C	31-40	2.5Y5/2	S		M	
Pedon 33						
Oi	0-2	10YR2/2	PT		M	3VF,F,1M
Oe	2-4	7.5YR2.5/3	PTMK		W	3VF,F,1M
Bg1	4-13	10YR3/4;30%7.5YR3/3;10% 10YR3/2	S		W	3VF,F
Bg2	13-20	2.5Y4/4;30%10YR4/4; 20%10YR3/4	LS		W	2VF,F
Bg3	20-25	2.5Y4/2;20%7.5YR4/6	SIL		W	1VF,F
C	25-40	variegated	GS,SIL	10	M	
Pedon 34						
Oe	0-2	7.5YR2.5/3	PT		M	3VF,F,2M
O/A	2-8	10YR2/2	MKSL		M	3Vf,F,2M
A&B	8-17	10YR2/2;40%7.5YR2.5/2	SL		M	2VF,F,1M
BC	17-25	2.5Y5/4;10YR4/6	VFSL		M	1VF,F
C	25-40	2.5YR4/3;10%10YR4/6	VFSL		M	
Pedon 35						
Oi	0-43	7.5YR2.5/2	PT		M	3VF,F,2M
AB	4-6	7.5YR2.5/2	SL		M	3VF,F,1M
Bw	6-8	7.5YR3/3	SL		M	3VF,F,1M
BC	8-19	2.5Y4/2	SL		M	3VF,F,1M
Ab	19-20	10YR2/2	SL		M	2VF,F
C	20-40	2.5YR3/2	SIL		M	1F
Pedon 36						
Oi	0-2	7.5YR2.5/2	PT		M	3VF,F,M
Oe	2-4	7.5YR2.5/2	PTMK		M	3VF,F,M
Bw	4-15	10YR2/2	SL		M	2VF,F,1M
BC	15-17	2.5Y3/3; 10YR3/3	S		M	2VF,F
C	17-40	2.5Y3/3; 10YR2/2	GLS	20	M	

Pedon 37							
A	0-12	10YR4/3	S	5	D	2VF,F,3M,1C	
AC	12-21	2.5Y4/3	S		D	1VF,F,2M	
C	21-30	2.5Y6/2	S		D		30”to sand
Cr	30+						stone
Pedon 38							
Oi	0-0.5		PT		D		
OA	0.5-4	7.5YR2.5/2	MKS		M	3VF,F,M	
C	4-11	10YR4/3	S		M	3VF,F,2M	
2Bwb	11-15	7.5YR4/4	GSIL,30%S	15	M	2VF,F	
2BC	15-22	5YR4/3	GVSIL	60	M	1VF,F	22” to sand
Cr	22+						stone
Pedon 39							
Oi	0-0.5		PT		D		
C1	0.5-6	2.5Y4/3	S	5	D	3VF,F	Sandy texture
Oa/C	6-7	10YR2/2;2.5Y4/3	MKS		M	1VF,F,3M,1C	
Bwb	7-19	10YR4/3;7.5YR4/6	S	10	M	1VF,F	
Ab	19-21	10YR3/2	S		M	1VF,F	
2C2	21-30	2.5Y4/3	S		M		
2C3	30-40	2.5Y6/1	S		M		
Pedon 40							
Oi	0-2		PT		D		
Oe	2-6	7.5YR2.5/3	MKS		M	3VF,F,M	Sandy texture
A	6-10	10YR3/3	S		M	2VF,F,M,C	
AC	10-17	2.5Y4/3	S		M	2VF,F,1M	
C1	17-28	10YR5/3;2.5Y6/1;10YR2/2	S		M	1f,M	
C2	28-30	2.5Y6/1	S		M	1F	
C3	30-40	2.5Y4/3	S		M		
Pedon 41							
Oi	0-2	10YR2/2	PT		D		
Oe	2-6	10YR4/2	PTMK		M	3VF,F,2M,1C	Sandy texture
A	6-19	5YR3/2	S		M	2VF,F	
C1	19-32	10YR4/2	S		M	1VF,F	
C2	32-40	10YR3/2,4/4	S		M	!F	

Table 3. Criteria to Establish Suitability of Topsoil

Parameter	Unsuitable Level
pH	<4.0
Texture	sand, clay
Coarse fragments	
Gravel (2mm-3inch)	>35% by volume
Cobble and stone	>15% by volume
Slope	>33%

Table 4. Maximum Potential Salvage Depth of Topsoils in Jumbo Dome Road Acess Corridor Permitting Area

Map Unit Symbol	Maximum Potential Salvage Depth (inch)	% Slope	Limiting Factors
3	N/A	0	wetness
4	N/A	>100	no topsoil
6	N/A	N/A	utility corridor
13	40	0-15	seasonal wetness
14	40	0-15	sand
15	40	25-60	sand, steep slope
16	40	0-12	sand
17	40	25-50	sand, steep slope
18	N/A	45-90	steep slope
19	N/A	45-90	steep slope
20	40	0-12	wetness, sand
21	40	0-3	wetness
22	40	3-15	wetness
23	40	15-45	wetness, steep slope, stone
24	40	0-8	wetness
25	40	8-25	wetness, sand
30	40	0-15	ocassional gravelly substratum
31	60	0-25	none
32	40	0-25	sandy
33	40	0-15	none
40	40	40-70	sand, steep slope

APPENDIX A.

Soil Profile Descriptions of excavated pits, Jumbo Dome Road Access Corridor

Pit # U-1
Pedon Decription
DATE Sampled: 09/07/2005
Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road
Latitude: 63° 58.792' N
Longitude: 148° 45.261' W
Elevation: 2185 ft asl (GPS)

Slope Characteristic Information
Slope: 1 percent
Aspect: 250 degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province:
Local: terrace
Geomorphic Position: middle slope
Microtopography: slightly undulating and Sphagnum mounds
Surface stones: none
Parent material: alluvium
Drainage: poor (standing water in between mounds and microlows in 20% of the unit)
Runoff: negligible

Type of Erosion: none
Degree of Erosion: none

Classification: Loamy-skeletal, mixed, active, frigid Histic Cryaquept

Vegetative Information:
Landcover type: Spruce forest
Plant Names: *Picea mariana, Betula grandulosa, Salix* spp., *Ledum groenlandicum, Vaccinium vitis-idaea, Vaccinium uliginosum, Calamagrostis canadensis, Hylocumium splendens, Plorusium schreberi*, lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 6 cm; black (7.5YR 3/2) peaty mucky; many very fine, fine and common medium roots; abrupt smooth boundary. (6-10 cm)

Oa - 6 to 22 cm; dark brown (7.5YR3/2) muck; weak medium subangular structure; very friable, nonsticky and nonplastic; many fine and common medium roots; abrupt smooth boundary

Bg – 22 to 41 cm; very dark grayish brown (10YR3/2; 20% 2.5Y3/2 in mass) extremely channery silt loam; 75% subrounded channers (60%), cobblestone and gravel; weak medium subangular structure; friable, slightly sticky and slightly plastic; many very fine, common fine and few medium roots; abrupt wavy boundary

BC – 41 to 75 cm; 55% brown, strong brown (7.5YR4/4, 4/6) sand and 45% very dark grayish brown (10YR3/2) silt loam with 20% Fe concentration (10YR4/4) along platy structure faces; Single grains and strong medium lenticular structures, respectively; loose and nonsticky and nonplastic in sand; friable, slightly sticky and slightly plastic; abrupt smooth boundary

C – 75 to 100 cm; very dark brown (10YR2/2) very gravelly silt loam; 50% angular and subrounded gravel and fractured schist; strong fine lenticular structure; friable, slightly sticky and slightly plastic.

Pit # U- 2
Pedon Decription
DATE Sampled: 09/07/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 58.539’ N
Longitude: 148^{o} 45.312’ W

Slope Characteristic Information
Slope: 8 percent
Aspect: 260 degrees
Horizontal Shape: slightly convex
Vertical Shape: slightly convex
Elevation: 2150 ft asl (GPS)

Physiographic Province:
Local: alluviual fen
Geomorphic Position: upper slope
Microtopography: slightly undulating
Surface stones: none
Parent material: alluvium over river outwash
Drainage: poor
Runoff: negligible

Type of Erosion: none
Degree of Erosion: none

Classification: Loamy-skeletal, mixed, active, frigid Typic Cryaquept

Vegetative Information:
Landcover type: forest tundra
Plant Names: *Picea mariana, Picea glauca, Betula grandulosa, Salix* spp., *Vaccinium vitis-idaea, Vaccinium uliginosum, Calamagrostis canadensis, Hylocumium splendens,* lichens.

Landuse:

Described and sampled by: C.L. Ping

Oi – 0 to 6 cm; dark brown (7.5YR 3/3) peat; many very fine, fine and common medium roots; abrupt smooth boundary.

Oa - 6 to 12 cm; dark brown (7.5YR3/2) muck; weak medium subangular structure; very friable, nonsticky and nonplastic; many very fine, fine, common medium and few coarse roots; abrupt smooth boundary

A – 12 to 16 cm; very dark grayish brown (10YR3/2) extremely cobbly mucky silt loam; 70% cobble stone and gravel; massive; 60% subrounded cobblestone massive; friable, slightly sticky and slightly plastic; many very fine, common fine and few medium roots; abrupt smooth boundary

Bg – 16 to 24 cm; 50% olive brown (2.5Y4/2),40% strong brown (7.5YR4/6) and 10% dark olive brown (2.5Y3/3) gravelly sandy loam; moderate medium platy structure; friable, slightly sticky and slightly plastic; few very fine and fine roots; clear wavy boundary

BC – 24 to 40 cm; dark brown (10YR3/3) very cobbly sandy loam; 60% subrounded cobble and gravel; massive (slightly compact); friable, nonsticky and nonplastic; clear smooth boundary

C – 40 to100 cm; dark brown (10YR3/3) extremely cobbly sandy loam; 70% subrounded cobble, gravel and fractured schist; massive (slightly compact); friable, nonsticky and nonplastic.

Pit # U- 3
Pedon Decription
DATE Sampled: 09/07/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 58.853’ N
Longitude: 148° 45.267’ W

Slope Characteristic Information
Slope: 0 percent
Aspect: degrees
Horizontal Shape:
Vertical Shape:

Elevation: 2152 ft asl (GPS)

Physiographic Province:
Local: alluviual fen
Geomorphic Position: middle of the fen
Microtopography: flat but dissect by draginageways
Surface stones: none
Parent material: alluvium over river outwash
Drainage: very poor
Type of saturation: epi-saturation; periodical inundation of surface water

Type of Erosion: none
Degree of Erosion: none

Classification: Coarse loamy over sandy or sandy-skeletal, mixed, frigid Typic Cryaquept

Vegetative Information:
Landcover type: shrubland
Plant Names: *Picea glauca, Betula grandulosa, Salix* spp., *Vaccinium uliginosum, Carex* spp., *Hylocumium splendens*, lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 5 cm; dark brown (7.5YR 3/3) mucky peat; many very fine, fine and common medium roots; abrupt smooth boundary.

Bw – 5 to 17 cm; brown (10YR4/3) sandy loam; 10% pebble; massive, saturated; friable, nonsticky and nonplastic; many very fine, common fine and few medium roots; abrupt smooth boundary

Bg1 – 17 to 30 cm; very dark grayish brown (2.5Y3/2) silt loam; 10% pebble weak medium platy structure; friable, slightly sticky and slightly plastic; few very fine and fine roots; abrupt wavy boundary

Bg2 – 30 to 50 cm; brown (7.5YR4/4) gravelly sandy loam; 16% pebble; massive friable, nonsticky and nonplastic; abruptr smooth boundary

2C – 50 to100 cm; variegated very gravelly sand; 65% clean gravel.

Pit # U- 4
Pedon Decription
DATE Sampled: 09/07/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 58.’ N
Longitude: 148^{o} 45.’ W

Elevation: 2170 ft asl (GPS)

Slope Characteristic Information
Slope: 52 percent
Aspect: 110degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province:
Local: terrace break
Geomorphic Position: middle slope
Microtopography: slightly undulating
Surface stones: none
Parent material: outwash
Drainage: excessive
Type of saturation: none (upland)

Type of Erosion: sheet
Degree of Erosion: moderate

Classification: Coarse loamy over sandy or sandy-skeletal, mixed, frigid Typic Cryorthod

Vegetative Information:
Landcover type: open forest
Plant Names: *Picea glauca, Betula grandulosa, Salix* spp., *Vaccinium vitis-idaea, Empetrum nigrum,* lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 2 cm; very dark brown (7.5YR 2.5/2) peat; many very fine, few fine and common medium roots; abrupt smooth boundary.

AE – 2 to 6 cm; brown (10YR4/2) fine sandy loam; weak medium platy structure; friable, slightly sticky and slightly plastic; common very fine, fine, many medium and few coarse roots; clear smooth boundary

Bs1 – 6 to 25cm; brown (7.5Y4/4) very gravelly sandy loam; 40% gravel, Fe-organic complex undercoating; weak medium subangular structure; friable, nonticky and nonplastic; many medium and common fine roots; abrupt smooth boundary

Bs2 – 25 to 30 cm; strong brown (7.5YR4/6) loam sand; single grain; loose, nonsticky and nonplastic; many medium and common fine roots abrupt smooth boundary

BC – 30 to55 cm; yellowish brown (10YR5/4) sand, single grain; loose, nonsticky and nonplastic; few fine and medium roots; clear smooth boundary

C – 55 to 100 cm; brown (10YR5/3) sand; single grain; loose, nonsticky and nonplastic; few fine roots.

Pit # U- 5
Pedon Decription
DATE Sampled: 09/07/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 58.864' N
Longitude: 148° 45.170' W
Elevation: 2177 ft asl (GPS)

Slope Characteristic Information
Slope: 8 percent
Aspect: 280 degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province:
Local: terrace
Geomorphic Position: middle slope
Microtopography: slightly undulating
Surface stones: none
Parent material: loess over outwash
Drainage: moderately well
Type of saturation: none (upland)

Type of Erosion: sheet
Degree of Erosion: moderate

Classification: Coarse loamy over sandy or sandy-skeletal, mixed, frigid Humic Dystrocryept

Vegetative Information:
Landcover type: shrubland
Plant Names: *Picea glauca* (scattered), *Betula grandulosa, Salix* spp., *Vaccinium vitis-idaea, Empetrum nigrum, Vaccinium uliginosum, Hylocumium splendens, Polytricum* spp., *Kinnikinnick,* lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 4 cm; very dark brown (7.5YR 2.5/2) mucky peat; many very fine, few fine and common medium roots; abrupt smooth boundary.

A – 4 to 21 cm; very dark brown (10YR2/2) and very dark grayish brown (10YR3/2) very cobbly silt loam; 30% 5-10" flat cobblestones and 10% gravel; weak medium platy structure; friable, slightly sticky and slightly plastic; many very fine, fine, common medium roots; abrupt smooth boundary

Bw – 21 to 42 cm; mixed; 40% very dark grayish brown (10YR3/2) silt loam and 60% strong brown (7.5Y4/6) gravelly sand; strong thin platy structure in silt loam; friable, slightly sticky and slightly plastic; single grain and nonsticky and nonplastic in sand; common very fine, fine and few medium roots; clear smooth boundary

BC – 42 to 70 cm; stratified strong brown (7.5YR4/6) gravelly sand and dark yellowish brown (10YR4/4) gravelly sandy loam; single grain; loose, nonsticky and nonplastic; few fine and medium roots; clear smooth boundary

C – 70 to 100 cm; very dark grayish brown (10YR3/2) very gravelly silt loam; massive, compact; slightly firm, slightly sticky and slightly plastic.

Pit # U- 6
Pedon Decription
DATE Sampled: 09/07/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 58.910' N
Longitude: 148^{o} 45.045' W
Elevation: 2130 ft asl (GPS)

Slope Characteristic Information
Slope: 34 percent
Aspect: 110degrees
Horizontal Shape: complex
Vertical Shape: complex

Physiographic Province: Alaska Range
Local: valley
Geomorphic Position: upper slope
Microtopography: slump, undulating
Surface stones: none
Parent material: colluvium
Drainage: poor
Type of saturation: endo saturation (ground water)

Type of Erosion: gully
Degree of Erosion: moderately high

Classification: Coarse loamy over sandy or sandy-skeletal, mixed, frigid Typic Cryaquept

Vegetative Information:
Landcover type: forest

Plant Names: *Picea mariana, Betula grandulosa*, Salix spp., *Vaccinium uliginosum, Carex spp., Calamagrostas canadensis, Hylocumium splendens, Polytricum* spp., *Sphagnum* spp., *Empetrum nigrum*, lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 8 cm; black (10YR 2/1) and very dark brown (10YR2/2) mucky peat; many very fine, few fine and few medium roots; abrupt irregular boundary (0-10 cm)

Oa – 8 to 11 cm; very dark brown (10YR2/2) muck; many very fine, fine and few medium roots; abrupt irregular boundary (0-8 cm)

BE – 11 to 23cm; brown (10Y4/3) very cobbly sandy loam; 40% cobblestone; weak medium subangular structure; friable, nonticky and nonplastic; many many very fine, fine and few medium roots; abrupt smooth boundary (2-12 cm)

Bw – 23 to 36 cm; strong brown and brown (7.5YR4/6; 4/4) very cobbly sandy loam; 40% cobblestoneand 10% gravel; weak medium subangular structure; friable, nonticky and nonplastic; common very fine, fine and few medium roots; abrupt smooth boundary

Bg 1– 36 to59 cm; dark gray (2.5Y4/1) silt loam; 10% black (2.5Y2/1) soft pyrite mass; strong H_2S smell; massive; slightly firm, slightly sticky and slightly plastic; few fine roots; abrupt smooth boundary

Bg2 – 59 to 90 cm; stratified bands of 40% brown (10YR4/4), 40% dark grayish brown (2.5Y4/2) and strong brown (7.5YR4/6) sandy loam; weak medium platy structure; friable; slightly sticky and slightly plastic.

Pit # U- 7
Pedon Decription
DATE Sampled: 09/07/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63^{o} 58.946’ N
Longitude: 148^{o} 44.997’ W
Elevation: 2198 ft asl (GPS)

Slope Characteristic Information
Slope: 52 percent
Aspect: 300 degrees
Horizontal Shape: plane
Vertical Shape: convex

Physiographic Province:
Local: rolling Mountain

Geomorphic Position: back slope
Microtopography: slightly undulating
Surface stones: 0.5% boulder
Parent material: loess over outwash
Drainage: moderately well
Type of saturation: none (upland)

Type of Erosion: gully
Degree of Erosion: high

Classification: Coarse silty over sandy or sandy-skeletal, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca* (scattered), *Betula grandulosa, Salix* spp., *Ledum Groenlandicum; Vaccinium vitis-idaea, Empetrum nigrum, Vaccinium uliginosum, Hylocumium splendens, Polytricum* spp., *Calamagrostis canadensis*, lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 10 cm; dry moss layer; abrupt smooth boundary (0-20 cm)

A1 – 10 to 30 cm; very dark brown (10YR2/2) silt loam; weak coarse subangular structure; friable, slightly sticky and slightly plastic; many very fine, fine, medium and common coarse roots; clear smooth boundary

A2 – 30 to 55 cm; very dark brown (10YR2/2) extremely cobbly silt loam; 60% cobblestone and 10 % gravel; weak medium platy structure; friable, slightly sticky and slightly plastic; many very fine, fine and few medium roots; clear smooth boundary

2AC – 55 to 80 cm; very dark grayish brown (10YR3/2) very gravelly sand; single grain; loose, nonsticky and nonplastic; few very fine and fine roots; clear smooth boundary

2C – 80 to 100 cm; gray (2.5Y5/1) gravelly sand; single grain; loose, nonsticky and nonplastic.

Pit # U-8
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 58.’ N
Longitude: 148^{o} 45.’ W
Elevation: ft asl (GPS)

Slope Characteristic Information
Slope: 0 percent
Aspect: degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province: Alaska Range
Local: River terrace
Geomorphic Position: middle terrace
Microtopography: slightly undulating and moss mounds
Surface stones: none
Parent material: alluvium/outwash
Drainage: somewhat poor
Runoff: negligible
Type of saturation: Episaturation (surface inundation)
Type of Erosion: none
Degree of Erosion: none

Classification: Coarse-loamy over sandy or sandy-skeletal, mixed, frigid Aquic Dystrocryept

Vegetative Information:
Landcover type: Spruce forest
Plant Names: Picea mariana, Betula grandulosa, Salix spp., Ledum groenlandicum, Vaccinium vitis-idaea, Vaccinium uliginosum, Calamagrostis canadensis, Hylocumium splendens, Pleurozium schreiberi, lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 4 cm; very dark brown (7.5YR 2.5/3) peat; many very fine, fine and common medium roots; abrupt smooth boundary

A - 4 to 8 cm; very dark grayish brown (10YR3/2) silt loam; weak medium platy structure; friable, slightly sticky and slightly plastic; common very fine, fine and many medium roots; abrupt smooth boundary

Bw – 8 to 24 cm; strong brown (7.5YR 4/6) silt loam; 40% gray (2.5Y4/1) and dark grayish brown (2.5Y4/2) coarse mottles; moderate medium platy structure; friable, slightly sticky and slightly plastic; few very fine and fine roots; clear smooth boundary

2BC – 24 to 32 cm; brown (10YR4/3) very cobbly sandy loam; 30% very dark gray (2.5Y4/3) Fe-depletion and 10% strong brown (10YR4/6) Fe-concentration in platy masses; weak medium platy structure; few very fien and fine roots; clear wavy boundary

2C – 32 to 100 cm; variegated extremely gravelly sand; single grain,; loose, nonsticky and nonplastic.

Pit # U- 9
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 58.521' N
Longitude: 148° 45.534' W
Elevation: ft asl (GPS)

Slope Characteristic Information
Slope: 14 percent
Aspect: 230 degrees
Horizontal Shape: plane
Vertical Shape: slightly concave

Physiographic Province:
Local: foothill
Geomorphic Position: middle slope
Microtopography: hummocky (moss mounds)
Surface stones: none
Parent material: residue/colluvium
Drainage: poor
Runoff: medium
Type of saturation: endosaturation (ground water; water table @50 cm)

Type of Erosion: grill
Degree of Erosion: medium

Classification: Coarse loamy, mixed, frigid Histic Cryaquept

Vegetative Information:
Landcover type: forest tundra
Plant Names: *Picea mariana, Salix spp., Vaccinium vitis-idaea, Vaccinium uliginosum, Carex* spp., *Empetrum nigrum; Pleurozium schriberi; Sphagnum* spp., river moss

Described and sampled by: C.L. Ping

Oi – 0 to 10 cm; dark brown (7.5YR 3/3) peat; dead moss; abrupt irregular boundary.

Oa - 10 to 21 cm; black (10YR2/1) muck; saturated; many very fine, fine and common roots; abrupt smooth boundary (pH 6.34)

Bg1 – 21 to 35 cm; dark grayish brown (2.5Y4/2) sandy loam; saturated; massive; nonsticky and nonplastic; common very fine, fine and few medium roots; abrupt smooth boundary

Bg 2– 35 to 50 cm; 60% brown (10YR4/4),40% dark grayish brown (2.5Y4/2) sandy loam; saturated; nonsticky and nonplastic; common fine and few medium roots.

Pit # U- 10
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 58.603' N
Longitude: 148° 45.534' W
Elevation: ft asl (GPS)

Slope Characteristic Information
Slope: 34 percent
Aspect: 260 degrees
Slope Shape: vertical –convex; horizontal - convex

Physiographic Province: Alaska Range
Local: rolling hills
Geomorphic Position: bavck slope
Microtopography: flat but dissect by draginageways
Surface stones: 0.5%
Parent material: sand stone
Drainage: well
Type of saturation: n/a

Type of Erosion: none
Degree of Erosion: none

Classification: Sandy, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Betula grandulosa, Ledum decumbens, Empetrum nigrum, Salix* spp., *Vaccinium uliginosum, Vaccinium vitis-idaea, Hylocumium splendens, Pleurozium schriberi, Polytricum* spp., *Cladonia* spp., *Cladina* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 9 cm; dark brown (7.5YR 3/2) peat; common very fine, fine, many medium and few coarse roots; abrupt smooth boundary.

Oe – 9 to 11 cm; dark brown (7.5YR 3/2) peaty muck; many very fine, fine, medium and few coarse roots; abrupt smooth boundary

Oa – 11 to 19 cm; black (7.5YR2.5/1) muck; weak medium platy structure; many very fine, fine roots; abrupt smooth boundary

Bw – 19 to 23 cm; brown (10YR4/4) sandy loam; weak medium granular structure; very friable, nonsticky and nonplastic; many very fine, fine, and few medium roots; abrupt wavy boundary

2BC – 23 to 44 cm; brown (10YR4/3) very cobbly sand; single grain; loose, nonsticky and nonplastic; many very fine, fine, and few medium roots; abrupt smooth boundary

3C – 44 to100 cm; brown (2.5Y4/3) sand; few fine and medium roots.

Pit # U- 11
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 58.710' N
Longitude: 148° 45.470' W

Slope Characteristic Information
Slope: 0 percent
Aspect: degrees
Horizontal Shape: plane
Vertical Shape:
Elevation: 2156 ft asl (GPS)

Physiographic Province:
Local: terrace
Geomorphic Position:
Microtopography:
Surface stones: none
Parent material: alluvium (schist rock)
Drainage: poor
Type of saturation: episaturation

Type of Erosion: sheet
Degree of Erosion: moderate

Classification: Coarse-loamy, mixed, frigid Histic Cryaquept

Vegetative Information:
Landcover type: open forest

Plant Names: *Picea mariana, Betula grandulosa, Betula nana, Salix* spp., *Calamagrostis canadensis, Sphagnum* spp., river moss

Described and sampled by: C.L. Ping

Oe – 0 to 7 cm; dark reddish brown (5YR3/2) peaty muck; many very fine, fine and medium roots; abrupt smooth boundary.

Oa – 7 to 20 cm; dark brown (7.5YR3/3) mucky silt loam mixed with lens of dark reddish brown (5YR3/2) muck; weak medium platy structure; friable, nonsticky and slightly plastic; many very fine, fine and medium roots; abrupt smooth boundary

Bg – 20 to 39 cm; very dark gray (2.5Y3/1) silt loam; 20% strong brown (7.5YR4/6) and 10% dark brown (7.5YR3/3) Fe-concentration in pore linings, and 10% as mass as strong brown (10YR4/6) prominent coarse mottles; moderate, medium platy structure; friable, slightly sticky and slightly plastic; common very fine, fine roots; abrupt smooth boundary

BC – 39 to 79 cm; dark gray (10YR4/1) sandy loam; Fe-concentrations as common fine pore linings (10YR4/4) and faint medium Fe- concentrations (10YR4/4) in mass; moderate, medium platy structure; friable, nonsticky and slightly plastic; few very fine, fine roots; abrupt smooth boundary

C – 79 to 100 cm; brown (10YR4/4) gravelly sandy loam; 20% gravel; massive; friable, nonsticky and nonplastic; few fine roots.

Pit # U- 12
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63^{o} 58.673’ N
Longitude: 148^{o} 45.514’ W
Elevation: 2171 ft asl (GPS)

Slope Characteristic Information
Slope: 0 percent
Aspect: degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province:
Local: terrace
Geomorphic Position:
Microtopography:
Surface stones: none

Parent material: loess over outwash
Drainage: somewhat poor
Type of saturation: episaturation (upland)

Type of Erosion: none
Degree of Erosion: minimal

Classification: Coarse-silty over sandy or sandy-skeletal, mixed, frigid Typic Cryaquept

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Picea mariana, Betula grandulosa, Salix* spp., *Vaccinium vitis-idaea, Vaccinium uliginosum, Ledum decumbins, Pleurozium schriberi, Polytricum* spp., *Cladonia* spp., *Cladona* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 7 cm; very dark brown (7.5YR 2.5/2) peat; many very fine, few fine and common medium roots; abrupt smooth boundary.

A/O – 7 to 16 cm; black (10YR2/1) and 40% reddish brown (5YR4/3) mucky silt loam; many fine charcoal particles; many very fine, fine, and few medium roots; abrupt smooth boundary

Bg – 16 to 35 cm; dark gray (2.5Y4/1) silt loam; 30% strong brown (7.5Y4/6) Fe-concentration as prominent, medium masses and pore linings; weak thin platy; friable, slightly sticky and slightly plastic; common very fine, fine roots; clear smooth boundary

BC – 35 to 80 cm; stratified brown (7.5YR4/4, 60%) dark gray (2.5Y4/1) loamy sand; massive; very friable, nonsticky and nonplastic; few fine roots; clear smooth boundary

C – 80 to 100 cm; variegated gravelly sand.

Pit # U- 13
Pedon Decription
Date Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 58.616’ N
Longitude: 148^{o} 45.409’ W
Elevation: 2254 ft asl (GPS)

Slope Characteristic Information
Slope: 7 percent
Aspect: 280 degrees

Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: High terrace
Geomorphic Position: middle slope
Microtopography: slightly undulating
Surface stones: none
Parent material: alluvium
Drainage: moderately well
Type of saturation: episaturation (surface water)

Type of Erosion: sheet
Degree of Erosion: low

Classification: Coarse-loamy, mixed, frigid Histic Cryaquept

Vegetative Information:
Landcover type: forest
Plant Names: *Picea mariana, Picea glauca, Betula grandulosa, Salix* spp., *Vaccinium uliginosum, Carex* spp., *Sphagnum* spp., *Hylocumium splendens, Polytricum* spp., *Pleurozium schriberi,* lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 4 cm; dark brown (7.5YR3/2) very channery peaty muck; many very fine, few fine and common medium roots; 45% channers 5 – 15 " dia. at base of horizon; abrupt irregular boundary (pH 3.6)

Oa – 4 to 20 cm; very dark brown (7.5YR2.5/2) muck; strong medium platy structure; friable, nonticky and nonplastic; many very fine, fine and common medium roots; abrupt irregular boundary

A – 20 to 27 cm; very dark grayish brown (10Y3/2) silt loam; moderate medium platy structure; friable, slightly sticky and slightly plastic; many very fine, fine roots; abrupt irregular boundary (0-8 cm)

Oa' – 27 to 35 cm; black (7.5YR2.5/1) muck; weak medium platy break to fine subangular structure; friable, nonticky and nonplastic; many very fine, fine medium roots; abrupt smooth boundary

Bw1– 35 to 43 cm; very dark grayish brown (10YR3/2) sandy loam; weak medium platy structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; clear smooth boundary

Bw2 – 43 to 55 cm; stratified bands brown (10YR4/2) and dark brown (2.5Y3/2) sandy loam; 10% brown (10YR4/4) Fe-concentrations; weak medium platy structure; very friable; nonsticky and nonplastic; few fine and medium roots; clear smooth boundary

BC – 55 to 90 cm; stratified dark grayish brown (2.5Y4/2) silt loam and brown (10YR4/4) loamy sand; Fe-concentratins as prominent medium to coarse masses and pore linings; moderate fine platy structure; very friable, nonsticky and nonplastic; no roots; abrupt smooth boundary

2C – 90 to 100 cm; brown (10YR4/4) gravelly loamy sand; massive; very friable, nonsticky and nonplastic; 20% gravel.

Pit # U- 14
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 58.537' N
Longitude: 148° 45.731' W
Elevation: 2139 ft asl (GPS)

Slope Characteristic Information
Slope: 0 percent
Aspect: degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province:
Local: Flood plain
Geomorphic Position:
Microtopography: dissected by tributaries
Surface stones: none
Parent material: alluvium over outwash
Drainage: somewhat poor
Type of saturation: episaturation (inundation by river)

Type of Erosion: gully
Degree of Erosion: high

Classification: Coarse-loamy, mixed, frigid Typic Cryaquent

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca* (scattered), *Alnus tenuifolia, Salix* spp., *Calamagrostis canadensis*, river moss

Described and sampled by: C.L. Ping

Oi – 0 to 2 cm; dark brown (7.5YR3/2) peat; many very fine, fine, common medium and few coarse roots; abrupt smooth boundary

A – 2 to 13 cm; dark grayish brown (2.5Y4/2) stratified sandy loam with buried organic matter about 1 cm thick; ; weak fie platy structure; very friable, nonsticky and nonplastic; many very fine, fine, medium and common coarse roots; abrupt smooth boundary

Bw– 13 to 22 cm; 60% brown (10YR4/4) and strong brown (10YR4/6) mica-rich loamy sand and 30% dark gray (2.5Y4/1) silt loam; one coarse coal fragment at lower boundary; weak medium platy structure; friable, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt smooth boundary

Bg– 22 to 80 cm; stratified dark gray (2.5Y4/1) sandy loam and variegated oxidized sand (10YR4/4); one medium branch; few fine and medium roots; clear smooth boundary

C – 80 to 100 cm; variegated gravelly sand; single grain; loose, nonsticky and nonplastic.

Pit # U-15
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road
Latitude: 63^{o} 58.453' N
Longitude: 148^{o} 45.772' W
Elevation: 2209 ft asl (GPS)

Slope Characteristic Information
Slope: 70 percent
Aspect: 340 degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province:
Local: Mountain
Geomorphic Position: back slope
Microtopography:
Surface stones: none
Parent material: colluvium
Drainage: somewhat excessive
Runoff: rapid

Type of Erosion: sheet and grill
Degree of Erosion: high

Classification: Coarse-loamy, mixed, frigid Lithic Dystrocryept

Vegetative Information:
Landcover type: Spruce forest

Plant Names: *Picea mariana, Betula grandulosa, Alnus crispa, Ledum groenlandicum, Vaccinium vitis-idaea, Vaccinium uliginosum, Sphagnum* spp., *Hylocumium splendens, Cladonia* sp., *Cladina* sp.

Described and sampled by: C.L. Ping

Oi – 0 to 4 cm; very dark brown (10YR 2/2) peat; many very fine, fine and common medium roots; abrupt smooth boundary

Bw – 4 to 12 cm; yellowish brown (10YR5/6) gravelly sandy loam; 30% fractured schist; weak medium subangular structure; friable, slightly sticky and slightly plastic; abrupt smooth boundary

R – 12+ cm; fractured schist bedrock; dense root mat over rock fragment and into cracks.

Pit # U- 16
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road
Latitude: 63^{o} 58.539' N
Longitude: 148^{o} 45.772' W
Elevation: 2172 ft asl (GPS)

Slope Characteristic Information
Slope: 70 percent
Aspect: 260 degrees
Horizontal Shape: slightly concave
Vertical Shape: slightly convex
Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: bak slope; upper slope
Microtopography: slightly undulating
Surface stones: none
Parent material: colluvium
Drainage: well
Runoff: very rapid

Type of Erosion: gully
Degree of Erosion: severe

Classification: Coarse-loamy, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: forest

Plant Names: *Picea glauca, Betula grandulosa, Salix* spp., *Alnus crispa, Vaccinium vitis-idaea, Empetrum nigrum, Ledum decumbens, Calamagrostis canadensis, Hylocumium splendens, Lycopodium* spp., *Rhododendren* sp., lichens.

Described and sampled by: C.L. Ping

Oe– 0 to 7 cm; very dark brown (7.5YR 2.5/2) peaty muck; many very fine, fine, and medium roots; abrupt smooth boundary.

Bw – 7 to 20 cm; brown (10YR5/3) gravelly sandy loam; 20% angular rock fragments; weak subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and few medium roots; clear smooth boundary

C1 – 20 to 60 cm; light brown (10YR6/4) sandy loam; 10% gravel; massive; friable, slightly sticky and slightly plastic; common medium and few very fine roots; clear smooth boundary

C2 – 60 to 100 cm; light brown (10YR6/4) sandy loam; 10% gravel; massive; friable, slightly sticky and slightly plastic; no roots.

Pit # U- 17
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road

Latitude: 63° 58.353' N
Longitude: 148° 45.897' W
Elevation: 2316 ft asl (GPS)

Slope Characteristic Information
Slope: 20 percent
Aspect: 80 degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: shoulder slope
Microtopography: slightly undulating
Surface stones: none
Parent material: outwash
Drainage: somewhat excessive
Type of saturation: n/a

Type of Erosion: grill on exposed slope
Degree of Erosion: moderate

Classification: Sandy-skeletal, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Betula grandulosa, Vaccinium vitis-idaea, Empetrum nigrum Vaccinium uliginosum, Ledium decumbens, Ledum groenlandicum*, lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 7 cm; very dark brown (7.5YR 2.5/2) peat; common very fine, fine and medium roots; abrupt smooth boundary.

Oe – 7 to 10 cm; very dark brown (7.5YR 2.5/2) peaty muck; moderate fine and medium crumb structure; very friable, nonsticky and nonplastic; many very fine, fine and medium roots; abrupt smooth boundary

Oa – 10 to 12 cm; very dark brown (10YR2/2) muck; moderate medium granular structure; very friable, nonsticky and nonplastic; many very fine, fine and medium roots; abrupt smooth boundary

Bw – 12 to 31 cm; yellowish brown (10YR5/6; 60%) and dark yellowish brown (10YR4/4) sandy loam; 5% gravel; weak thin to medium platy structure; friable, slightly sticky and slightly plastic; common fine and medium roots; abrupt smooth boundary

2BC – 31 to 50 cm; brown (10YR4/3) very cobbly sand; 70% cobblestone and gravel; single grain; loose, nonsticky and nonplastic; few fine and medium roots; clear smooth boundary

2C – 50 to 100 cm; dark grayish brown (10YR4/2) very cobbly sand; 70% cobblestone and gravel; single grain; loose, nonsticky and nonplastic.

U- 18
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road

Latitude: 63^{o} 58.319’ N
Longitude: 148^{o} 45.983’ W

Slope Characteristic Information
Slope: 7 percent
Aspect: 90 degrees

Horizontal Shape: plane
Vertical Shape: slightly convex
Elevation: 2320 ft asl (GPS)

Physiographic Province: Alaska range
Local: terrace
Geomorphic Position: lower slope
Microtopography: slightly undulating
Surface stones: none
Parent material: resuduum
Drainage: poor (surface water in low spot)
Type of saturation: endosaturation (ground water)

Type of Erosion: sheet
Degree of Erosion: low

Classification: Coarse-loamy, mixed, frigid Histic Cryaquept

Vegetative Information:
Landcover type: forest tundra
Plant Names: *Picea glauca, Picea mariana, Betula grandulosa, Salix spp., Empetrum nigrum, Vaccinium uliginosum Vaccinium vitis-idaea, Empetrum nigrum, Ledum decumbeins, Pleurozium schriberi, Polytricum* spp., *Peltigera* spp., lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 9 cm; dark brown (7.5YR 3/2) peaty muck; many very fine, few fine and common medium roots; abrupt smooth boundary.

Oa – 9 to 19 cm; black (7.5YR2.5/1) muck; saturated; many very fine, fine, and few medium roots; abrupt smooth boundary (pH 3.9)

Bw – 19 to 45cm; brown (10YR4/3) fine sandy loam; 10% Fe-depletion (2.5Y4/1) and 7% Fe-concentration (10YR4/6) as pore linings and along ped surface; moderate thin platy structure; friable, slightly sticky and slightly plastic; common very fine, fine and few medium roots; clear smooth boundary (pH3.8)

Bg – 45 to 70 cm; dark gray (2.5Y4/1) fine sandy loam; saturated; common medium elongated Fe-concentrations (10YR4/4) in mass; 10% pebble; weal fine platy structure; friable, slightly sticky and slightly plastic; few fine roots; clear smooth boundary

C – 55 to 100 cm; dark yellowish brown (10YR4/4) gravelly sandy loam; 20% gravel; massive, saturated; nonsticky and nonplastic.

Pit #: U- 19
Pedon Description
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 55.739' N
Longitude: 148° 47.498' W
Elevation: 2183 ft asl (GPS)

Slope Characteristic Information
Slope: 85 percent
Aspect: 120degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: upper back slope
Microtopography: undulating
Surface stones:
Parent material: colluvium/outwash/sandstone
Drainage: excessive
Type of saturation: none (upland)

Type of Erosion: gully
Degree of Erosion: severe

Classification: Sandy, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: forest (old spruce stand)
Plant Names: *Picea glauca, Pleurozium schriberi, Hylocumium splendens*, *Viburnum edule*, *Epilobium angustafolia, Fescue* spp., *Polytricum* spp., *Peltigera* spp..

Described and sampled by: C.L. Ping

Oi – 0 to 9 cm; very dark brown (10YR 2/2) peat; many very fine, few fine and common medium roots; abrupt smooth boundary.

A – 9 to 39 cm; dark yellowish brown (10YR3/4) loamy sand; 10% gravel; massive; very friable, nonsticky and nonplastic; many very fine, fine, medium and few coarse roots; clear smooth boundary

AC – 39 to 61 cm; dark olive brown (2.5Y3/3) gravelly sand; 20% gravel; single grain, nonsticky and nonplastic; common very fine, fine and medium roots; 1.5 cm thick black sandy band (10YR2/1) at 51-52cm; clear smooth boundary

C – 61 to 120 cm; dark grayish brown (2.5Y4/2) sand; single grain, nonsticky and nonplastic; few fine and medium roots to 85 cm.

Pit #: U- 20
Pedon Decription
DATE Sampled: 09/09/2005
Soil Series: Not surveyed
Location Information
Soil Survey Area: Jumbo Dome Access Road

Latitude: 63° 55.808' N
Longitude: 148° 47.664' W
Elevation: 2130 ft asl (GPS)

Slope Characteristic Information
Slope: 50 percent
Aspect: 20degrees
Horizontal Shape: complex
Vertical Shape: complex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: upper shoulder slope
Microtopography: landslide slump, undulating
Surface stones: none
Parent material: colluvium
Drainage: well
Type of saturation: none (upland)
Type of Erosion: gully
Degree of Erosion: moderately high

Classification: Sandy, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: forest
Plant Names: Picea glauca, Alnus crispa, rosa acicularis, Equisetum sp., Calmagrostas Canadensis, Hylocumium splendens, Polytricum sp., lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 4 cm; dark brown (10YR 3/3) mucky peat; many very fine, common fine and many medium roots; abrupt smooth boundary

A – 4 to 27 cm; very dark brown (7.5YR2.5/3) sand; single grain; loose, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt wavy boundary

B&A – 27 to 39 cm; brown (10YR4/3) sand mixed with 30% very dark brown (7.5YR2.5/2) A in pockets; single grain; loose, nonsticky and nonplastic; many very fine, fine roots; abrupt smooth boundary

Oa'– 39 to 46 cm; very dark brown (7.5YR2.5/2) mucky sand; single grain; loose, nonsticky and nonplastic; common very fine, fine and few medium roots; abrupt wavy boundary

ACb – 46 to 60 cm; olive brown (2.5Y4/3) sand; single grain; loose, nonsticky and nonplastic; common fine and few medium roots; clear wavy boundary

C – 60 to 100 cm; dark grayish brown (2.5Y4/2) sand; few prominent medium (1.2 cm dia.) strong brown (7.5YR4/6) mottles; single grain; loose, nonsticky and nonplastic; few very fine, fine and medium roots.

Pit #: U- 21
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63^{o} 55.860' N
Longitude: 148^{o} 47.646' W
Elevation: ft asl (GPS)

Slope Characteristic Information
Slope: 14 percent
Aspect: 110 degrees
Horizontal Shape: slightly concave
Vertical Shape: plane

Physiographic Province: Alaska Range
Local: rolling Mountain
Geomorphic Position: headwater at valley bottom
Microtopography: short terraces
Surface stones: none
Parent material: alluvium
Drainage: well
Type of saturation: none (upland)

Type of Erosion: sheet and gully
Degree of Erosion: moderate

Classification: Sandy, mixed, frigid Typic Cryofluvent

Vegetative Information:
Landcover type: forest
Plant Names: *Alnus crispa, Epilobium angustafolia, Rubus* spp., (Rassbery) *Rabis triasic, Equisetum* spp., *Viburnum edule, Calamagrostis canadensis*, mosses and lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 3 cm; very dark brown (10YR2/2) peat mostly from bluejoint straw; common fine and medium roots; abrupt smooth boundary

A – 3 to 20 cm; dark brown (10YR3/3) coarse sand with 20% stratified very dark brown (10YR2/2) loamy sand and one lens of medum (1cm) very dark brown (10YR2/2) Oe at 12 cm depth; single grain; loose, nonsticky and nonplastic; many medium, common very fine and fine roots; abrupt smooth boundary

Ab – 20 to 24 cm; dark brown (10YR3/3) silt loam; weak medium platy structure; friable, slightly sticky and slightly plastic; common very fine, fine and few medium roots; abrupt smooth boundary

C1 – 24 to 30 cm; olive brown (2.5Y4/3) sand; single grain; loose, nonsticky and nonplastic; common very fine and fine roots; abrupt smooth boundary

Ab' – 30 to 38 cm; dark grayish brown (10YR4/2) loamy coarse sand; single grain; loose, nonsticky and nonplastic; common very fine and fine roots; abrupt smooth boundary

A&C2 – 38 to 100 cm; stratified A and C bands of 5-15 cm thick; dark brown (10YR3/3) loamy sand and brown (10YR4/3) sand; single grain; loose, nonsticky and nonplastic; few fine and very fine roots.

Pit # U-22
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Road Access area
Latitude: 63° 54.866' N
Longitude: 148° 47.583' W
Elevation: 2403 ft asl (GPS)

Slope Characteristic Information
Slope: 90 percent
Aspect: 180 degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: back slope
Microtopography: slightly undulating and moss mounds
Surface stones: none
Parent material: colluvium
Drainage: somewhat excessive

Runoff: rapid
Type of saturation: None (upland)
Type of Erosion: gully
Degree of Erosion: severe

Classification: Sandy, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: Spruce forest
Plant Names: *Picea glauca, Rosa acicularis, Alnus crispa, Fescue*, spp., *Vaccinium vitis-idaea, Geocaulon lividum, Kinnikinnick.*

Described and sampled by: C.L. Ping

Oi – 0 to 3 cm; peat; litter layer; abrupt smooth boundary

Oa – 3 to 19 cm; very dark brown (10YR 2/2) mucky sand; many very fine, fine, medium and few coarse roots; abrupt wavy boundary

A - 19 to 31 cm; brown (10YR4/3) loamy sand; weak medium granular structure; very friable, nonsticky and nonplastic; many very fine, fine, common medium and few coarse roots; abrupt smooth boundary

AC – 31 to 50 cm; yellowish brown (10YR 5/4) loamy fine sand; massive; very friable, nonsticky and nonplastic; common very fine, fine and few medium roots; clear smooth boundary

C1 – 50 to 75 cm; olive brown (2.5Y4/3) sandy loam; moderate medium platy structure; very friable, nonsticky and nonplastic; common very fine, fine roots; clear smooth boundary

C2 – 75 to 120 cm; brown (10YR4/3) fine sand; single grain; loose, nonsticky and nonplastic; common very fine and fine roots; abrupt smooth boundary

C3 – 120 cm+; strong brown (7.5YR4/5) sand; single grain; loose, nonsticky and nonplastic.

Pit # U- 23
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road
Latitude: 63^{o} 55.929’ N
Longitude: 148^{o} 47.599’ W
Elevation: 2235 ft asl (GPS)

Slope Characteristic Information

Slope: 60 percent
Aspect: 220 degrees
Horizontal Shape: convex
Vertical Shape: concave

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: shoulder slope; middle slope
Microtopography: smooth
Surface stones: none
Parent material: residue/sandstone
Drainage: excessiver
Runoff: rapid
Type of saturation: none (upland)

Type of Erosion: gully and sheet
Degree of Erosion: severe

Classification: Sandy, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Betula papyerifera, Rosa acicularis, Geocaulon lividum, Vaccinium vitis-idaea, Equisetum* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 2 cm; litter layer; abrupt smooth boundary

Oa - 2 to 11 cm; very dark brown (7.5YR 2.5/3) mucky sand; common very fine, fine and many medium roots; abrupt wavy boundary

A – 11 to 24 cm; dark yellowish brown (10YR4/4) sand; single grain; loose, nonsticky and nonplastic; common very fine, fine, medium and few coarse roots; clear smooth boundary

AC – 24 to 60 cm; brown (10YR4/3) sand; single grain; loose, nonsticky and nonplastic; few very fine, fine and common medium roots; abrupt smooth boundary

Ab – 60 to 62 cm; very dark brown (10YR2/2) muck sand; few very fine, fine and medium roots; abrupt smooth boundary

C – 62 to 100 cm; olive brown (2.5Y4/3) sand; single grain; loose, nonsticky and nonplastic; few very fine roots.

Pit # U- 24
Pedon Decription
DATE Sampled: 09/08/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road

Latitude: 63° 56.024' N
Longitude: 148° 47.571' W
Elevation: 2706 ft asl (GPS)

Slope Characteristic Information
Slope: 54 percent
Aspect: 110 degrees
Slope Shape: vertical – complex; horizontal - concave

Physiographic Province: Alaska Range
Local: hills
Geomorphic Position: lower back slope
Microtopography: undulating
Surface stones: none
Parent material: sandstone/coal seam
Drainage: well
Type of saturation: n/a

Type of Erosion: gully
Degree of Erosion: moderate

Classification: Coarse-loamy, mixed, frigid Typic Cryorthent

Vegetative Information:
Landcover type: forest (alder groove)
Plant Names: *Alnus crispa, Betula papyrifera, Ribes* sp., *Calamagrostis Canadensis, Pyrola* sp., *Kennikennick, Pleurozium schriberi*, fern

Described and sampled by: C.L. Ping

Oi – 0 to 4 cm; litter layer; clear smooth boundary

Oe – 4 to 11 cm; very dark brown and dark brown (10YR 3/3; 2/2) sandy mucky peat; 10% gravel; many very fine, fine, and common medium roots; abrupt wavy boundary

AC – 11 to 28 cm; dark yellowish brown (10YR4/4) sand; 12% gravel; single grain; loose, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt wavy boundary

Ab – 28 to 35 cm; brown (10YR4/3) gravelly sand; 20% gravel; single grain; loose, nonsticky and nonplastic; band of very dark brown (10YR2/2) sandy loam on top 1cm and also mixed below as pockets; many very fine, fine, and common medium roots; abrupt wavy boundary

C1 – 35 to 52 cm; dark grayish brown (10YR4/2) loamy sand; single grain; loose, nonsticky and nonplastic; few very fine, fine roots; abrupt smooth boundary

2C2 – 52 to100 cm; dark grayish brown (2.5Y4/2) silt loam mixed with coal particles; moderate medium lenticular structure; friable, slightly sticky and slightly plastic.

Pit # U- 25
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road

Latitude: 63^{o} 56.080' N
Longitude: 148^{o} 47.133' W
Elevation: 2053 ft asl (GPS)

Slope Characteristic Information
Slope: 18 percent
Aspect: 180 degrees
Horizontal Shape: convex
Vertical Shape: complex

Physiographic Province: Alaska Range
Local: foot slope
Geomorphic Position: slump
Microtopography: undulating
Surface stones: none
Parent material: colluvium
Drainage: moderate well
Type of saturation: none

Type of Erosion:
Degree of Erosion:
Classification: Coarse-silty over sandy or sandy-skeletal, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: open forest

Plant Names: *Picea glauca, Betula grandulosa, Vaccinium uliginosum Vaccinium vitis-idaea, Ledum groenlandicum, Equisetum* spp., *Hylocomium splendens, Pleurozium schreberi, Petasites frigidus, Peltigera apthosa.*

Described and sampled by: C.L. Ping

Oe – 0 to 7 cm; black (10YR2/1) peaty muck; common very fine, fine and medium roots; abrupt smooth boundary.

O/A – 7 to 11 cm; black (10YR2/1) mucky sand; weak medium granular structure; very friable, nonsticky and nonplastic; many very fine, fine, common medium and few coarse roots; abrupt smooth boundary

Bw – 11 to 21 cm; dark yellowish brown (10YR3/4) and dark brown (7.5YR3/3) sand; single grain; loose, nonsticky and nonplastic; many very fine, fine and common medium roots; abrupt smooth boundary

BC – 21 to 70 cm; stratified light olive brown (2.5Y5/3) silty clay loam with olive brown (2.5Y4/3) and dark yellowish brown (10YR4/4) sand; strong fine granular structure in silty clay loam; firm, sticky and plastic; single grain, loose, nonsticky and nonplastic in sand; few very fine, fine and common medium roots; clear smooth boundary

C – 70 to 110 cm; dark gray (2.5Y4/1) sand; single grain; loose, nonsticky and nonplastic; few fine and medium roots.

Pit # U- 26
Pedon Decription
DATE Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 55.954’ N
Longitude: 148° 47.292’ W
Elevation: 2171 ft asl (GPS)

Slope Characteristic Information
Slope: 8 percent
Aspect: 200 degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province: Alaska Range
Local: Valley
Geomorphic Position: valley floor
Microtopography: slightly undulating, dissected by drainage ways

Surface stones: 0.5%
Parent material: alluvium
Drainage: very poor
Type of saturation: endosaturation (water table at 25 cm in pit and on surface in microlow)

Type of Erosion: gully
Degree of Erosion: moderate

Classification: Sandy, mixed, frigid Typic Cryaquent

Vegetative Information:
Land cover type: forest
Plant Names: *Picea glauca, Salix* spp.,

Described and sampled by: C.L. Ping

A – 0 to 11 cm; olive brown (2.5Y4/3) loamy coarse sand; single grain; loose, nonsticky and nonplastic; many very fine and fine roots; abrupt smooth boundary

Bg – 11 to 32 cm; 35% dark gray (5Y4/1) silt loam with Fe-conc. in pore linings; 35% dark grayish brown (2.5Y4/2) sand and 30% dark brown (10YR3/3) Fe-concentration as coatings on coarse sand; many very fine common fine roots; clear smooth boundary

C1 – 32 to 60 cm; stratified brown (7.5YR4/4, 60%) dark gray (2.5Y4/1) loamy sand; massive; very friable, nonsticky and nonplastic; few fine roots; clear smooth boundary

C 2– 80 to 100 cm; dark brown (10YR3/3) sand; few fine roots.

Pit #: U- 27
Pedon Decription
Date Sampled: 09/09/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road

Latitude: 63^{o} 55.915’ N
Longitude: 148^{o} 47.304’ W
Elevation: ft asl (GPS)

Slope Characteristic Information
Slope: 48 percent
Aspect: 260 degrees
Horizontal Shape: concave
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: Valley
Geomorphic Position: Toe slope
Microtopography: undulating
Surface stones: none
Parent material: colluvium
Drainage: well
Type of saturation: none

Type of Erosion:
Degree of Erosion:

Classification: Sandy, mixed, frigid Typic Cryopsamment

Vegetative Information:
Landcover type: forest
Plant Names: *Alnus crispa, Calamagrostis canadensis, Rosa acicularis, Ledium groenlandicum, Linnaea borealis, Pyrola* sp., *Kennikenick, Equisetum* sp., *Pleurozium schriberi,* lichens.

Described and sampled by: C.L. Ping

Oi/Oe – 0 to 3 cm; very dark brown (10YR2/2) mucky peat; many very fine, few fine roots; abrupt wavy boundary

A – 3 to 8 cm; very dark grayish brown (10Y3/2) sandy loam; weak medium granular structure; friable, nonsticky and nonplastic; many very fine, fine roots; abrupt smooth boundary

Bw– 8 to 18 cm; olive brown (2.5Y4/3) loamy sand; massive; very friable, nonsticky and nonplastic; many very fine and fine roots; clear wavy boundary

BC – 18 to 37 cm; dark grayish brown (2.5Y4/2) sand; single grain; loose; nonsticky and nonplastic; common very fine and fine roots; clear smooth boundary

C1 – 37 to 72 cm; stratified very dark grayish brown (2.5Y3/2) and olive brown (2.5Y4/3, 30%) sand; single grain; loose, nonsticky and nonplastic; few very fine and fine roots; abrupt smooth boundary

C2 – 72 to 100 cm; very dark grayish brown (2.5Y4/2) gravelly sand; single grain; loose, nonsticky and nonplastic; 20% gravel..

Pit #: U- 28
Pedon Decription
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 58.090' N
Longitude: 148° 46.463' W
Elevation: 2434 ft asl (GPS)

Slope Characteristic Information
Slope: 15 percent
Aspect: 85 degrees
Horizontal Shape: concave
Vertical Shape: concave

Physiographic Province: Alaska Range
Local: Rolling Mountain
Geomorphic Position: foot slope
Microtopography: nonsorted circle (frost boils)
Surface stones: none
Parent material: colluvium
Drainage: somewhat poor
Type of saturation: episaturation

Type of Erosion: gully
Degree of Erosion: high

Classification: Coarse-loamy, mixed, frigid Typic Cryaquept

Vegetative Information:
Landcover type: forest
Plant Names: *Picea mariana, Picea glauca* (scattered), *Betula grandulosa, Vaccinium uliginosum Vaccinium vitis-idaea, Ledum decumbens, Empetrum nigrum, Hylocomium splendens, Salix* spp., *Carex* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 2 cm; litter layer; abrupt smooth boundary

Oa – 2 to 6 cm; very dark brown (10YR2/2) muck; weak medium granular; very friable, nonsticky and nonplastic; many very fine, fine and common medium roots; abrupt smooth boundary (pH 4.6)

Bw– 6 to 19 cm; yellowish brown (10YR5/4) sandy loam; 30% Fe-concentration (10YR5/6) as masses and 20% Fe-depletion (5Y6/1) in pore linings; weak medium platy structure; friable, slightly sticky and slightly plastic; many very fine, fine and few medium roots; abrupt smooth boundary (pH 4.7)

Ab – 19 to 23 cm; dark brown (10YR3/3) sandy loam; moderate fine platy structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; abrupt irregular boundary

Bwb – 23 to 55 cm; dark yellowish brown (10YR4/6) gravelly sandy loam; 20% gravel; 20% white (10YR8/1), 20%light olive brown (2.5Y5/2) Fe-depletion; weak medium platy structure; friable, slightly sticky and slightly plastic; common very fine and few fine roots; clear smooth boundary

BC– 55 to 82 cm; light yellowish brown (2.5Y6/4) gravelly sandy loam; 30% gravel; weak medium platy structure; friable, slightly sticky and slightly plastic; few fine roots; abrupt wavy boundary

Ab' – 82 to 105 cm; brown (10YR4/3) loamy sand; weak medium lenticular structure; very friable, nonsticky and nonplastic; few very fine and fine root remains.

Pit # U-29
Pedon Decription
DATE Sampled: 09/07/2005
Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Access Road
Latitude: 63° 57.979' N
Longitude: 148° 46.601 W
Elevation: 2405 ft asl (GPS)

Slope Characteristic Information
Slope: 8 percent
Aspect: 34 degrees
Horizontal Shape: concave
Vertical Shape: plane

Physiographic Province: Alaska Range
Local: Valley
Geomorphic Position: Alluvial fan
Microtopography: slightly undulating; dissected by drainages
Surface stones: 1%
Parent material: alluvium
Drainage: very poor (standing water in between mounds and microlows)
Type of saturation: endosaturation (water table at 35 cm)

Type of Erosion: gully and grills
Degree of Erosion: moderate

Classification: Sandy, mixed, frigid Typic Cryaquent

Vegetative Information:
Land cover type: scrubland, riparian zone
Plant Names: *Picea glauca, Picea mariana, Salix* spp., *Vaccinium uliginosum, Carex* sp., *Polytricum* sp., (river moss), liverworts.

Described and sampled by: C.L. Ping

Oe – 0 to 5 cm; black (7.5YR 2.5/1) peaty mucky; many very fine, fine and few medium roots; abrupt smooth boundary

Oa - 5 to 9 cm; very dark gray (7.5YR3/1) muck; weak medium granular structure; very friable, nonsticky and nonplastic; many very fine, fine and common medium roots; abrupt smooth boundary

Bg1 – 9 to 15 cm; very dark grayish brown (10YR3/2) sand; 20% Fe-depletion (2.5Y3/2) and Fe-concentration (7.5YR4/4) in mass; single grain; loose, nonsticky and nonplastic; many very fine and fine roots; abrupt smooth boundary

Oa' – 15 to 30 cm; black (10YR2/1) muck. Moderate fine platy structure; very friable, nonsticky and nonplastic; abrupt smooth boundary

Bg2 – 30 to 40 cm; very dark gray (5Y3/1) very stony sand; few faint root channel linings; single grains; loose and nonsticky and nonplastic; many very fine and fine roots; abrupt smooth boundary

C – 40 to 60 cm; variegated extremely cobbly sand

Pit #: U- 30
Pedon Decription
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 57.947' N
Longitude: 148° 46.633' W
Elevation: 2437 ft asl (GPS)

Slope Characteristic Information
Slope: 10 percent
Aspect: 300 degrees
Horizontal Shape: slightly concave
Vertical Shape: slightly convex

Physiographic Province: Alaska Range
Local: High terrace
Geomorphic Position: upper slope
Microtopography: slightly undulating
Surface stones: none
Parent material: loess over alluvium
Drainage: moderately well
Type of saturation: episaturation due to seasonal frost (upland)

Type of Erosion:
Degree of Erosion: low

Classification: Coarse-loamy, mixed, frigid Aquic Dystrocryept

Vegetative Information:
Landcover type: forest tundra
Plant Names: *Picea mariana, Picea glauca, Betula grandulosa, Ledum decumbens, Vaccinium vitis-idaea, Vaccinium uliginosum, Hylocumium splendens, Peltigera* spp., *Polytricum* spp, and lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 8 cm; very dark brown (7.5YR 2.5/2) peat; many very fine, fine and common medium roots; abrupt smooth boundary.

A – 8 to 13 cm; very dark brown (10YR2/2) sandy loam; 20% Fe-depletion (2.5Y4/1) as pore linings in oxidized mass (10YR4/4); moderate medium granular and fine subangular blocky structure; friable, nonsticky and nonplastic; many very fine, fine and medium roots; abrupt wavy boundary

Bw1 – 13 to 39 cm; dark yellowish brown (10YR3/4) sandy loam; massive; very friable, nonsticky and nonplastic; common very fine, fine and medium roots; abrupt smooth boundary

Bw2 – 39 to 50 cm; olive brown (2.5Y4/4) fine sandy loam; 30% Fe-concentration (10YR4/6); common old wood fragments; mica particles visible; weak medium platy structure; very friable, nonsticky and nonplastic; few very fine and fine roots; clear smooth boundary

BC – 50 to75 cm; stratified dark yellowish brown (10YR4/4) and brown (10YR4/3) sand; single grains; loose, nonsticky and nonplastic; clear smooth boundary

C – 75 to 100cm; stratified strong brown (7.5YR5/8, 40%) and olive brown (2.5Y4/3) sandy loam; weak medium platy structure; very friable, nonsticky and nonplastic. .

Pit #: U- 31
Pedon Description
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Road access area
Latitude: 63° 57.839’ N
Longitude: 148° 46.610’ W
Elevation: 2472 ft asl (GPS)

Slope Characteristic Information
Slope: 6 percent
Aspect: 20 degrees

Horizontal Shape: slightly concave
Vertical Shape: slightly concave

Physiographic Province: Alaska Range
Local: Piedmont
Geomorphic Position: middle of the fen
Microtopography: slightly undulating
Surface stones: none
Parent material: loess over alluvium
Drainage: moderately well
Type of saturation: none (upland)

Type of Erosion: none
Degree of Erosion: none

Classification: Coarse-silty, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: forest
Plant Names: *Picea mariana, Picea glauca* (10%), *Betula grandulosa, Ledum decumbens, Vaccinium vitis-idaea, Vaccinium uliginosum*, bog rosemary, *Aulocomium* sp., *Carex* sp., lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 7 cm; very dark brown (7.5YR 2.5/2) mucky peat; many very fine, fine and medium roots; abrupt smooth boundary.

Oa – 7 to 14 cm; very dark brown (10YR2/2) muck sandy loam; massive; friable, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt smooth boundary

A1 – 17 to 30 cm; very dark brown (10YR2/2) silt loam; weak thin platy structure; very friable, slightly sticky and slightly plastic; many very fine, fine and few medium roots; abrupt smooth boundary

A2 – 30 to 34 cm; black (10YR2/1) silt loam; weak thin platy structure; very friable, slightly sticky and slightly plastic; many very fine, fine and few medium roots; abrupt smooth boundary

A3 – 34 to 50 cm; vary dark brown (10YR2/2) and very dark grayish brown (10YR3/2, 40%) silt loam; weak medium platy structure; very friable, slightly sticky and slightly plastic; common fine roots; abrupt smooth boundary

A&B – 50 to 85 cm; very dark grayish brown (10YR3/2) and 45% dark yellowish brown (10YR4/4) silt loam; moderate coarse platy structure; very friable, slightly sticky and slightly plastic; few fine roots; abrupt smooth boundary

C – 50 to100 cm; dark yellowish brown (10YR4/6) loamy fine sand; massive; very friable, nonsticky and nonplastic.

Pit #: U- 32
Pedon Description
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome Road access area
Latitude: 63° 57.756' N
Longitude: 148° 46.273' W
Elevation: 2447 ft asl (GPS)

Slope Characteristic Information
Slope: 2 percent
Aspect: 35 degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: rolling Mountain
Geomorphic Position: shoulder slope
Microtopography: slightly undulating
Surface stones: none
Parent material: loess
Drainage: well
Type of saturation: none (upland)

Type of Erosion:
Degree of Erosion: low

Classification: Coarse silty over sandy or sandy-skeletal, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: open forest
Plant Names: *Picea glauca, Betula grandulosa, Ledum groenlandicum, Vaccinium vitis-idaea, Vaccinium uliginosum, Empetrum nigrum, Lycopodum annotinum, Hylocumium splendens, Polytricum* spp, and lichens.

Described and sampled by: C.L. Ping

Oe – 0 to 9 cm; black (10YR 2/1) peaty muck; weak medium granular structure; very friable, nonsticky and nonplastic; many very fine, few fine and common medium roots; abrupt wavy boundary.

A – 9 to 14 cm; very dark brown (10YR2/2) silt loam; massive; friable, slightly sticky and slightly plastic; common very fine, fine and common medium roots; abrupt smooth boundary

E – 14 to 17 cm; grayish brown (10YR5/2) silt loam; massive; friable, slightly sticky and slightly plastic; many very fine, fine and few medium roots; abrupt smooth boundary

Bw – 17 to 41 cm; dark yellowish brown (10YR4/4; 4/6) very fine sandy loam; 40% dark brown (10YR3/3) streaks; weak medium subangular blocky structure; very friable, nonsticky and nonplastic; common very fine, fine and few medium roots abrupt smooth boundary

Ab – 41 to 45 cm; very dark brown (10YR2/2) silt loam; weak thin platy structure; very friable, nonsticky and slightly plastic; few very fine, fine roots; abrupt smooth boundary

Bwb – 45 to 77 cm; brown (10YR4/4) sandy loam; 20% Fe-depletion (2.5Y4/1) and 10% Fe-concentration (5YR4/6) in masses; 20% black (10YR2/1) streaks; weak thin platy structure; very friable, nonsticky and slightly plastic; few very fine, fine roots; abrupt smooth boundary

C – 77 to 100 cm; grayish brown (2.5Y5/2) sand; single grain; loose, nonsticky and nonplastic.

Pit #: U- 33
Pedon Description
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 57.677' N
Longitude: 148° 46.139' W
Elevation: 2431 ft asl (GPS)

Slope Characteristic Information
Slope: 5 percent
Aspect: 70 degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province: Alaska Range
Local: Floodplain
Geomorphic Position: middle
Microtopography: flat
Surface stones: none
Parent material: alluvium over weathered sandstone
Drainage: poor
Type of saturation: endosaturation

Type of Erosion: sheet
Degree of Erosion: moderate

Classification: Coarse-loamy over sandy or sandy-skeletal, mixed, frigid Typic Cryaquept

Vegetative Information:
Landcover type: shrubland
Plant Names: *Picea glauca, Betula grandulosa, Salix* spp., *Calamagrostis canadensis*, moss.

Described and sampled by: C.L. Ping

Oi – 0 to 5 cm; vary dark brown (10YR 2/2) peat; many very fine, few fine and few medium roots; abrupt smooth boundary

Oe – 5 to 11 cm; very dark brown (7.5YR2.5/3) peaty muck; weak fine granular structure; very friable, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt smooth boundary

Bg1 – 11 to 32cm; dark yellowish brown (10Y3/4) sand; 30% stratified medium prominent mottles (7/5YR3/3) and 10% faint medium mottles (10YR3/2); weak medium platy structure; very friable, nonticky and nonplastic; many many very fine and fine roots; clear smooth boundary

Bg2 – 32 to 50 cm; olive brown (2.5Y4/4) loamy sand; 30% Fe-concentrations (10YR4/4) as pore linings and 20% as masses (10YR3/4); massive; very friable, nonticky and nonplastic; common very fine, fine roots; abrupt smooth boundary

Bg3– 50 to 62 cm; dark grayish brown (2.5Y4/2) silt loam; 20% Fe-concentrations as pore linings (7.5YR4/6); massive; friable, slightly sticky and slightly plastic; few fine roots; abrupt smooth boundary

C – 62 to 100 cm; stratified sand, gravel and silt layers.

Pit #: U- 33b
Pedon Decription
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 57.692’ N
Longitude: 148^{o} 46.111’ W
Elevation: 2445 ft asl (GPS)

SAME as Pit #30, verified.

Pit #: U- 34
Pedon Description
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area: Jumbo Dome access road
Latitude: 63° 57.662' N
Longitude: 148° 45.927' W
Elevation: 2422 ft asl (GPS)

Slope Characteristic Information
Slope: 4 percent
Aspect: 40 degrees
Horizontal Shape: plane
Vertical Shape: plane

Physiographic Province: Alaska Range
Local: terrace
Geomorphic Position:
Microtopography:
Surface stones: 0.5% boulder
Parent material: alluvium
Drainage: moderately well
Type of saturation: none (upland)

Type of Erosion: gully
Degree of Erosion: high

Classification: Coarse-loamy, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Picea mariana, Betula grandulosa, Vaccinium vitis-idaea, Alnus crispa, Vaccinium uliginosum, Polytricum* spp.

Described and sampled by: C.L. Ping

Oe – 0 to 4 cm; very dark brown (7.5YR2.5/3) peat; many very fine, fine and common medium roots; abrupt smooth boundary

OA – 4 to 20 cm; very dark brown (10YR2/2) muck sandy loam; massive; very friable, nonsticky and nonplastic; many very fine, fine, and common medium roots; abrupt wavy boundary

A&B – 20 to 45 cm; stratified very dark brown (10YR2/2, 60%; 7.5YR2.5/2) sandy loam; weak medium platy structure; friable, slightly sticky and slightly plastic; common very fine, fine and few medium roots; abrupt smooth boundary

BC – 45 to 62 cm; light olive brown (2.5Y5/4) and dark yellowish brown (10YR4/6) very fine sandy loam; moderate fine platy structure; very friable, nonsticky and slightly plastic; few very fine and fine roots; clear smooth boundary

C – 62 to 100 cm; olive brown (2.5Y4/3) very fine sandy loam; 10% Fe-concentration dark yellowish brown (10YR4/6) in elongated masses and pore linings; moderate fine platy structure; very friable, slightly sticky and slightly plastic.

Pit #: U-35
Pedon Description
DATE Sampled: 09/10/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 57.595' N
Longitude: 148° 45.936' W
Elevation: 2377 ft asl (GPS)

Slope Characteristic Information
Slope: 4 percent
Aspect: 25 degrees
Horizontal Shape: convex
Vertical Shape: convex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: Alluvial fan, middle terrace
Microtopography: dissected by runoff
Surface stones: none
Parent material: alluvium
Drainage: moderately well
Runoff: negligible
Type of saturation: none)
Type of Erosion: none
Degree of Erosion: none

Classification: Coarse-loamy, mixed, frigid Typic Dystrocryept

Vegetative Information:
Landcover type: Spruce forest
Plant Names: *Picea glauca, Picea mariana, Betula grandulosa, Salix* spp., *Vaccinium vitis-idaea, Vaccinium uliginosum, Hylocumium splendens, Pleurozium schreiberi*, lichens.

Described and sampled by: C.L. Ping

Oi – 0 to 9 cm; very dark brown (7.5YR 2.5/2) peat; many very fine, fine and common medium roots; abrupt smooth boundary

AB - 9 to 15 cm; very dark brown (7.5YR2.5/2) sandy loam; weak thin platy structure; very friable, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt smooth boundary

Bw – 15 to 20 cm; dark brown (7.5YR 3/3) sandy loam; strong thin platy structure; friable, slightly sticky and slightly plastic; many very fine, fine and few medium roots; clear smooth boundary

BC– 20 to48 cm; dark grayish brown (2.5Y4/2) sandy loam; common distinct mottles (10YR4/4) as pore linings; moderate thin platy structure; very friable, nonsticky and nonplastic; many very fine, fine and few medium roots; abrupt smooth boundary

Ab – 48 to 51 cm; very dark brown (10YR2/2) sandy loam; moderate medium granular structure; friable; slightly sticky and slightly plastic; common very fine and fine roots; abrupt smooth boundary

C – 51 to 100 cm; very dark grayish brown (2.5Y3/2) silt loam; 20% brown (10YR4/3) Fe-concentration in pore linings and masses; strong thin platy structure; few fine roots..

Pit #: U- 36
Pedon Description
DATE Sampled: 09/11/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 55.553' N
Longitude: 148° 48.199' W
Elevation: 1733 ft asl (GPS)

Slope Characteristic Information
Slope: 8 percent
Aspect: 290 degrees
Horizontal Shape: slightly convex
Vertical Shape: slightly convex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: alluvial fan, middle slope
Microtopography: dissected by runoff
Surface stones: none
Parent material: alluvium
Drainage: moderately well
Runoff: medium
Type of saturation:
Type of Erosion: grill
Degree of Erosion: medium

Classification: Sandy, mixed, frigid Typic Cryofluvent
Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Betula Papyrifera, Carex sp., Empetrum nigrum; Pleurozium schreberi; Calamagrostis canadensis, Linnaea borealis, Kinnikinnick, Equisetum* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 4cm; very dark brown (7.5YR 2.5/2) peat; many very fine, fine and medium roots; abrupt smooth boundary

Oe – 4 to 10 cm; very dark brown (7.5YR 2.5/2) peaty muck; weak medium granular structure; many fine, medium common very fine and few coarse roots; abrupt smooth boundary

A/B – 10 to 27 cm; stratified very dark brown (10YR2/2) and olive brown (2.5Y4/3) sand and loamy sand; weak medium platy to weak medium subangular blocky structures; very friable, nonsticky and nonplastic; common very fine, fine and few medium roots; clear smooth boundary

BC– 27 to 42 cm; olive brown (2.5Y3/3) and 30% dark brown (10YR3/3) sand in stratified bands; single grains; loose, nonsticky and nonplastic; common very fine and fine roots; clear smooth boundary

C – 42 to 100 cm; dark olive brown (2.5Y3/3) very gravelly loamy sand; 10% stratified dark brown (10YR2/2) organic and 1-2 cm buried Oa at 45 cm; 30% red sand; weak medium platy structure; very friable, nonsticky and nonplastic.

Pit #: U- 37
Pedon Description
DATE Sampled: 09/11/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 55.608’ N
Longitude: 148° 47.982’ W
Elevation: 1797 ft asl (GPS)

Slope Characteristic Information
Slope: 60 percent
Aspect: 310 degrees
Slope Shape: vertical –concave
horizontal - complex

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: back slope

Microtopography: undulating
Surface stones: none
Parent material: sand stone
Drainage: excessive
Type of saturation: n/a

Type of Erosion: gully
Degree of Erosion: severe

Classification: Sandy, mixed, frigid Typic Cryopsamment

Vegetative Information:
Landcover type: forest
Plant Names: *Picea glauca, Betula papyrifera, Hylocumium splendens, Pleurozium schreberi, Dicranum* spp., *Peltigera* sp., *Cladonia* sp., *Cladina* sp.

Described and sampled by: C.L. Ping

A – 0 to 30 cm; brown (10YR4/3) sand; 5% pebble; single grains; loose, nonsticky and nonplastic; common very fine and fine, many medium and few coarse roots; abrupt smooth boundary

AC – 30 to 52 cm; olive brown (2.5Y4/3) sand; single grains; loose, nonsticky and nonplastic; common medium and few fine and very fine roots; abrupt smooth boundary

C – 52 to 75 cm; light brownish gray (2.5Y6/2) sand; single grains; loose, nonsticky and nonplastic; clear smooth boundary

Cr – 75 + cm; sandstone

Pit #: U- 38
Pedon Description
DATE Sampled: 09/11/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 55.537’ N
Longitude: 148^{o} 48.509’ W
Elevation: 1880 ft asl (GPS)

Slope Characteristic Information
Slope: 50 percent
Aspect: 120 degrees
Horizontal Shape: complex
Vertical Shape: complex
Elevation: 1880 ft asl (GPS)

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: back slope
Microtopography:
Surface stones: none
Parent material: alluvium (schist rock)
Drainage: well
Type of saturation: none (upland)
Type of Erosion: gully
Degree of Erosion: severe

Classification: Loamy-skeletal, mixed, frigid Lithic Dystrocryept

Vegetative Information:
Landcover type: open forest
Plant Names: *Picea glauca, Betula papyrifera, Kinnikinnick, Alnus crispa, Geocaulon lividum, Hylocumium splendens, Pleurozium schreberi, Aulocumium* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 1 cm; litter layer; abrupt smooth boundary.

OA – 1 to 9 cm; very dark brown (7.5YR2.5/2) mucky sand; weak medium granular structure; very friable, nonsticky and nonplastic; many very fine, fine and medium roots; abrupt smooth boundary

C – 9 to 27 cm; brown (10YR4/3) sand; single grains; loose, nonsticky and nonplastic; many very fine, fine, common medium and few coarse roots; abrupt smooth boundary

2Bwb – 27 to 37 cm; brown (7.5YR4/4) gravelly silt loam; 30% sand; moderate, medium subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine, fine roots; clear smooth boundary

2BC – 37 to 55 cm; reddish brown (5YR4/3) very gravelly silt loam; 60% gravel; strong fine subangular blocky structure; friable, slightly sticky and slightly plastic; few very fine, fine roots; clear smooth boundary

C r – 55+ cm; fractured sandstone.

Pit #: U- 39
Pedon Description
DATE Sampled: 09/11/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:

Latitude: 63° 55.320' N
Longitude: 148° 49.436' W
Elevation: 1693 ft asl (GPS)

Slope Characteristic Information
Slope: 13 percent
Aspect: 105 degrees
Horizontal Shape: complex
Vertical Shape: convex
Elevation: 1880 ft asl (GPS)

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: alluvial fan
Microtopography: dissected by many erosion gullies andgrills
Surface stones: none
Parent material: alluvium (sandstone)
Drainage: moderately well
Type of saturation: none (upland)
Type of Erosion: gully
Degree of Erosion: severe

Classification: Sandy, mixed, frigid Aquic Cryopsamment

Vegetative Information:
Landcover type: open forest
Plant Names: *Picea glauca, Betula papyrifera, Alnus crispa, Viburnum edule, Linnaea borealis, Calamagrostis canadensis, Pyrola* spp., *Equisetum* sp., moss.

Described and sampled by: C.L. Ping

Oi – 0 to 1 cm; bluejoint straw; abrupt smooth boundary

C1– 1 to 14 cm; olive brown (2.5Y4/3) sand; 5% gravel; single grains; loose, nonsticky and nonplastic; many very fine and fine roots; abrupt smooth boundary

Oa&C – 14 to 18 cm; stratified very dark brown (10YR2/2) mucky sand and olive brown (2.5YR4/3) sand; single grains; loose, nonsticky and nonplastic; few very fine, fine, many medium and few coarse roots; abrupt smooth boundary

Bwb – 18 to 47 cm; brown (10YR4/3) and strong brown (7.5YR4/6, 30%) sand; 10% cobble and many organic debris; single grains; loose, nonsticky and nonplastic; common very fine and fine roots; abrupt wavy boundary

Ab – 47 to 52 cm; very dark grayish brown (10YR3/2) sand; single grains; loose, nonsticky and nonplastic; few very fine and fine roots; abrupt wavy boundary

2C2 – 52 to 75 cm; brown (2.5Y4/3) sand and organic rich dark grayish brown (10YR4/2, 40%) sand; single grain; loose, nonsticky and nonplastic; clear smooth boundary

2C3 – 75 to100 cm; gray (2.5Y6/1) sand; single grain; loose, nonsticky and nonplastic.

Pit #: U-40

Pedon Description
DATE Sampled: 09/11/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63° 55.439' N
Longitude: 148° 49.374' W
Elevation: 1866 ft asl (GPS)

Slope Characteristic Information
Slope: 75 percent
Aspect: 100 degrees
Horizontal Shape: complex
Vertical Shape: concave

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: back slope
Microtopography: undulating
Surface stones: none
Parent material: colluvium (sandstone)
Drainage: well
Type of saturation: none (upland)
Type of Erosion: gully
Degree of Erosion: severe

Classification: Sandy, mixed, frigid Typic Cryopsamment

Vegetative Information:
Landcover type: open forest
Plant Names: *Picea glauca, Betula papyrifera, Populus tremuloides, Populus balsmnifera, Linnaea borealis, Rosa acicularis, Epilobium angustifolium, Delphinium glaucum, Calamagrostis canadensis, Equisetum* spp.

Described and sampled by: C.L. Ping

Oi – 0 to 4 cm; peat; litters; abrupt smooth boundary

Oe – 4 to 16cm; very dark brown (7.5YR2.5/3) muck sand; single grains; loose, nonsticky and nonplastic; many very fine, fine and medium roots; abrupt smooth boundary.

A – 16 to 26 cm; dark brown (10YR3/3) sand; single grains; loose, nonsticky and nonplastic; common very fine, fine, few medium and common coarse roots; clear smooth boundary

AC – 26 to 42 cm; olive brown (2.5Y4/3) sand; single grains; loose, nonsticky and nonplastic; common fine and few medium roots; clear smooth boundary

C1 – 42 to 69 cm; stratified brown (10YR5/3) and gray (2.5Y6/1) sand with buried A (10YR2/2) mucky sand; single grains; loose, nonsticky and nonplastic; few fine and medium roots; abrupt smooth boundary

C2 – 69 to 76 cm; gray (2.5Y6/1) sand; single grain; loose, nonsticky and nonplastic; few fine roots; abrupt smooth boundary

C3 – 76 to100 cm; olive brown (2.5Y4/3) sand; single grain; loose, nonsticky and nonplastic.

Pit #: U-41
Pedon Description
DATE Sampled: 09/11/2005

Soil Series: Not surveyed

Location Information
Soil Survey Area:
Latitude: 63^{o} 55.396’ N
Longitude: 148^{o} 49.374’ W
Elevation: 1736 ft asl (GPS)

Slope Characteristic Information
Slope: 38 percent
Aspect: 100 degrees
Horizontal Shape: complex
Vertical Shape: concave

Physiographic Province: Alaska Range
Local: Mountain
Geomorphic Position: Toe slope
Microtopography: undulating
Surface stones: none
Parent material: colluvium (sandstone)
Drainage: well
Type of saturation: none (upland)
Type of Erosion: gully
Degree of Erosion: moderate

Classification: Sandy, mixed, frigid Typic Cryopsamment

Vegetative Information:
Landcover type: open forest
Plant Names: Betula papyrifera, scattered Picea glauca
Described and sampled by: C.L. Ping

Oi – 0 to 5 cm; very dark brown (7.5YR2.5/2); abrupt smooth boundary

Oe – 5 to 15 cm; very dark brown (7.5YR2.5/2) peaty muck; many very fine, fine, common medium and few coarse roots; abrupt smooth boundary

A – 15 to 48 cm; dark brown (10YR3/3) sand; dark band of charcoal on top of horizon, many charcoal particle scattered in horizon, and many organic debris; single grains; loose, nonsticky and nonplastic; common very fine and fine roots; clear smooth boundary

C1 – 48 to 80 cm; dark brown (10YR3/3) sand; single grain; loose, nonsticky and nonplastic; few very fine and fine roots; clear smooth boundary

C2 – 80 to100 cm; dark olive brown (2.5Y3/3) sand; single grain; loose, nonsticky and nonplastic; few fine roots.

APPENDIX B

SOIL CLASSIFICATION OF PEDONS AT JUMBO DOME ROAD ACCESS AREA

Pedon #	Classification
1	Histic Cryqaquept, Loamy-skeletal, mixed, frigid
2	Typic Cryaquept, Loamy-skeletal, mixed, frigid
3	Typic Cryaquept, Coarse loamy over sandy or sandy-skeletal, mixed, frigid
4	Typic Haplocryod, Coarse loamy over sandy or sandy-skeletal, mixed, frigid
5	Humic Dystrocryept, Coarse loamy over sandy or sandy-skeletal, mixed, frigid
6	Typic Cryaquept, Coarse-loamy over sandy or sandy-skeletal, mixed, frigid
7	Typic Cryorthent, Coarse-loamy over sandy or sandy-skeletal, mixed, frigid
8	Aquic Dystrocryept, Coarse-loamy over sandy or sandy-skeletal, mixed, frigid
9	Histic Cryaquept, Coarse loamy, mixed, frigid
10	Typic Cryorthent, Sandy, mixed, frigid
11	Histic Cryaquept, Coarse-loamy, mixed, frigid
12	Typic Cryaquept, Coarse silty over sandy or sandy-skeletal, mixed, frigid
13	Histic Cryaquept, Coarse-loamy, mixed, frigid
14	Typic Cryaquent, Coarse-loamy, mixed, frigid
15	Lithic Dystrocryept, Coarse-loamy, mixed, frigid
16	Typic Dystrocryept, Coarse-loamy, mixed, frigid
17	Typic Dystrocryept, Sandy-skeltal, mixed, frigid
18	Histic Cryaquept, Coarse-loamy, mixed, firgid
19	Typic Cryorthent, Sandy, mixed, frigid
20	Typic Cryorthent, Sandy, mixed, frigid
21	Typic Cryofluvent, Sandy, mixed, frigid
22	Typic Cryorthent, Sandy, mixed, frigid
23	Typic Cryorthent, Sandy, mixed, frigid

24 Typic Cryorthent, Coarse-loamy, mixed, frigid
25 Typic Dystrocryept, Coarse-silty over sandy or sandy-skeletal, mixed, frigid
26 Typic Cryaquent, Sandy, mixed, frigid
27 Typic Cryopsamment, Sandy, mixed, frigid
28 Typic Cryaquept, Coarse-loamy, mixed, frigid
29 Typic Cryaquent, Sandy, mixed, frigid
30 Aquic Dystrocryept, Coarse-loamy, mixed, frigid
31 Typic Dystrocryept, Coarse-silty, mixed, frigid
32 Typic Dystrocryept, Coarse-silty over sandy or sandy-skeletal, mixed, frigid
33 Typic Cryaquept, Coarse-loamy over sandy or sandy-skeletal, mixed, frigid
34 Typic Dystrocryept, Coarse-loamy, mixed, frigid
35 Typic Dystrocryept, Coarse-loamy, mixed, frigid
36 Typic Cryorthent, Sandy, mixed, frigid
37 Typic Cryopsamment, Sandy, mixed, frigid
38 Typic Dystrocryept, Loamy-skeletal, mixed, frigid
39 Aquic Cryopsamment, Sandy, mixed, frigid
40 Typic Cryopsamment, Sandy, mixed, frigid
41 Typic Cryopsamment, Sandy, mixed, frigid

CHAPTER XI
LAND USE INFORMATION

TABLE OF CONTENTS

1.0 EXISTING AND HISTORIC LAND USES

1.1 PAST USE

The patterns of settlement in the area and associated land uses that occurred are largely related to coal development activities that took place starting about the turn of the century. In 1915 the General land Office subdivided the Nenana Coal Field into sections and townships and in 1916 the Geological Survey divided the field into leasing units and began issuing coal leases. Coal mining subsequently began around Healy, a station along the Alaska Railroad, in 1918. Five years later the Alaska Engineering Commission built a railroad spur line to developing coal mines near Suntrana. In 1943, Emil Usibelli started a small surface coal mining operation east of Suntrana and later bought several other underground coal properties in the area. As marketing opportunities evolved, Usibelli's operations grew and eventually expanded into the Hoseanna Creek valley in 1972. Exploration drilling was conducted by Usibelli Coal Mine, Inc. (UCM) as early as 1971. Today the company produces approximately 1.6 million tons of coal per year and continues to expand the traditional coal mining land use within the resource area.

Besides coal mining, gold claims and mines were also established in the surrounding areas in the early 1900's. Although exploration and mining activities have been major uses since the turn of the century, no disturbances other than trails are evident in the proposed permit area. This area as well as the surrounding areas not associated with mineral resource development have been used primarily as wildlife habitat.

1.2 PRESENT USE

Current land uses for the proposed permit area include coal mining, wildlife habitat, and to a limited extent, timber harvesting. UCM has been active in the immediate vicinity of the proposed mining area since 1976 when haul road construction and pre-stripping operations were initiated for the Poker Flats coal mine.

Some farming and haying has been done on previously mined and reclaimed areas to support feed requirements for local livestock owners. In the past, a small timber processing mill was utilized to provide a local supply source for building materials.

Access into recreational and other mineral areas has been established and maintained by virtue of the existing mine haul road system. Sport hunting of large game and fur trapping continue to be primary uses. Other recreational activities in the general area include trail rides and pack trips into remote areas.

2.0 COMMUNITY CHARACTERISTICS

The proposed permit area lies within the newly established Denali Borough. The population of the Borough is estimated at approximately 2,077 residents. The unincorporated Healy area (Healy, Suntrana, and Usibelli) has a population of approximately 700 residents. The mainstay of the local economy is the Usibelli Coal Mine with additional employment provided by Golden Valley Electric Association, the Borough School District, and tourism.

Clear Air Force Station is the largest employer in the Borough and employs over 300 people. UCM is the other major employer, employing approximately 100 people. Other opportunities for year-round employment are somewhat limited by the seasonal nature of the area's tourist industry and a lack of commercial and industrial development.

3.0 LAND MANAGEMENT PLANS

The Alaska Department of Natural Resources develops land use management plans at three levels: statewide, areawide, and within specific management units. These plans provide land use guidance with emphasis on state lands within the area of jurisdiction. The Tanana Basin Area Plan for State Lands addresses a broad area including the Jumbo Road Corridor project and provides general recommendations for land use. It identifies the primary and secondary surface

and subsurface uses planned for state lands in the Tanana Basin area. The area is divided into eight subregions and each subregion is divided into management units. The Plan establishes guidelines to allow for multiple uses of state land while minimizing conflicts.

The Jumbo Road Corridor project falls within subunit D-4 of the Parks Highway/West Alaska Range subregion. One of the primary management goals for subsurface resources within the subregion is to contribute to Alaska's economy by making subsurface resources available for development. For subunit D-4, the principal management objectives focus on development of subsurface coal and hardrock minerals, while protecting fish and wildlife habitat and recreation values to the extent feasible. The entire subunit is open to mineral entry with minerals and wildlife habitat as the primary land use designations. Forestry and public recreation are listed as secondary land use designations.

4.0 LAND CONDITION AND CAPABILITY

The proposed permit area for the Jumbo Road Corridor project is in a relatively undisturbed natural condition. Other than access trails and trenches for mineral exploration, no other disturbances are evident. The pre-mining landuse, including surface and subsurface manmade features, is shown on Plate CV-1, Location of Surface Water Bodies. As previously discussed in Chapters IV, V, and X, soil and hydrologic conditions do not limit the capability of the area.

A study by the Soil Conservation Service (SCS) identified land use capabilities in a publication entitled Exploratory Soil Survey of Alaska. The proposed permit area for the Jumbo Road Corridor is located within the area identified by the study as IQ25 (Section 173 Alaska Range). The major land resource areas were rated in two categories. The first category assessed suitability of the land for use as cropland; as rangeland for cattle, sheep, and reindeer; and for commercial forestry. In each of these categories, the proposed mine area was determined to be unsuitable with the exception of rangeland for reindeer. The second category defined limitations on land use in relation to road location, buildings, recreation, and off-road traffic. The SCS noted that all land areas were in the severe to very severe limitation categories.

The permit area is not under high levels of management and no yield data is present. However, productivity for wildlife is expected to return to pre-mining conditions soon after final bond release. During the life of the project precautions such as erosion protection and aggressive re-vegetation will help to encourage adequate wildlife productivity.

5.0 RESPONSIBLE PARTIES

This Chapter was prepared by Usibelli Coal Mine, Inc.