ENVIRONMENTAL INVESTIGATION AND SITE ANALYSIS

TOKOSITNA
DENALI STATE PARK

ALASKA
ENVIRONMENTAL INVESTIGATION AND SITE ANALYSIS

TOKOSITNA STUDY AREA

DENALI STATE PARK

ALASKA

July 1980
Prepared by
Division of State Parks
Alaska Department of Natural Resources
and
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INTRODUCTION

This report analyzes key environmental information about the physical aspects of the Tokositna study area, which is being studied to determine the feasibility of locating recreation activities and facilities here. In addition some information on the cultural and socioeconomic environments is inventoried. The study area is within the western boundary of Denali State Park and at the northwestern edge of the Susitna Basin. It includes the headwaters of the Tokositna River and the foothills to the south called Dutch and Peters hills. The foothills overlook the Tokositna Glacier and provide an excellent view, weather permitting, of Mount McKinley, the highest mountain in North America.

The Tokositna study area is approximately 110 air miles northwest of Anchorage and 180 air miles southwest of Fairbanks. The George A. Parks Highway, Alaska Route 3, which connects Anchorage and Fairbanks, is 15 air miles east, and the Alaska Railroad more or less parallels the highway on the east side. Four small communities within the study area vicinity include Talkeetna, Trappers Creek, Peters Creek, and Petersville. Improved roads in the vicinity include a 7-mile spur from the Parks Highway into Talkeetna and a 20-mile gravel/dirt road to Petersville and the Cache Creek mining area 6 miles south of the study area (see Region map).

BACKGROUND OF THE STUDY

The concept of locating a recreation development at Tokositna emerged from a study undertaken by the state about ten years ago to explore ways to increase the role of tourism in the Alaskan economy. One of the study recommendations was the construction of a hotel in the Mount McKinley area. Bradford Washburn, the director of the Boston Museum of Science and world renowned Mount McKinley cartographer and photographer, recommended that visitor facilities be constructed at a site south of the Tokositna River.

In 1972, U.S. Senator Mike Gravel urged the state and the federal government to jointly study the feasibility of locating visitor facilities on the south side of Mount McKinley. In 1973, the Mount McKinley National Park master plan recommended an expansion of the park boundary to the south and a shift of visitor attention and facilities to this side of Mount McKinley. The 1975 Denali State Park master plan recommended the addition of the Tokositna study area to the state park for the development of visitor and recreation facilities. In 1976, the state legislature added the land that comprises the study area to the state park. (The area includes all of T29N, R7W, and five-sixths of T29N, R9W).
Following these events, State Senator Patrick Rodey and Representative Clark Gruening, with the strong support of Senator Gravel, sponsored the passage of two appropriation bills in the 1978 legislature. One bill appropriated $310,000 to the Alaska Department of Natural Resources to investigate the feasibility of constructing a lodge and visitor center complex at Tokositna, and the second bill appropriated $85,000 to the Alaska Department of Transportation and Public Facilities to study access to the area. These developments led to a memorandum of understanding, signed in October 1978 by the secretary of the U.S. Department of Interior, the governor of Alaska, and the mayor of the Matanuska-Susitna Borough, to jointly plan visitor facilities and programs in Denali State Park.

In May 1979, the state legislature set up the Tokositna Special Committee, with Senator Gravel, State Senator Rodey, and Commissioner of Natural Resources Robert LeResche as members. The purpose of this committee is to provide direction for the Tokositna project. The committee is also directed to review, propose, and recommend contracts or agreements for study and research concerning potential park and recreation developments. (Relevant state acts and the memorandum of understanding are included in appendixes A and B, respectively.)

**SCOPE OF STUDY**

This report is one of four reports that deal with the feasibility of developing major recreation facilities at Tokositna. The other reports are a market analysis and economic study, a downhill/cross-country ski and outdoor recreation study, and a transportation access study. Findings from all of these studies will be evaluated and synthesized in a separate report so that recommendations about the type and scope of development for Tokositna can be made.

The purpose of this report is to inventory environmental, cultural, and socioeconomic data, and to analyze the site's capability for accommodating development. Information about Tokositna is limited; therefore, professionals and scientists familiar with the region visited the site for reconnaissance surveys and interpreted the significance of the data in the light of possible future development.
INVENTORY OF THE NATURAL ENVIRONMENT

Components of the natural environment that were analyzed include physiography, geology, soils, climate, water resources, vegetation, wildlife, and visual resources. Detailed maps for each of these components show the location of special features.

PHYSIOGRAPHY

The Tokositna study area is in the southcentral physiographic region, between the Cook Inlet-Susitna lowlands to the south and east and the Alaska Range to the north and west. The Tokositna River cuts southeast across the northern and eastern portions of the study area. The Dutch and Peters hills rise from the south side of the river valley and form parallel ridges extending to the southwest. The north-facing slopes of these hills are terraced because of the frequent passage of glaciers. The Dutch and Peters hills are divided by a large, flat, relatively low-lying area, referred to as the saddle.

The study area is characterized by diverse landforms, varying from hills with rocky peaks, steep clifflike slopes, and sharp ravines, to gently rolling hillsides and terraces, to flat wide river valley bottoms (see the Landform map).

The highest point in the study area, 4,200 feet, occurs on one of the ridges of the Dutch Hills in the western quarter of the site. The second highest point, 3,929 feet, occurs on Long peak, which is a smooth, elongated foothill in the center of the study area. From the saddle area (elevation 2,000 feet) there is a continuous even slope to the floodplain of the Tokositna River, which is the lowest part of the study area, at an elevation of 700 feet. The floodplain contains lakes and the braided channel of the Tokositna River. Ramsdyke Creek, which originates in the Dutch Hills, and Long Creek, which originates in the saddle area, have cut deep ravines through two distinct moraine terraces.

Slopes in the study area range from very gentle rolling terrain to steep, rugged cliffs (see Slope map). Most of the slopes that are oriented toward Mount McKinley are in the sun shadow of the Dutch and Peters hills. Therefore, they receive little or no direct sunlight during the winter season.

GEOLOGY

During the Paleozoic era and early Mesozoic era, a sea occupied southcentral Alaska. Following this period, uplift and volcanic activity formed the core of the Alaska Range, which is composed of igneous rock. During the Jurassic and Cretaceous times,
extensive erosion caused sediment deposition in the basins surrounding the mountains. The main mountain range, foothill ridges, and large river valleys in the Alaska Range were formed by the end of the Tertiary period by uplifting, deformation, and faulting actions. These features were then acted upon by four major glaciations in the ensuing Quaternary period to form the present landscape. In the last 100,000 years, the Eklutna, Knik, Naptowne, and Alaskan glaciations have at least partially covered the study area. The Peters Hills were probably covered entirely by several glaciers at different times, which accounts for the rounded outlines and smooth crestline of the hills. The Dutch Hills too were covered by glacial ice, except for the highest peaks. (Sites in the study area with glacial deposits are shown on the Geology map.) Present-day glaciers near the study area are remnants of the Alaskan glaciation, which occurred between 4,800 and 200 years ago. This glacial advance was very limited, with the maximum advance of the ice fronts being only about 2 kilometers beyond the existing ice fronts.

Surficial materials in the Tokositna study area are comprised of glacial, alluvial, and colluvial deposits, with areas of exposed bedrock on the upper slopes (see the Surficial Deposits map). To describe these deposits, the study area was broken down into three regions: the Tokositna River valley, the saddle and the bench, and the hills.

**Tokositna River Valley (600-1,000 feet elevation)** — The Tokositna River bottom contains alluvium, undifferentiated alluvium, and swamp deposits. The alluvium on the active floodplain is composed of unconsolidated glacial debris, which is being reworked and moved downstream.

Undifferentiated alluviums are composed of alluvial material above active floodplains. This material includes outwash from previous glaciations, alluvial fans from small tributaries or streams, and other alluvial material on the gently inclining floodplain. This area consists of boulders scattered at various depths beneath the surface, sand, and gravel, with localized areas of silt and clay.

Scattered in pools and backwaters of the floodplain are swamp deposits containing fine sand, clay, and organic matter. The river bottom, except in swamp deposits, is probably permafrost free because of the melting action of the morning water (U.S. Department of the Interior, Geological Survey [USDI, GS] 1977b). The alluvial deposits beneath the Tokositna River are probably thick and are being recharged year around by the river.

**Bench and Saddle Areas (1,000-2,500 feet elevation)** — Benches in the study area are moderately sloping terraces of the Dutch and Peters hills and are covered by glacial drift that is a homogeneous mixture of clays, gravel, and boulders. The glacial history of this area is also manifested by lateral moraines, kettle holes, and eskers.
The lateral moraines were developed through deposition during various glacial retreats. This material forms the terraces on the north-facing slopes of the Dutch and Peters hills. Textures in such morainal deposits vary from fine-grained materials such as clays and silts to coarse-grained gravels and boulders. These terraces are being eroded by streams and surface runoff and are characterized by well-healed erosional scars.

Kettle holes are depressions formed by the melting of blocks of ice that were deposited by glaciers and buried under glacial drift. The poor drainage characteristics of these kettles lead to the formation of bogs and the deposition of fine-grained materials, frequently organic. The surface of these bogs is patterned by long, stringlike ridges, with open water and/or marsh vegetation in between. The origin of bogs is not well understood, but most researchers agree that processes associated with frozen ground play a significant role, either through the thrusting of pond ice during winter freezing, the impedance of solifluction due to the presence of pond ice, or the disturbance of permafrost.

Some steeper portions of bench areas appear to have been created by some type of mass-wasting process, solifluction, or slump. Some geologists feel the slumping could date to the last glaciation, having been caused by the undercutting of the hillside by a glacier, resulting in the movement of the ground above. The areas showing evidence of slumping are mainly on the terraces of the Peters Hills. No major mass-wasting phenomena are apparent in the area today.

The geology of the saddle area (2,000 to 2,500 feet elevation) includes glacial drift, fluviolacustrine deposits, and bedrock. The exposing of bedrock is probably caused by fault uplift. The glacial drift in this area resulted from glacial events similar to those in the benches. The fluviolacustrine deposits resulted in part from a glacier-dammed lake on the edge of the nearly level saddle area and the sloping bench area. Fine clay particles probably were deposited in this lake, resulting in a lake bottom that is fairly impermeable and may contribute to poor drainage. Placer gold could likely be found in these deposits (USDI, GS 1977b).

The bedrock deposits in the saddle area are bedded conglomerates and marine sedimentary deposits. The conglomerates consist of small rocks bound together by a clayey and sometimes ferruginous material known as the matrix. The marine sedimentary deposits consist of a variety of sedimentary rocks of different grain sizes and a metamorphic rock known as phyllite. Sedimentary rock types include argillite, graywacke, and siltstone (USDI, GS 1977b).

Hills (2,500 to 4,200 feet elevation) — Bedrock is exposed on the upper slopes of the Peters and Dutch hills. It consists of a thick sequence of bedded sedimentary rock (USDI, GS 1977a). Shallow colluvial deposits, consisting of angular clasts
derived through weathering and gravity processes, also occur on the upper slopes. Colluvial materials of both glacial and bedrock origin typically lie adjacent to these deposits on lower slopes.

Earthquakes in southcentral Alaska are part of a seismically active belt that circumscribes the entire Pacific Ocean basin. It is one of the most seismically active areas in North America, experiencing thousands of earthquake shocks each year (Selkregg 1974).

Within the study area, a fault runs through the saddle area and parallels the Peters Hills (see the Surficial Deposits map). The faulting action probably uplifted the Peters Hills. Preliminary examination indicates this fault is inactive; however, detailed geological studies are necessary to confirm this.

Numerous small faults in and near the study area may not directly cause earthquakes that could affect development in the study area; however, major earthquakes in other areas could trigger subsidiary movements along these smaller faults. The Alaska southcentral regional profile indicates that the largest earthquakes in this area measure over six on the Richter scale (Selkregg 1974). It also indicates that the earthquake damage potential generally decreases from the Anchorage area toward the interior. Different parts of the study area may be affected to different degrees by earthquakes. The saddle area may be subject to translatory landslides. These landslides occur in clayey areas such as this because of the tendency of these deposits to "flow" during an earthquake. Areas occurring beneath steep slopes may be subject to rockslides and avalanches triggered by earthquakes.

Permafrost can generally be found on most north-facing slopes in the Alaska Range (Selkregg 1974). However, typical surface features associated with permafrost, such as polygonal ground patterns, pingos, and sorted stones, are not readily apparent on available imagery of the site. Small solifluction lobes, composed of poorly drained, saturated sediment moving downslope through seasonal frost heaving, can be identified in isolated areas on north-facing slopes. Such movement in these surficial materials may be associated with the presence of shallow permafrost and/or bedrock. Although preliminary field investigations found no permafrost, further detailed investigations are needed to ensure that it is not present.

SOILS

A preliminary soil survey has been conducted for the northern portion of the study area. Detailed soil investigations will be required at any building site prior to construction. Soils were investigated only to a depth of 40 inches.
The entire study area consists mainly of well-drained soils formed in a mantle of silty volcanic ash and loess that range from a few inches to about two feet in thickness over glacial till. The till in the area is often variable in compactness and in the proportions of cobble, gravel, sand, and fine-grained material it contains. This variableness alters the permeability rates and internal drainage of soils over short distances. As a result, poorly drained soils in areas affected by seepage and drainageways commonly occur on the slopes of moraines in close association with well-drained soils. Very poorly drained peat is common in scattered depressions in the moraines and alluvial plains. The occurrence of poorly and very poorly drained soils is greater in less sloping areas, especially at lower elevations that receive the greatest amount of runoff.

Three soil associations, four slope phases of a soil association, and one land type were mapped in the study area (see the Soils map).

**Talkeetna-Mutnala Association**

This association dominates the area. It is composed of well-drained silt loams, which are shallow to moderately deep and are over very gravelly sandy loams on moraines. It is found in areas of rolling to steep ground moraines, with a few very small lakes and depressions, and hilly to very steep lateral moraines cut by many small drainageways.

Talkeetna soils occur mostly above treeline and the Mutnala soils are dominant below 1,200 feet elevation. These soils formed in 12 to 28 inches of silt loam volcanic ash and loess over very gravelly, sandy loam glacial till. The Talkeetna soils above 1,200 feet elevation have a thicker layer of organic carbon accumulation in the subhorizons and are less compact in the subsoils than are the Mutnala soils at these elevations.

Included in this association are areas of very poorly drained Borohemist peat soils in small muskegs, on muskeg borders, and in depressions; Typic Cryaquents are also included and are found in wet seepage spots and along narrow drainageways.

Talkeetna-Mutnala association soils have been mapped according to units based on the degree of slope: less than 20 percent, 20 to 40 percent, 40 to 60 percent, and greater than 60 percent. These units are described below.

**TM1 — less than 20 percent complex slopes** — This unit consists of moderately sloping to hilly, well-drained soils on ground moraines and of bench areas on lateral moraines. Included are areas on slopes of less than 10 percent. Borohemist peat soils make up about 15 percent of the unit; at lower elevations this percentage may be higher.

**TM2 — 20 to 40 percent complex slopes** — This unit consists of many short, moderately steep to steep slopes on ground moraines and of bench areas on lateral
moraines. Many small areas of this association are on rolling to hilly slopes. There are minor areas of Borohemist peat soils and other poorly drained soils in seepage spots; these soils make up about 10 percent of the unit, but at lower elevations the percentage may be higher.

**TM3 — 40 to 60 percent complex slopes** — This unit consists of many short, steep to very steep, well-drained soils on lateral moraines. Many small drainageways and seepage spots are included in this unit. Peat occurs in some depressions in less than 10 percent of the unit.

**TM4 — greater than 60 percent complex slopes** — This unit consists of moderately to very steep, well-drained soils on lateral moraines. Many small areas of poorly drained soils in narrow drainageways and a few seepage spots are included, which make up about 5 percent of the unit.

**Cryorthents-Cryorthods Association**
This soil association consists of very steep, well-drained soils mainly on escarpments along drainageways. This soil formed in gravelly loam glacial till. In places the soil has a shallow mantle of silty volcanic ash over very gravelly loam till. The vegetation on these soils includes paper birch, white spruce, alder, and grass; eroded areas are barren.

**EO1 — greater than 60 percent slopes** — Included in this unit are areas severely eroded by water, with bedrock exposures in some spots.

**Cryaquents-Borohemists Association**
This soil association consists of nearly level, poorly drained loamy soils on alluvial fans, floodplains, and muskeg borders along drainageways. It also includes very poorly drained peat soils in floodplain depressions and in bench areas on lateral moraines. The Cryaquents formed in poorly drained, shallow, loamy alluvial material over very gravelly sand and, in places, loess over glacial till. The Borohemists occur in slightly lower positions on floodplains than the Cryaquents and in depressions on moraines. The Borohemists formed in shallow to moderately deep, partly decomposed sedges and mosses over very gravelly loamy material.

**EA1 — 0 to 7 percent slopes** — Areas of soil in this association are highly susceptible to flooding, high water table, and soft peaty material.

**Rough Mountainous Land**
This land type consists of very steep, rocky side slopes of mountains with little or no vegetation and very shallow, stony soils with low alpine vegetation.

**RM** — Included in this mapping unit are areas of shallow and very shallow Cryorthod soils.
CLIMATE

The study area is in the transition climatic zone, between the maritime and continental zones. Consequently, it exhibits characteristics of both zones. The maritime zone is typified by heavy precipitation, strong winds, cool summers, and warm winters, relative to the rest of Alaska. The continental zone is characterized by light precipitation, calm air movements, and extreme temperatures.

Limited information exists about microclimatic conditions at the Tokositna study area. Automated weather-recording instruments were placed on the site in February 1979. Usually a period of three to five years of weather data collection is needed to establish patterns and to project trends.

Weather data from Talkeetna, the Chulitna River Lodge, and the Peters Hills indicate generalized weather patterns. The weather station in Talkeetna is 28 miles southeast of the study area, and information has been collected at this weather station since 1931, constituting the longest historical weather record in the vicinity. Although weather conditions should be somewhat similar to those at the study area, differences do occur because the study area is mountainous and varies in elevation from 600 to 4,200 feet, while Talkeetna is in a floodplain at an elevation of 345 feet. The higher elevation in the study area results in temperature and precipitation differences.

At the Chulitna River Lodge, 36 miles northeast of the study area and about 2 miles west of Parks Highway, only five years of weather data are available. Although projections based on this relatively short period could be misleading, the lodge is located in terrain similar to that of the study area, at an elevation of 1,259 feet.

Seasons
Alaska has very long winters, extremely short springs and falls, and about three months of summer. The first snowfall usually occurs in September or October, and snow stays on the ground until May. The winter days are typified by short daylight hours, low sun angle, and cold temperatures. Spring usually occurs in May; fall, in September. Both seasons may only last a few weeks and sometimes only a few days. Summer begins around June and lasts until August. It is typified by long daylight hours, high sun angle, and warm temperatures.

Precipitation/Snowfall
The annual precipitation in Talkeetna is 29 inches; at the Chulitna River Lodge, it is 32 inches. Snowfall in the study area was estimated by Sno-Engineering (1979). Their method involved correlating data from a snowstake site in the Peters Hills, 8 miles from the study area and at an elevation of 2,010 feet, with detailed data from Talkeetna. Based on ten years of snow moisture content, data indicate the snowfall amount is approximately 11 times greater than the amount of precipitation. Therefore
Sno-Engineering has estimated the average annual snowfall in the study area at about 195 inches.

Temperature
Because of similar topography and elevation, onsite temperatures in the study area should resemble those recorded at the Chulitna River Lodge (see tables 1 and 2). Temperatures at the study area are most likely warmer than at Talkeetna in the winter owing to cold air settling over the low-lying Susitna Basin. Because of these cold air inversions, data from Talkeetna indicate the worst case conditions for temperatures in the study area. Recorded lows for Talkeetna for November through February range from -48°F to -41°F.

Wind
Topography and general weather patterns can be used to predict general wind patterns. The strongest winds probably occur on ridgetops, where there is maximum exposure and where cold air drainage from the high mountains creates some winds. The mid-elevation zones at the study area, although extensively vegetated by alder and willow in many areas, are not protected from wind.

Data from onsite weather instruments for March through June 1979 show the maximum recorded wind velocity at the study area was 30 miles per hour (mph). The average wind velocity did not exceed 5 mph. Occasionally strong winds from 14 mph to 30 mph came from all directions. The most frequent winds came from north-northwest and west-southwest. Tree coverage substantially reduces the effects of wind in the lower valleys.

Wind chill factors are an important consideration for any development at Tokositna. Even a light wind increases the rate of body heat loss. A strong wind can produce a rate of loss greater than the body can replace. The relationship between body heat loss and wind speed has been developed and is shown in table 3.

Shadows and Insolation
The amount of daily sunlight changes rapidly during spring and fall. The solar angle extremes for this latitude (63° north) occur on June 21, when there is a full 21 hours of sunlight/twilight, and on December 21, when there is less than 7 hours of sunlight/twilight. Shadows, even on north slopes, are minimal during summer sunlight hours. After June 21, sunlight decreases at the average rate of 6 minutes per day. The solar insolation extremes occur on the same dates, with a maximum of 239 BTUs per square foot possible on a horizontal surface in June, and 7 BTUs in December. (Four Shadows and Insolation maps show the degree of shadowing during June, April and August, February and October, and December.)
Table 1: Onsite Temperatures
(°F)

<table>
<thead>
<tr>
<th>Month</th>
<th>Upper Station 3,500 Feet</th>
<th>Middle Station 2,300 Feet</th>
<th>Lower Station 900 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>23-28</td>
<td>-6</td>
<td>3.2</td>
</tr>
<tr>
<td>March</td>
<td>0</td>
<td>14.7</td>
<td>40</td>
</tr>
<tr>
<td>April</td>
<td>2-30</td>
<td>4</td>
<td>14.0</td>
</tr>
<tr>
<td>May</td>
<td>(incomplete records)</td>
<td>20**</td>
<td>31.8**</td>
</tr>
<tr>
<td>June</td>
<td>(incomplete records)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>37.2</td>
<td>64</td>
</tr>
</tbody>
</table>


* 11 days only
** 4 days only
*** Instrument broke down
Table 2: Minimum and Maximum Temperatures
Chulitna River Lodge
(five-year average)

<table>
<thead>
<tr>
<th></th>
<th>Average Daily Minimum</th>
<th>Average Daily Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.2</td>
<td>14.4</td>
</tr>
<tr>
<td>February</td>
<td>2.9</td>
<td>17.3</td>
</tr>
<tr>
<td>March</td>
<td>8.2</td>
<td>24.0</td>
</tr>
<tr>
<td>April</td>
<td>20.9</td>
<td>32.1</td>
</tr>
<tr>
<td>May</td>
<td>33.8</td>
<td>33.6</td>
</tr>
<tr>
<td>June</td>
<td>42.9</td>
<td>62.2</td>
</tr>
<tr>
<td>July</td>
<td>47.9</td>
<td>68.4</td>
</tr>
<tr>
<td>August</td>
<td>46.0</td>
<td>64.1</td>
</tr>
<tr>
<td>September</td>
<td>35.6</td>
<td>53.0</td>
</tr>
<tr>
<td>October</td>
<td>21.6</td>
<td>35.1</td>
</tr>
<tr>
<td>November</td>
<td>8.0</td>
<td>22.0</td>
</tr>
<tr>
<td>December</td>
<td>7.1</td>
<td>18.6</td>
</tr>
</tbody>
</table>

Source: Arctic Environmental Information and Data Center, University of Alaska, 1978.

Whiteout
A whiteout is an optical effect that cannot be forecasted. It occurs when snow or ice cover the terrain and there is a cloud layer of uniform thickness over most of the sky. When the parallel rays of the sun pass through the cloud layer, they are diffused, causing the sun rays to strike the snow surface from many different angles. After striking the snow, the rays are reflected up to the cloud layer and back again to the snow. As a result, all shadows are destroyed, the horizon cannot be distinguished, and depth perception is lost. The onset of a whiteout can be very sudden, increasing the danger associated with it. Whiteout conditions occur frequently in mountain areas like the study area.

Avalanches
Avalanches occur on a variety of slopes, but most commonly on 30 to 45 percent slopes or at sharp terrain bends, such as ridge crests and cliffs. Considerable snow accumulation in the form of cornices on this type of topography contributes to avalanche potential. Wind can also have a strong influence on the stability of snow pack. Eastern- and southern-facing slopes are more prone to avalanches because of the warming effect of the sun.
JUNE
SHADOWS AND
INSOLATION
TOKOSITNA
DENALI STATE PARK
ALASKA
AUGUST / APRIL
SHADOWS AND
INSOLATION
TOKOSITNA
DENALI STATE PARK
ALKASKA
DECEMBER
SHADOWS AND INSOLATION
TOKOSITNA
DENALI STATE PARK
ALASKA
Table 3: Cooling Power of Wind
(expressed as "equivalent chill temperature")

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Winds Above Little Danger Increasing Danger Great Danger
40 Have Little Additional Effect (Flesh may freeze within 1 min.) (Flesh may freeze within 30 seconds)

A large number of slopes in the study area are in the 30 to 45 percent category, and most of them, along with several ridge crests, face north. Signs of avalanches have been observed on the eastern slopes of the Dutch Hills. Avalanche-prone areas have been identified in a preliminary study by Sno-Engineering, Inc. However, detailed, investigations of avalanche history and snow stratigraphy have yet to be made to locate avalanche-prone areas precisely.

WATER RESOURCES

Surface Water
The physiography of southcentral Alaska changes abruptly from the Alaska Range to the Susitna lowlands, and the surface hydrology changes abruptly from glaciers to streams. The Kanikula, Tokositna, Ruth, and Kahiltna glaciers, which originate from cirques on Mount McKinley, terminate in the foothills region. Most of the major rivers originate at these glaciers. The Tokositna River originates at the Kanikula and Tokositna glacial outwash, meanders, and forms numerous braided channels before entering the Chulitna and Susitna rivers, and eventually flows into the Cook Inlet.

Glacial runoff has peculiar characteristics — peak flows in midsummer, distinct day-to-night differences, a large silt content, and occasional floods. Usually the flow is high in the late afternoon or early evening and low in the early morning; the delay in the runoff peak is due to the storage and movement of water in the glacier. Meltwater from glaciers could be an important source of water because the spring runoff coincides with the increased need for water for domestic uses during midsummer.

The Tokositna River, which flows year around through the study area and drains approximately 19 square miles, is the largest surface water body in the area (see Surficial Hydrology map). It consists of glacial runoff from the Kanikula and Tokositna glaciers and of stream runoff from Long and Ramsdyke creeks. The total length of the river is 41 miles, of which approximately 11 miles lie within the study area (Selkregg 1974). Because of the glacial origin of most of its water, the river is very turbid. It forms numerous channels before entering the Chulitna River. Other perennial creeks in the study area include Poorman, Willow, Divide, Canyon, and Wolf. There are also several unnamed perennial and intermittent creeks in the study area.

Both Canyon and Divide creeks, which drain approximately 1,900 acres, feed into the 1/4- to 1/2-mile-wide V-shaped Long Creek valley. On June 19, 1979, flow in Long Creek was gauged at 16.1 cubic feet per second at about 2,000 feet elevation and at 26.4 cubic feet per second at 1,400 feet elevation. Ramsdyke Creek, which is fed by Wolf Creek and two unnamed creeks, flows in a much narrower valley than Long Creek, and it lacks a broad upland area as is found above Long Creek. On April 6, 1979, the flow at the base of the Dutch Hills was estimated at 10 cubic feet per
The water was ice free, clear, and probably of high chemical and biological quality (Alaska Division of Geological and Geophysical Surveys [ADGGS] 1979). On June 20, 1979, the flow at this location was gaged at 47.3 cubic feet per second, the increased flow resulting from snowmelt and precipitation.

Numerous small lakes are found in the study area. The largest is called Home Lake and is within the Tokositna River floodplain. This shallow lake is about 3/4 mile long and about 1/4 mile wide, and it is large enough for a ski-equipped plane to land in winter.

Flood records are not available for the Tokositna River valley. However, topographic and vegetative analyses indicate that any structures in the Tokositna River valley could be exposed to flooding. Flooding of sites above the Tokositna River floodplain is unlikely. Ramsdyke, Long, and other unnamed small tributary streams flow through incised tributary valleys. The sides of these valleys are steep, with narrow or nonexistent floodplains (ADGGS 1979).

Groundwater
No wells or boreholes are present in the area, making an accurate determination of groundwater yields impossible. However, some general trends of potential groundwater yields can be determined based on surficial geology.

The flat, alluvium-filled Tokositna River valley probably contains large quantities of groundwater (ADGGS 1979). This water may contain fine silty material from the turbid Tokositna River; however, this turbidity is probably not a problem because alluvial sand and gravel in the river valley filter the silt as it percolates downward (see Groundwater Potential map). The mouths of Ramsdyke and Long creeks contain two small alluvial fans, indicating the probability of significant amounts of groundwater.

The groundwater potential for the saddle and bench areas is lower than for the river bottom area because the recharge area above the saddle and bench area is smaller. Surficial geology maps indicate fluviolacustrine materials underlying the floor of the saddle area. These materials generally do not make good aquifers. However, the presence of surface water during winter in Long and Canyon creeks indicates that at least a limited quantity of groundwater is available, because there is little or no runoff from snowmelt or rain. Waters from these aquifers are probably within safe drinking water standards (ADGGS 1979). The groundwater of the saddle area could be contained in a high, or perched, water table.

The surficial deposits on the terraces are of glacial origin, varying in depth from surface deposits to several hundred feet, and rest on bedrock. Because of this depositional pattern, groundwater distribution is erratic, and well volume estimates are difficult without seismic studies (ADGGS 1979).
VEGETATION

Vegetation distribution in the study area approaches the northern limit of tree growth and is generally similar to that of interior Alaska. Trees are found in the less severe microclimate of the valley floor. They are widely spaced at lower elevations, and the timberline barely reaches an elevation of 1,500 feet. Above timberline, the land is dominated by a dense thicket of willow and alder up to about 2,200 feet, above which only alpine tundra, moss, and lichens grow. (Tokositna, an Athabaskan Indian word, means treeless area.)

Vegetation of the study area has been analyzed by using satellite imagery taken in July 1977. Available color infrared film was enlarged to produce a map of the seven plant associations found in the area.

Floodplain Meadow
This association is found in the floodplain of the Tokositna River, which is very wet and is characterized by standing water during most of the year. Consequently, this area is not suitable for woody vegetation growth; sedges and grasses are the dominant species.

Floodplain Thicket
Thickets are found along the Tokositna River valley and are composed mostly of woody shrubs, predominantly willows. Because the water level in the braided channel of the river fluctuates constantly, areas along the floodplain are continually exposed and then flooded. This association rapidly invades newly exposed alluvial deposits along the river.

Bog and Muskeg
Bogs and muskegs are found in the Tokositna River valley and around ponds or other permanent bodies of water scattered throughout the study area. Trees are rare because conditions are too wet. Large, localized patches of cottongrass tussocks, dwarf shrubs, and sphagnum moss are the dominant species. Most larger mammals use this plant association only intermittently. It is an important habitat for waterfowl, and it provides nesting habitat for the trumpeter swan.

Lowland Spruce and Hardwood
This association is a lowland forest of evergreen and deciduous trees. Tree coverage is locally dense, with a closed canopy and 60 to 100 percent ground coverage. However, in some relatively open stands, ground coverage is only 25 to 60 percent. Dominant species include white spruce and Alaska paper birch, which are mixed with large cottonwoods along drainage channels. Understory brush species in this association furnish browse and shelter for moose.
GROUNDWATER POTENTIAL
TOKOSITNA
DENALI STATE PARK
ALASKA
High Brush
The high brush association occurs between timberline and alpine tundra. Vegetation ranges from very dense to relatively open brush systems, with widely scattered trees. The dominant species are dense willow along the streams and dense alder in the drier areas. Many animals, such as moose, bears, and beavers, use this association during part of the year.

Alpine Tundra
Tundras are found at high altitudes and generally consist of low-growing, matlike herbaceous and shrubby plants that usually form a complete ground cover. Species composition varies from almost continuous cottongrass tussocks, with a sparse growth of sedges and dwarf shrubs, to stands where dwarf shrubs dominate. Many animals inhabit this association during at least part of the year, including ptarmigans, foxes, lynxes, and marmots. This association regenerates slowly if disturbed by man or natural causes.

Lichen
Lichens are found on the highest, windiest, and rockiest places where other vegetation could not survive. Lichens are extremely slow growing, so they have an extremely slow regeneration rate and are ultra sensitive to any disturbance.

WILDLIFE

The Tokositna study area includes a wide variety of wildlife, similar to what is found in southcentral Alaska.

Mammals
Mammals in the study area are varied, and several species are abundant. Large mammals include moose, brown-grizzly bears, black bears, and wolves. Smaller mammals include red foxes, beavers, wolverines, otters, minks, weasels, pine martens, lynxes, snowshoe hares, red and flying squirrels, porcupines, and possibly coyotes.

Moose are abundant year-round residents in the study area. At times there may be as many as 2,000 moose in the vicinity (Alaska Department of Fish and Game [ADFG] 1979c). Moose concentration areas during fall and winter are shown on the Wildlife map. Moose can be dangerous anytime, but rutting males are especially dangerous because their behavior is unpredictable. Most females with young are very protective and can also be dangerous (Caras 1967).

The caribou is a migrating herd animal. The primary species found in the study area is the barren ground caribou.
Both brown-grizzly and black bears inhabit the area. Because these bears do not generally coexist unless food is abundant, the study area appears to provide good bear habitat. Both species are omnivorous, feeding primarily on vegetable matter, including berries, roots, sedges, and grasses. Bears also rely heavily on salmon during spawning. Brown-grizzlies have large territories, moving from place to place mainly to take advantage of different food sources. In October, brown-grizzlies in the study area vicinity begin a period of dormancy that lasts until about April. Brown-grizzly bears den in the high alpine areas of the Peters and Dutch Hills within the study area (ADFG 1979f).

Canids in the area include wolves, red foxes, and possibly coyotes. Wolves are the largest of the canids, and their most important prey within the study area is moose. Other prey species include marmot, beaver, porcupine, ptarmigan, and snowshoe hare. Wolves give birth to their young in March and April in dens that can be caves or excavations into hillsides (Caras 1967). Although population data are not available for the study area, significant numbers are present (ADFG 1979f).

The lynx is the only cat native to Alaska. Normally, it is nocturnal, but in Alaska it is sometimes forced to hunt in full daylight because of the long summer days. Lynxes usually inhabit spruce forests and wetlands. The snowshoe hare is the lynx's most important prey species.

Minks, otters, wolverines, pine martens, and least weasels are found in the study area. Population estimates are unknown; pine martens are probably the most numerous.

Snowshoe hares inhabit the lower elevation forest and wetlands, and they are important for both sport and subsistence hunters in the area. Snowshoe hare populations in northern climes are cyclic.

Birds

Birdlife in the area is abundant; however, insufficient data make evaluation of this resource difficult. Most species in the area are migratory. Migratory waterfowl are particularly abundant, and the density of the breeding waterfowl population in the Tokositna River valley is about 12 individuals per square mile. Nonmigratory birds in the area include chickadees, ravens, magpies, downy woodpeckers, bald and golden eagles, willow and rock ptarmigans, and several species of owls.

One bird of special interest is the trumpeter swan, and the floodplain meadow association in the Tokositna River valley provides important nesting and feeding habitat (see Wildlife Habitat map). In 1979, five active nests were recorded in the study area. In addition, 16 nonnesting birds were counted (USDI, NPS 1979). Trumpeter swans have been noted to be extremely sensitive to human disturbance (Hansen and others 1971). Recent studies (ADFG 1979a) seem to indicate that a ½-mile buffer
DENALI STATE PARK

WILDLIFE HABITAT
TOKOSITNA
DENALI STATE PARK
ALASKA
around man-made developments is necessary to prevent the displacement of nesting swans.

**Fish**
The variety of fish species within the study area is limited, although numerous species occur in drainages immediately to the south and east (see Wildlife map). Fish found in the upper Tokositna drainage include grayling and whitefish and occasionally dolly varden and Arctic char. King salmon reach as far as Bunco Lake and lower Bunco Creek, and sockeye salmon as far as Swan Lake. Kings are also found in Cache, Peters, Kroto, and Moose creeks, while sockeyes occur in Kroto and Moose creeks (ADFG 1978a). Pink salmon enter Cache Creek and the lower reaches of Peters Creek, while coho are found in both Peters and Moose creeks. Chum have been observed only in the lower reaches of Peters Creek. The glacial nature of the Tokositna River and its variable silt load most likely influence the composition and seasonal occurrence of fish species within the drainage.

**Invertebrates**
Several species of invertebrates are of special interest, including mosquitos and several kinds of biting gnats. These insect pests are especially prevalent in the lower portion of the Tokositna River valley, where winds are reduced by forest vegetation. In exposed areas along the Dutch and Peters hills, winds tend to disperse most of these insects. However, during certain times, especially at night, insects can be very numerous.

**VISUAL RESOURCES**
Scenic features within the study area that are of special interest to visitors include extensive glacial systems, mountains of the Alaska Range, and wildlife. The study area contains excellent vantage points for viewing the extended glacial systems and mountains of the south slope of the Alaska Range. The glaciers of the region are among the longest in the world, and Mount McKinley (20,320 feet), Mount Foraker (17,400 feet), and Mount Hunter (14,573 feet) dominate the skyline. However, wildlife viewing opportunities are not as great as in Mount McKinley National Park.

**Mount McKinley Views**
Mount McKinley is one of the major tourist attractions in Alaska, and excellent views of it are available from the study area. Four categories of views of the mountain from the study area have been identified (each category is referred to as a view cone). In the first view cone, Mount McKinley is seen centered over the Tokositna Glacier. Long peak, part of Long Creek, and the river valley lie within this cone (see Mount McKinley View Cones map). In the second view cone, which includes the area between Ramsdyke and Long creeks and on either side of the first view cone, the view of Mount McKinley is slightly off center over the glacier. The area west of Ramsdyke Creek, the
lower Dutch Hills, and the area east of Long peak fall into the third view cone. The view of the mountain is somewhat obscured by the foreground and midground mountains. The fourth view cone covers the extreme eastern and western parts of the study area. The peak of Mount McKinley is visible, but its lower elevations are obscured by the foreground mountains. From other portions of the site, the mountain cannot be seen at all.

In addition to the view cones, which cover the total study area, three specific viewpoints at different elevations were analyzed and mapped. The maps show the various features that can be seen and their distances, along with the view of Mount McKinley.

The highest viewpoint was on Long peak. This site has a 360° view, which encompasses Mount McKinley, Peters Hills, Dutch Hills, Tokosha Mountains, Tokositna River valley, Tokositna Glacier, and distant hills, mountains, and river valleys.

The midlevel view was from the saddle area. It encompasses a 240° view that includes most of the same features as the Long peak view, except the Dutch and Peters hills block the views of the river valleys to the south.

The lowest viewpoint, from the Tokositna River valley, has limited views in variety and direction. This site has trees, which provide a reference scale and frame views.

As with many of the world’s high mountains, Mount McKinley is often obscured by clouds. Observers 15 miles east of the study area have kept daily records for the past several years of the mountain’s visibility. As shown in table 4, the mountain was visible about 50 percent of the time (the mountain is considered visible when it can be seen for at least one hour a day). These records provide a good indication of the number of days the mountain would be visible from the study area.
View from Saddle
VIEW-SADDLE
TOKOSITNA
DENALI STATE PARK
ALASKA
Table 4: Visibility of Mount McKinley from a Point 15 Miles East

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<th>Month</th>
<th>Average Number of Days/Month Mount McKinley is Visible</th>
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<tr>
<td>December</td>
<td>16.7</td>
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Source: Data collected by Dave Johnston, Denali State Park.

Scenic Views Adjacent to the Study Area
Numerous points north of the study area command spectacular views. A few significant ones are the Tokosha Mountains, the ridge of the isthmus between Tokositna and Ruth glaciers, south Curry Ridge, Heather Point, and Great Gorge overlooks I and II (see the Existing Recreational Activities map in the socioeconomic environment discussion). From these locations, points of interest such as Mount McKinley, Great Gorge, Ruth Amphitheater, Tokosha Mountains, Mount Hunter, and Mount Foraker can be seen.

The 5,019-foot peak elevation of the Tokosha Mountains provides an exceptional view of Mount McKinley, and 360° views of valleys, hills, and distant mountains. The ridgetop of the isthmus allows for the viewing of the Tokositna and Ruth glaciers from one spot. South Curry Ridge provides an excellent view of Mount McKinley rising above the flat Chulitna River valley (this vantage point is also the most accessible of all the points, because it is only a short distance from Parks Highway). Heather Point, on the left bank of where the Tokositna Glacier bends, provides a close-up view of the
glacier and an excellent view of Mount McKinley. The Great Gorge overlooks give views of one of the most impressive features in the Alaska Range — the Great Gorge of the Ruth Glacier — in addition to excellent views of Mount McKinley.
<table>
<thead>
<tr>
<th>PHYSIOGRAPHY</th>
<th>Peter Hills</th>
<th>Glacial Terraces</th>
<th>Valley Floodplain</th>
<th>Tokosha Mountains</th>
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<td>GEOLOGY</td>
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<td>Glacial Moraine</td>
<td>Alluvium</td>
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<tr>
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<td>TM-Talkeetna-Mutnala</td>
<td>EA - Cryaquents Borohemists</td>
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<th>NATURAL PROFILE</th>
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<td>VEGETATION:</td>
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<th>Tokosha River</th>
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<th>Glacial Terraces</th>
<th>Valley Floodplain</th>
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<td>TM-Talkeetna-Mutnala</td>
<td>EA - Cryaquents Borohemists</td>
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ANALYSIS OF THE NATURAL ENVIRONMENT

To evaluate the degree of opportunity for, and constraint on, development, a rating system using a scale of 0 to 10 was developed for each category of the natural environment that was inventoried. A high number indicates a good opportunity for development; a low number, a constraint on development. These numerical ratings were applied to individual study maps of the natural and visual components to indicate relative suitability for development.

SLOPE

The gentler the slope, the greater the opportunity for low-cost engineering methods to be used for development. On 0 to 5 percent slopes, simple, conventional, and low-cost construction methods can be used. These areas were given a rating of 10. Because costs for earthwork and construction increase as the slopes become greater, 5 to 10 percent slopes were rated as 8; 10 to 25 percent slopes, 5; 25 to 50 percent slopes, 2; and slopes exceeding 50 percent, 1. (See table 5.) Disturbance and removal of the surface vegetation on slopes over 25 percent can produce and magnify soil erosion problems, and snow drifting also becomes a problem.

GEOLOGY

On a regional scale, southcentral Alaska has a high potential for earthquake damage; however, there are no signs of recent activity. Landslides and rockslides are not normally significant problems, but they may pose problems in bedrock outcrop areas during earthquakes. The same is true for avalanches. Generally development in areas under steep slopes should be avoided. Areas with fluviolacustrine deposits may also be unstable during an earthquake.

Fluviolacustrine and swamp deposits pose problems to construction. While these problems are not insurmountable, they do make construction more expensive. Slumping along the bench area of the Peters Hills is a potential problem.

By using the resource inventory, the most suitable deposits for the construction of facilities were determined. In the study area, these deposits are bedrock areas, which provide the most stable foundations for facilities, including low-rise buildings, roads, campgrounds, and trails. Because bedrock areas are dense, highly compressed deposits, they have a high weight-bearing capacity. Due to their consolidated nature, they have minimal pore space for water accumulation, so chances for permafrost problems are minimal. Bedrock areas were rated as 10.
### Table 5: Slope Characteristics and Analysis

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<th>Constraint</th>
<th>Opportunity</th>
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<td>X</td>
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<tr>
<td>5-10%</td>
<td>Fairly gentle slope</td>
<td>Minimal construction constraints</td>
<td>1</td>
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<tr>
<td>10-25%</td>
<td>Steep slope</td>
<td>Moderate construction constraints</td>
<td>2</td>
<td>X</td>
</tr>
<tr>
<td>25-50%</td>
<td>Very steep slope</td>
<td>Significant construction constraints</td>
<td>3</td>
<td>X</td>
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<tr>
<td>50% +</td>
<td>Extremely steep slope</td>
<td>Extreme construction constraints</td>
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Areas of glacial drift received a rating of 8 because the drift packs well and can support roads and buildings. However, because it is an unconsolidated deposit, water passes through it, creating the possibility of permafrost. The chance of pockets of fine-grained materials also presents a slight risk to development because these pockets act as water traps, have a lower bearing strength, and may become fluid during seismic activity.

Moraine deposits near bedrock were rated as 7 because of proximity and uneven depth to bedrock, which could result in an uneven support for structures. Also, water flowing over the impermeable bedrock layer tends to undercut the glacial drift materials, causing foundation stability problems.

Hummocky moraines were given a rating of 6 because of their uneven surface topography, which indicates poor drainage and fine-grained deposits.

Fluviolacustrine deposits were given the intermediate rating of 5 because they probably contain more fine-grained materials, owing to the deposition of silt in the lake environment, which was partially responsible for their formation. The presence of some gravel, especially along streamcourses, might be used to mitigate the negative effects of the fine-grained deposits.

Alluvial/colluvial deposits are usually located on slopes or at the base of slopes, often in steep-walled canyons. These deposits have shown movement in the recent past and are prone to movement. Therefore, these deposits were rated as 3. In some parts of the alluvial/colluvial areas, well-sorted gravel deposits may be present, potentially reducing the negative characteristics of instability in this area.

The purely colluvial areas were rated as 2 because they lack the presence of well-sorted gravels.

Active alluvial areas and alluvial fans were rated as 1 because they are prone to flooding. The principal area is the Tokositna River valley bottom. In this area, the river is constantly changing course, depositing new material, and reworking old material. As such, this is a very risky area for most development.

Swamp deposits were also rated as 1. These deposits have a low-bearing strength and a high shrink/swell potential. Construction on these deposits would require expensive excavation and backfilling with gravel. (See table 6.)
### Table 6: Geologic Characteristics and Analysis

<table>
<thead>
<tr>
<th>Type of Deposit</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock</td>
<td>Tightly consolidated, deep deposits without permafrost</td>
<td>Supports structures well; sometimes requires blasting to prepare for a construction site</td>
<td>X</td>
</tr>
<tr>
<td>Glacial Drift/</td>
<td>Mixture of fines, gravel, rock outwash deposits, highly</td>
<td>Packs well; generally supports roads and structures well in many areas</td>
<td></td>
</tr>
<tr>
<td>Lateral Moraine</td>
<td>variable surface drainage, ponds and bogs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moraine Deposits</td>
<td>Impermeable bedrock layer, with bedrock exposed in</td>
<td>Supports structures fairly well; impermeable bedrock layer may cause drainage problems</td>
<td>X</td>
</tr>
<tr>
<td>Over Bedrock</td>
<td>some places</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hummocky Moraine</td>
<td>Uneven surface topography</td>
<td>Highly variable textures and permeability</td>
<td>X</td>
</tr>
<tr>
<td>Fluvialacustrine</td>
<td>Formed by stream or lake deposits and containing sand,</td>
<td>Possibility of containing fine grain deposits that would provide a poor foundation, especially during earthquakes</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>gravel, and quite often, bluish gray mud</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alluvial/</td>
<td>Surface layers moving because of water and gravity</td>
<td>Poor foundation material, susceptible to movement; however, some gravel and sorting may be present</td>
<td>X</td>
</tr>
<tr>
<td>Colluvial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colluvial</td>
<td>Surface layers moved by gravity, often occurs on steep slopes</td>
<td>Risky foundation material for structures, especially in areas of steep slopes</td>
<td>X</td>
</tr>
<tr>
<td>Classification</td>
<td>Description</td>
<td>Characteristics</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Active Alluvium</td>
<td>Alluvial material being intermittently reworked by moving surface water.</td>
<td>Potential for flooding</td>
<td></td>
</tr>
<tr>
<td>Alluvial</td>
<td>Alluvial material above active floodplains.</td>
<td>Supports structures well</td>
<td></td>
</tr>
<tr>
<td>Alluvial Fans</td>
<td>Alluvial material transported by creeks and deposited at the mouth of drainages</td>
<td>Susceptible to flooding</td>
<td></td>
</tr>
<tr>
<td>Alluvial/Swamp</td>
<td>Most fine sand, silt, and organic material deposited near streambanks.</td>
<td>Very poor foundation base; susceptible to settling</td>
<td></td>
</tr>
</tbody>
</table>
SOILS

Engineering Considerations
Table 7 lists some factors that limit certain types of development. Some of the major engineering problems and practices are discussed below. More detailed soils information for the Tokositna study area is available in a U.S. Soil Conservation Service report (USDA, SCS 1979c).

The glacial drift deposits underlying the Talkeetna-Mutnala soils generally consist of poorly graded materials with an estimated 20 to 30 percent of fines. Essentially all pebbles and cobblestones are semirounded and angular. These morainal deposits are generally useful for subgrades and roadfill, but they are undesirable for most road surface materials or for concrete.

The only significant sources of sand or gravel within the soil survey area are the coarse glacial drift materials underlying the Talkeetna-Mutnala soils and the gravelly materials in a few small terraces and fans. Neither of these materials, however, is of superior quality.

The silty material in the upper 12 to 30 inches of the Talkeetna-Mutnala soils has a low bearing strength, but the underlying glacial till has high bearing strength. With the exception of those areas with steeper gradients, these soils have few limitations for the construction of buildings. All the other soils in the study area have some feature that severely limits their use as foundations for low buildings.

The gravelly materials in fans are loose and lack sufficient fines for good compaction. They are rounded and are generally poor for road surfacing. Other potential sources of roadfill or sand and gravel are the alluvial deposits along the creeks and the Tokositna River and also nearby mine tailings.

The Talkeetna-Mutnala soils are probably the best soils in the area for filter fields. These soils are well drained, the water table is deep, and in most places the underlying glacial till is estimated to have moderate permeability and percolation rates. The texture and firmness of the till is variable, however, and onsite testing and inspection would be necessary to evaluate soil suitability for any proposed installation. The slopes of these soils are probably the most limiting factor in the study area.

The Cryaquent and Borohemist soils included with the Talkeetna-Mutnala association are poorly and very poorly drained. They occur in areas that receive runoff from higher elevations and at seepage spots, depressions, and drainageways. The wet conditions in these soils severely limit most type of development.
Table 7: Engineering Interpretations of Soil Properties

<table>
<thead>
<tr>
<th>Soil Association or Land Type</th>
<th>Map Symbol</th>
<th>Suitability as source of</th>
<th>Potential Frost Action</th>
<th>Soil limitation ratings* and major limiting factors affecting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Roadfill</td>
<td>Sand and Gravel</td>
<td></td>
</tr>
<tr>
<td>Cryaquents—Borohemists Association</td>
<td>EA1</td>
<td>Fair to unsuited: wetness or excess humus</td>
<td>Fair to unsuited: wetness or excess humus</td>
<td>Variable</td>
</tr>
<tr>
<td>Cryorthents—Cryorthods Association</td>
<td>EO1</td>
<td>Uns suited</td>
<td>Uns suited</td>
<td>Variable</td>
</tr>
<tr>
<td>Rough Mountainous Land</td>
<td>RM</td>
<td>Uns suited</td>
<td>Uns suited</td>
<td>— — —</td>
</tr>
<tr>
<td>Talkeetna—Mutnala Association</td>
<td>TM1</td>
<td>Good</td>
<td>Fair: excess fines</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>TM2</td>
<td>Fair</td>
<td>Fair: excess fines</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>TM3</td>
<td>Poor</td>
<td>Poor</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>TM4</td>
<td>Poor</td>
<td>Poor</td>
<td>Medium</td>
</tr>
</tbody>
</table>

*Soil limitation ratings:
Slight — Soil limitations, if any, are easy to overcome.
Moderate — Soil limitations need to be recognized, but can be overcome by good planning, careful design, and proper construction.
Severe — Soil limitations are difficult to overcome; very careful engineering design and construction will be necessary if the soil is used for specified purpose. In some cases the limitations may not be economically feasible to correct.
Very severe — Soil limitations are ordinarily not economically feasible to overcome.
Potential Frost Action. Frost action in soils is a problem in the study area. The ratings given in table 7 depend largely on the texture of the soil material and the natural soil drainage.

Permafrost. Permafrost places certain constraints on facility construction. It makes the development of water wells and septic disposal fields very difficult. In addition, if buildings are constructed in areas where permafrost is close to the surface, the permafrost can melt, resulting in settling of the building.

Parks and Recreation. The soils of the survey area are evaluated in table 8 according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, depth to bedrock, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area, scenic quality, the ability of the soil to support vegetation, and the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreational use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreation facilities. The information in table 8 can be supplemented by interpretations for septic tank filter fields, for streets and roads, and for foundations for low buildings (in table 7).

Camp areas require site preparation, such as shaping and leveling out parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface should have few or no stones or boulders, absorb rainfall readily but remain firm, and not be dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic, with most vehicular traffic confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over rock or stony material should be sufficient to allow necessary grading.
Table 8: Soil Suitability for Recreation Development

Soil limitation ratings* and major limiting factors affecting

<table>
<thead>
<tr>
<th>Association</th>
<th>Map Symbol</th>
<th>Camp Areas</th>
<th>Picnic Areas</th>
<th>Playgrounds</th>
<th>Paths and Trails</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryaquents-Borohemists Association</td>
<td>EA1</td>
<td>Severe: floods</td>
<td>Moderate: floods</td>
<td>Moderate: floods</td>
<td>Moderate: dusty</td>
</tr>
<tr>
<td>Cryaquents part</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borohemists part</td>
<td></td>
<td>Severe: wetness; excess humus</td>
<td>Very severe: wetness; excess humus</td>
<td>Very severe: wetness; excess humus</td>
<td>Very severe: wetness; excess humus</td>
</tr>
<tr>
<td>Cryorthents-Cryorthods Association</td>
<td>EO1</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
</tr>
<tr>
<td>Rough Mountainous Land</td>
<td>RM</td>
<td>Very severe: bedrock; slope</td>
<td>Very severe: bedrock; slope</td>
<td>Very severe: bedrock; slope</td>
<td>Very severe: slope</td>
</tr>
<tr>
<td>Talkeetna-Mutnala Association</td>
<td>TM1</td>
<td>Moderate to severe: slope</td>
<td>Moderate to severe: slope; dusty</td>
<td>Moderate to severe: slope; dusty</td>
<td>Moderate to severe: erosates easily</td>
</tr>
<tr>
<td></td>
<td>TM2</td>
<td>Severe: slope</td>
<td>Severe: slope</td>
<td>Severe: slope</td>
<td>Moderate to severe: erosates easily; slope</td>
</tr>
<tr>
<td></td>
<td>TM3</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
<td>Severe: erosates easily; slope</td>
</tr>
<tr>
<td></td>
<td>TM4</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
<td>Very severe: slope</td>
<td>Very severe: erosates easily; slope</td>
</tr>
</tbody>
</table>

*Soil limitation ratings:
Slight — Soil limitations, if any, are easy to overcome.
Moderate — Soil limitations need to be recognized, but can be overcome by good planning, careful design, and proper construction.
Severe — Soil limitations are difficult to overcome, very careful engineering design and construction will be necessary if the soil is used for specified purposes. In some cases the limitations may not be economically feasible to correct.
Very severe — Soil limitations are ordinarily not economically feasible to overcome.
The design and layout of paths and trails for walking, horseback riding, and bicycling should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the period of use. They should have moderate slopes and few or no stones or boulders on the surface.

Soils for winter recreational activities, such as trails for snowshoeing, cross-country skiing, snowmobiling, and downhill skiing, are not rated in this report. Usually these activities occur when snow cover protects soils from impacts.

Slope is the most important limiting feature to consider in planning for all these uses. It is assumed that the planning process will consider the natural slope and that minimal disturbance of the soil will be required. Most disturbed areas should be revegetated to prevent erosion.

Ratings for Development
The Talkeetna-Mutnala soil association (TM) is most suitable for development (see table 9). Depending on slope, this association received ratings from 10 to 8. These soils are the most extensive at the study area, except for exposed bedrock and river valley bottoms. Exposed bedrock in the rough mountain areas, the poorly drained floodplain areas, and steep, eroded escarpments along drainages are all considered poor development areas.

CLIMATE

Detailed climatic studies are being conducted to determine the frequency and nature of temperature inversions in the Tokositna River valley and the pattern of air drainage to the Susitna Basin. The data will determine the amount of emissions that can be tolerated without exceeding the prevailing air quality standards. This in turn will affect the extent of development. Providing a comfortable human environment in a severe climate requires the use of energy, which means an increased burden is placed on the environment by the generation and transmission of this energy.

Generally, development in areas of severe climatic stress should be avoided (areas of high snow accumulation, drift, avalanche, and high wind exposure). The Slope and Vegetation maps indicate where these conditions are likely.

Temperatures do not seem to represent a constraint on slow-moving forms of outdoor recreation, such as cross-country skiing, dog mushing, and sightseeing. Fast-moving forms of recreation, such as downhill skiing and snowmobiling, are more affected by low temperatures because of the wind chill factor. Most people, if adequately dressed,
<table>
<thead>
<tr>
<th>Soil Association</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talkeetna-Mutnala Association (0%-20% slope)</td>
<td>Well-drained, strongly acidic soils on glacial moraine and terraces, on gentle slopes</td>
<td>Slight limitations for intensive recreation and most construction purposes</td>
<td>2 X</td>
</tr>
<tr>
<td>Talkeetna-Mutnala Association (20%-40% slope)</td>
<td>Well-drained, strongly acidic soils on glacial moraine and terraces, moderate slopes</td>
<td>Moderate limitations for intense recreation and most construction purposes</td>
<td>4 X</td>
</tr>
<tr>
<td>Talkeetna-Mutnala Association (40%-60% slope)</td>
<td>Well-drained, strongly acidic soils on glacial moraine terraces and steep slopes</td>
<td>Moderate to severe limitations for intense recreation and most construction purposes</td>
<td>7 X</td>
</tr>
<tr>
<td>Rough Mountainous Lands</td>
<td>Very steep rocky land, varying thickness in gravelly material</td>
<td>Very severe limitations for intensive recreation and most construction purposes</td>
<td>9 X</td>
</tr>
<tr>
<td>Cryaquents-Borohemists Association (0%-7% slope)</td>
<td>Very poorly drained soils, with scattered fibrous peat deposits normally occurring in low elevation areas</td>
<td>Very severe limitations for intense recreation and most construction purposes</td>
<td>9 X</td>
</tr>
<tr>
<td>Cryorthents-Cryorthods Association (60% + slope)</td>
<td>Well-drained, highly erodible soils occurring on steep streambanks</td>
<td>Extremely severe limitation for any recreation and construction purposes</td>
<td>9 X</td>
</tr>
</tbody>
</table>
can participate in these activities in calm dry air at $0^\circ$F. or above. See table 10 for the average number of days during winter when recreation would be possible.

**Table 10: Average Number of Winter Days With Daily Minimum Temperatures Above $0^\circ$F.**

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>30</td>
</tr>
<tr>
<td>November</td>
<td>21</td>
</tr>
<tr>
<td>December</td>
<td>16</td>
</tr>
<tr>
<td>January</td>
<td>15</td>
</tr>
<tr>
<td>February</td>
<td>17</td>
</tr>
<tr>
<td>March</td>
<td>21</td>
</tr>
<tr>
<td>April</td>
<td>30</td>
</tr>
</tbody>
</table>

The amount of precipitation will limit the number of days that are available for outdoor recreation. Snow engineers estimate that the downhill-ski season might begin in mid-November and run until late May. Because of rain and snowmelt during November and May, respectively, these months could be marginal for skiing. December and January would be marginal for downhill skiing because of the short daylight hours and, to a lesser degree, lack of direct sunlight. Cross-country skiing would depend more on the quantity and quality of snow than would downhill skiing. Because cross-country skiers are not confined to one location, they can take maximum advantage of available sunlight during December and January. The number of days available for dog mushing is probably equal to the number of days available for cross-country skiing. Activities oriented to children, such as tobagganing, would be available for at least as many days each month as downhill skiing.

Whiteouts represent a potentially severe problem in and near the study area for both recreation and aviation. Turbulence is another major weather-related aviation problem that applies to the study area. Mechanical turbulence is generated by strong, low-level winds blowing across rugged terrain. Mountains that may seem insignificant on a terrain map can cause severe low-level turbulence under these conditions. This problem is particularly acute in the mountains of the Alaska Range. Turbulence is more a problem during winter than during summer; in summer, turbulence is usually associated with thunderstorms.
SHADOWS

Developing facilities in areas to take maximum advantage of sunlight can enhance the visitor experience and can reduce construction, operation, and maintenance costs. The four Shadows and Insolation maps can be overlaid to show shadowing patterns in the study area. These patterns indicate shadows for each of the seasons and for up to six times a day. Areas where there are almost no daytime shadows were rated as 10. As shadows increase in duration, depending on the time of day and the season, the ratings decrease. Areas in shadow most of the time, except summer, were rated as 2 (see table 11).

WATER RESOURCES

Based on the water resource inventory, the study area possesses varying groundwater potentials, as shown in table 12. Numerical estimates for groundwater quantity are not available because of the lack of test drilling. Wells on or near the Tokositna floodplain and the alluvial fans of Ramsdyke and Long creeks would likely have high yields of good quality water. The Tokositna River alluvium was given a rating of 10 because the alluvium is thick, well sorted, and recharged year around by the river. The alluvial fans of the two creeks are also composed of thick, well-sorted rock and gravel, and they are recharged throughout the year by the creeks. The fans were rated as 9, slightly lower than the alluvium because they are smaller. These alluvial areas also have a high sewage disposal potential, but of course these two uses are mutually exclusive in any one area.

The glacial drift deposits were divided into those between the Tokositna River alluvium and treeline, and those above treeline and below the bedrock and fluviolacustrine deposits. In both areas, the glacial drift is composed of a mixture of fines, gravel, and rock. These deposits are not well sorted, which probably excludes a high groundwater potential. However, the lower portion has a higher potential for groundwater than the upper portion because it has a larger recharge area and is closer to the Tokositna River. Therefore, the lower area was given a rating of 8, and the upper area, 6.

The fluviolacustrine deposits in the broad, flat area at approximately 2,000 feet between the Dutch and Peters hills probably contain large volumes of clay; however, gravel deposits occur along the streams. Groundwater potential may be moderate in these areas because of the presence of well-sorted rock and gravel. As the distance from the stream increases, the groundwater potential decreases significantly because clay deposits, which are not good water sources, may be encountered. The fluviolacustrine deposits were rated as 5 because of the moderate groundwater potential along the streams.

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### Table 11: Shadowing Characteristics and Analysis

<table>
<thead>
<tr>
<th>Shadows</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
<th>Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum sunlight, minimum shadows</td>
<td>Almost no daytime shadows in any season</td>
<td>No constraint</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>In shadow part of the day in one or two seasons</td>
<td>No significant constraint</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In shadow during different times of the day and season</td>
<td>Slight adverse psychological effect and moderate to good solar radiation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>In shadow during different times of the day and season</td>
<td>Moderately adverse psychological effects and moderate solar radiation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>In shadow during different times of the day and season</td>
<td>Moderately adverse psychological effects and limited solar radiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In shadow much of the time in most seasons except summer</td>
<td>Adverse psychological effects and limited solar radiation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Minimum sunlight, maximum shadows</td>
<td>In shadow most of the time all seasons except summer</td>
<td>Adverse psychological effects and extremely limited solar radiation</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### Table 12: Groundwater Characteristics and Analysis

<table>
<thead>
<tr>
<th>Geologic Deposit</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
<th>Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alluvium</td>
<td>Thick, well-sorted rock and gravel material</td>
<td>Very high-yield groundwater potential</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Alluvial Fans</td>
<td>Moderately thick, well-sorted rock and gravel material</td>
<td>High-yield groundwater potential</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Glacial Drift</td>
<td>Mixture of fines, gravel, and rock; not well sorted, but near the Tokositna River</td>
<td>Moderate- to high-yield groundwater potential</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Glacial Drift and Lateral Moraine</td>
<td>Homogenous mixture of fines, gravel, and rocks; scattered deposits of gravel</td>
<td>Moderate-yield groundwater potential</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Fluvialacustrine</td>
<td>High probability of clay deposits; some gravel in ancient streams</td>
<td>Moderate- to low-yield groundwater potential</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Bedrock</td>
<td>Tightly consolidated sedimentary rock</td>
<td>Low-yield groundwater potential</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Bedrock areas are generally high in elevation and are tightly consolidated deposits that lack pore space for water accumulation. They were rated as 2.

The greater the distance of development above the Tokositna River, the harder groundwater will be to obtain. Potentially it can be found in significant quantities up to 2,200 feet elevation, but not much higher. If facilities are located in the saddle area, the possibility of a perched water table must be considered. This could result in foundation damage after percolation of surface water into an aquifer located above impermeable strata (ADGGS 1979).

Construction activities should be controlled and development sites selected to minimize impacts on streams in the study area. All development sites must be kept out of flood zones, primarily in the lower valley of the Tokositna River.

Glacier melt is extremely sensitive to change, especially if the percentage of incoming radiation that is reflected (albedo) is changed. Activities or development that could affect the rate of glacier melt of the Tokositna and Kanikula glaciers should be prohibited, as the long-term effects on the environment are unknown.

VEGETATION

The spruce/hardwood forest and upland thicket areas are assets to potential development in that they provide beautiful settings. So as not to lose this asset, any development will have to take into account the relative tolerance of each vegetation type to disturbance, both visually and ecologically. The denser and taller spruce/hardwood forest is more able to accommodate development from a visual standpoint; however, the upland thicket is more tolerant of disturbance because of its faster growth rate. The alpine zone must be considered intolerant to development because of the sensitive nature and slow regeneration rate of alpine plant species. Because there are very few trees in the study area, especially of the spruce hardwood association, the removal of these trees should be restricted.

The soil is unstable when exposed, especially along streambanks and on steep slopes. Vegetation removal would cause severe erosion problems, which could lead to slumping and landslide. Subsequent increased siltation would also threaten stream quality.

Only three of the seven vegetation associations received high ratings, indicating their suitability for development. The spruce hardwood forest was rated as 10 for limited activities and as 7 for development; upland thicket, 9; and floodplain thicket, 8. The spruce hardwood forest provides protection from the wind in both winter and summer. The upland thicket association does not provide as good a wind buffer in the winter,
<table>
<thead>
<tr>
<th>Vegetation Association</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce Hardwood</td>
<td>Predominantly spruce and birch, with cottonwood trees along drainages; often widely spaced, with shrubby understory; generally found below 1,200 feet</td>
<td>Offers good wind protection, moderates the microclimate; provides a sense of scale to the vast landscape</td>
<td>X</td>
</tr>
<tr>
<td>Upland Thicket</td>
<td>A rapid-growing, first generation association composed mainly of willow and alder; other species include blue joint, fireweed, and fern; generally found between 1,200 to 3,000 feet elevation; often completely covered with snow in the winter</td>
<td>Mature alder and willow approach tree size and grow in clusters; offers wind protection and some sense of scale in the summer only; fast regeneration after disturbance</td>
<td>X</td>
</tr>
<tr>
<td>Floodplain Thicket</td>
<td>Alder and willow dominate the zone from 600 feet to 2,000 feet elevation in Tokositna River floodplain; brush species not completely snow covered in winter</td>
<td>Mature alder and willow approach tree size and form dense ground cover; offers a sense of scale and wind protection in summer only; key to river erosion and flood control</td>
<td>X</td>
</tr>
<tr>
<td>Floodplain Meadow</td>
<td>Predominantly sedges and mosses found between 600 feet and 2,000 feet elevation in Tokositna River floodplain; no trees because soil is water saturated</td>
<td>Offers no wind protection</td>
<td>X</td>
</tr>
<tr>
<td>Alpine Tundra</td>
<td>Low-growing ground cover, species like crowberry, mountain heath, dwarf Arctic birch, bearberry, and blueberry</td>
<td>Sensitive to human disturbance; slow regeneration after disturbance; disturbed areas often overtaken by upland thicket species</td>
<td>X</td>
</tr>
<tr>
<td>Bog and Muskeg</td>
<td>Boglike community, containing sphagnum moss, feather moss, dwarf birch, with black spruce occurring around bog perimeter</td>
<td>Sensitive to human disturbance; offers little wind protection</td>
<td>X</td>
</tr>
<tr>
<td>Lichen</td>
<td>Moss and lichen growth on bare rocks and windy hilltops</td>
<td>Extremely sensitive to human disturbance and very slow regeneration after disturbance</td>
<td>X</td>
</tr>
</tbody>
</table>
but it regenerates quite rapidly after disturbance. The larger alders and willows in the floodplain thicket offer some wind protection, and the thicket is vital in river erosion control.

The floodplain meadow only supports grass growth such as sedges and mosses; because it offers little wind protection, it was rated as 5. Alpine tundra, bogs and muskegs, and lichens are extremely sensitive to disturbance and have slow rates of regeneration. These associations pose severe limitations to development and were rated 4, 3, and 1, respectively. (See table 13.)

WILDLIFE HABITAT

The study area affords significant viewing opportunities for a variety of wildlife, including red squirrels, black bears, brown-grizzly bears, moose, several species of fish, and birds. Viewing opportunities for lynxes, wolves, caribou, and mustelids are rare because population levels are low and these animals tend to stay out of human sight. The Tokositna River valley supports the most diversified wildlife habitat of the study area, and any development should ensure the preservation of this ecosystem. Otherwise, the scenic, economic, and biological values of the site could be irretrievably lost.

The brown-grizzly bear, black bear, trumpeter swan, and wolf are sensitive to human disturbance (see Wildlife Habitat map). Individuals of these species would likely be displaced following increased human use. Access to the site could increase opportunities for sport hunting and fishing in Denali State Park and adjacent lands. The major species that could be affected include brown-grizzly, black bear, and moose. The adverse impacts of any transportation system that cut across animal migration routes would have to be mitigated. Bear denning areas must be researched to understand the impacts of pursuing various recreational activities in nearby areas. Construction activities that could affect water quality in streams should be timed to minimize the effects on spawning salmon and other fish species.

Visitor enjoyment within the area could be influenced by the presence of a large number of mosquitoes and gnats, particularly in the evenings.

To determine which areas have the highest wildlife habitat value, the relative abundance and diversity of species for different areas were evaluated, and also the importance of an area for specific species was assessed. Habitats were rated according to sensitivity to human disturbance and to the greatest wildlife abundance. Areas within the study area that received high ratings for potential development had no unique or significant wildlife value and were categorized as mixed habitat areas. These areas, which were limited to the high alpine zone, received a rating of 9. (See table 14.)
<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>Areas containing anyone of a combination of habitat types, with no single outstanding type</td>
<td>Not known to be sensitive to human disturbance</td>
<td></td>
</tr>
<tr>
<td>Moose Summer Range</td>
<td>Areas containing large stands of willow; completely snow covered in winter</td>
<td>Limited wildlife viewing opportunities; not very sensitive to human disturbance</td>
<td></td>
</tr>
<tr>
<td>Bear Denning (Peters Hills)</td>
<td>Areas containing well-drained slopes near brushline and willow clumps; also moose summer range</td>
<td>Limited wildlife viewing opportunities; not very sensitive to human disturbance</td>
<td></td>
</tr>
<tr>
<td>Bear Denning (Dutch Hills)</td>
<td>Areas containing well-drained slopes near brushline; also moose summer range</td>
<td>Some wildlife viewing opportunities; sensitive to human disturbance; some hazards to human safety</td>
<td></td>
</tr>
<tr>
<td>Upland stream areas, beaver and moose</td>
<td>Small creeks and ponds for beaver, willow for moose</td>
<td>Good wildlife viewing opportunities for moose and beaver; moderately sensitive to human disturbance</td>
<td></td>
</tr>
<tr>
<td>Moose, beaver, and trumpeter swans</td>
<td>Areas with willow stands for moose winter range; large creeks and ponds for beaver; wet meadows for trumpeter swans</td>
<td>Variety of wildlife viewing opportunities; very sensitive to human disturbance</td>
<td></td>
</tr>
<tr>
<td>(western Tokositna River valley)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prime moose, beaver, and trumpeter swan area (eastern Tokositna River valley)</td>
<td>Large areas of willows for moose winter range; numerous large creeks and ponds for beaver; wet meadows for trumpeter swans</td>
<td>Variety of wildlife viewing opportunities; extremely sensitive to human disturbance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 14: Wildlife Habitat Characteristics and Analysis*
Summer moose range is the principal habitat value in large parts of the study area, mainly on the benches of Dutch and Peters hills. These areas have limited wildlife viewing opportunities because the animals are hidden by dense brush and are not present in high numbers. The winter range, and not summer range, is the limiting factor for the moose population; therefore the less sensitive summer range was rated as 8.

Areas above brushline where bear denning alone is the most significant wildlife habitat value were rated as slightly higher than areas where bear denning occurs in addition to moose summer range. The bear denning area in Peters Hills was rated as 7; and the area in Dutch Hills, 5.

Upland stream areas, where the streams pass through wet meadows and stands of willow, were rated as 3 because wildlife viewing opportunities are high. In the open meadows, moose and bear can occasionally be seen, and there are usually beaver in the creeks.

Generally, the Tokositna River valley provides habitat for moose, beavers, and trumpeter swans, and the eastern portion of the valley is prime habitat. The valley bottom contains moose winter range, which is essential to maintaining the moose population. The valley bottom also contains wet meadows and shallow waters that provide habitat for trumpeter swans, and beavers use the numerous side creeks and large stands of willow. These considerations led to a rating of 1 for this part of the valley. The same species are represented in the western portion of the valley, but trumpeter swans do not seem to be as concentrated. Consequently, it was rated as 2.

VISUAL RESOURCES

General View Analysis
Because a variety of views is considered more desirable for recreation development, a rating of 10 was given to hilltops and ridges, which have 360° views. The point rating is progressively lower as the views become more limited according to the elevation:

- 3,000 feet and above — 9
- 2,000 to 3,000 feet — 8
- 1,000 to 2,000 feet — 7
- 1,000 feet and below — 6

For certain functions and activities, good views are not necessary, and this analysis can be disregarded. (See table 15.)
Table 15: Visual Resource Characteristics and Analysis

<table>
<thead>
<tr>
<th>General Views</th>
<th>Characteristics</th>
<th>Considerations</th>
<th>Rating</th>
<th>Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain Tops</td>
<td>Panoramic views of nearby and distant mountains, peaks, glaciers, valleys, and rivers</td>
<td>Large variety of views due to high elevation and 360° view</td>
<td>4</td>
<td>X</td>
</tr>
<tr>
<td>Areas above 3,000 ft.</td>
<td>Views of nearby and distant mountains, glaciers, valleys, rivers, and peaks</td>
<td>Variety of views and near 360° view</td>
<td>4</td>
<td>X</td>
</tr>
<tr>
<td>Areas between 2,000 ft. and 3,000 ft.</td>
<td>Views of mountains, valleys, glaciers, and rivers; many views of nearby landforms</td>
<td>Variety of views</td>
<td>4</td>
<td>X</td>
</tr>
<tr>
<td>Areas between 1,000 ft. and 2,000 ft.</td>
<td>Views of mountains, valleys, glaciers, and rivers; most views are of nearby landforms.</td>
<td>Somewhat limited variety of views</td>
<td>4</td>
<td>X</td>
</tr>
<tr>
<td>Areas below 1,000 ft.</td>
<td>Almost all views are of nearby landforms</td>
<td>Limited variety of views</td>
<td>4</td>
<td>X</td>
</tr>
</tbody>
</table>

Mount McKinley View Cones

| Prime View Cone     | Mount McKinley centered over the Tokositna Glacier valley                     | Best view                                                                                           | 4      | X           |
| Good View Cone      | Mount McKinley slightly off-center over the Tokositna Glacier valley           | Good view                                                                                           | 4      | X           |
| Fair View Cone      | Mount McKinley partially obscured by foreground mountains                      | Fairly good view                                                                                   | 4      | X           |
| Poor View Cone      | Mount McKinley largely obscured by foreground mountains                         | Acceptable view                                                                                     | 4      | X           |
| Not Visible         | Mount McKinley hidden by foreground and midground mountains                    | No view                                                                                             | 4      | X           |
Mount McKinley Views
Based on the view cone analysis, the best views of Mount McKinley are from points within the first view cone, which was rated as 10. The second view cone was rated as 9, the third as 8, and the fourth as 7. Areas with no views of Mount McKinley received no rating. These ratings would only be appropriate for activities and developments where views of the mountain would be important. (See table 15.)
SITE SUITABILITY FOR DEVELOPMENT

The information derived during the inventory and analysis of the natural environment is valuable in determining the most suitable sites for activities and development. To facilitate the compilation of this information, all the natural and numerical ratings for visual components were computerized, translated into shading patterns, and overlaid on base maps to enhance readability. On the computer maps, densely shaded areas represent sites where conditions are relatively suitable for development (that is, areas that received high ratings); lightly shaded areas or a lack of a pattern represents sites where activities or development would be undesirable. For this report, four computer maps are included: one for components of the natural environment (which integrates the ratings for slope, geology, soils, shadows, groundwater, vegetation, and wildlife habitat), one for the areas most sensitive and hazardous to development, one for the best views of Mount McKinley, and one for the best general views. (Other base information collected during the study is on file with the Alaska Division of State Parks in Anchorage.)

The four analysis maps should be used together to determine the locations of various uses. The engineering and visual requirements for a particular type of use would dictate the relative weighting given to each map. For example, to locate sites for a structure from where many visitors could see Mount McKinley, the maps showing Mount McKinley views, general views, and natural environment components would be overlaid to determine the most desirable locations (see the Composite Analysis sample map). By weighting the three maps equally, the results favor sites with good view characteristics; of course, development would be precluded in the most sensitive areas. When a program or alternative programs for the Tokositna study area have been developed, this procedure can be used to determine the most suitable locations for various types of activities and facilities; however, a different set of criteria and weighting system could be used. The functional relationship of the elements within a program may necessitate some trade-offs in selecting sites.

Except for the sensitive areas that have already been identified, the study area can physically accommodate a wide range of park and recreational uses, and potentially even intense resort levels of development. However, as the level of development increases, the physical characteristics that limit development become more critical (for example, water availability and sewage disposal). Socioeconomic and political factors, which have not yet been fully evaluated, will also affect the type and level of development.
SENSITIVE AREAS

TOKOSITNA
DENALI STATE PARK
ALASKA
MCKINLEY VIEWS
TOKOSITNA
DENALI STATE PARK
ALASKA
COMPOSITE ANALYSIS
TOKOSITNA
DENALI STATE PARK
ALASKA
CULTURAL RESOURCES INVENTORY

DESCRIPTION

No specific cultural resources have been identified within the study area to date. Only one prehistoric site for the Talkeetna quadrangle is listed in the files of the Alaska Heritage Resource Survey. The site is about 40 miles southwest of the study area. Several historic sites for the Talkeetna quadrangle are listed (roadhouses, railroad section camps, etc.), but they are outside the study area.

The primary reason for the lack of identified sites is that no field surveys for cultural resources have been conducted in the study area. An examination of glacial geology indicates that the Tokositna Valley was open for use by man towards the end of the Naptowne glaciation, or sometime between approximately 9,000 and 5,500 years ago. These dates for prehistoric occupation in the study area have been supported by other archeological studies conducted in the region, particularly Bacon’s work in the upper Susitna Basin (1978a, 1978b) and the Matanuska Valley (1975, 1978c), and West’s studies in the Tangle Lakes area (1967, 1975, 1976). An archeological survey was conducted in the eastern portion of Denali State Park in 1971 (West); however, no sites were discovered within the park. One site, which dated to approximately 6,000 years before present, was outside the park boundary in the vicinity of Stephan Lake. Cultural materials deposited during the interstadial periods of the Naptowne and the more recent Alaskan glaciations probably no longer retain their original integrity because of glacial activity and mass-wasting processes. However, even secondarily deposited materials may contain significant finds. The most likely areas for such prehistoric resources are high grounds away from the valley floor.

Athapaskan Indian groups were known to have inhabited the upper Cook Inlet region and the Susitna Valley by about 2,500 to 3,000 years ago. They were certainly present in the area at the time of Euro-American contact. West (1971) postulates that the upper Susitna Valley was only sparsely populated by seminomadic groups during the prehistoric period because of adverse environmental conditions — long cold winters and a lack of plentiful food resources.

During the historic period (post-1740), population levels in the study area remained low, but the northern Athapaskans were known to have entered into the upper Susitna Basin for hunting and trading during the spring and fall. The Ahtena Athapaskans lived farthest inland, near the headwaters of the Susitna River, but their major villages were outside the study area. The Tanaina Athapaskans lived along the lower Susitna River and Cook Inlet. The Indian usage of the Susitna River basin during the historic period has been well documented in the accounts of civilian and military explorers and adventurers, but very few sites associated with the early historic period have been located in the upper Susitna River valley.
Fishing may have been a viable pursuit for Indians using the study area, especially since salmon and other fish resources are present in the lower reaches of the Tokositna River and in streams south of Peters and Dutch hills. Seasonal camps keyed to fish resources may thus be expected, particularly at stream confluences and at the inlets and outlets of lakes. Hunting sites could be located on any of the hill benches and knolls of the upland areas, particularly if game resources, especially bear and moose, were concentrated in the same areas as they are today.

Winter use of the upper Susitna Valley appears to have increased during the historic period because of the fur-trapping industry, but this was only a seasonal pattern. Permanent Athapaskan villages became concentrated in the vicinity of the trading company outlets along the lower Susitna River and the upper Cook Inlet.

In 1905, gold was discovered in Peters and Cache creeks. By 1911, about 100 men were working these claims (see Placer Mines and Trails map). At least one operation was located by Long Creek in the study area. Support facilities for the placer-mining operations included development of a pack/wagon trail and a sawmill. Significant cultural remains associated with the early mining period are probably located in the Dutch and Peters hills areas.

Other historic sites associated with early exploration, such as the Cook assault on Mount McKinley, may also be located in the study area.

PLANNING CONSIDERATIONS

Because very little is known about the cultural resources of the study area, sites that may be identified through archeological surveys or during the implementation of various developmental plans or construction projects would be significant. Consequently, any specific ground-disturbing activities must be preceded by a site-specific archeological survey. Archeological, historical, and sociocultural studies should also be conducted in any areas that would be indirectly affected by these undertakings. (This situation also exists for the entire area west of the Susitna River above its confluence with the Yentna River.)

Archeological surveys, excavations, and cultural reconstructions are needed for an understanding of cultural history, cultural processes, and the nature of dynamic cultural systems within the area. Impacts upon the resource base cannot be assessed without an accurate and complete data base.
SOCIOECONOMIC ENVIRONMENT INVENTORY

The socioeconomic conditions that have great influence on any development at the Tokositna site are analyzed in this chapter. The analysis of potential in-state and out-of-state visitor use demand were covered in a separate report, called the "Market Analysis/Economic Feasibility Study" (Economic Research Associates 1979).

COMMUNITIES

Description
The Tokositna study area lies between the two largest communities in Alaska, Anchorage and Fairbanks. These two cities support more than half of the state's population, and they are the largest sources of in-state support for any development at Tokositna.

Anchorage. Anchorage is approximately 150 miles from the Tokositna study area by way of Parks Highway, or about a 3½-hour drive. Its population expanded rapidly from 1970 to 1978, growing from 120,000 to 204,000 people.

An important characteristic of the Anchorage population with regard to recreation and travel is the young median age: 25 as opposed to the national median of 29. (Of the population, 77 percent is under age 40, and 88.9 percent is under age 50.) This young population results in a high participation rate in recreational activities such as camping, fishing, and picnicking (see table 16).

Tourism is an important factor in the Anchorage economy, and it is second only to oil and gas in its contribution to the state economy. Anchorage is the major point of entry for tourists bound for most destinations within Alaska. Of the estimated 500,000 tourists visiting Alaska in 1979, 385,000 entered through Anchorage (Alaska Visitor Association 1979). The Alaska Division of Tourism estimates that tourism directly or indirectly contributed about $225 million to the state's economy in 1979.

Anchorage is serviced by an extensive transportation system. The Alaska Railroad connects Anchorage with Seward, Talkeetna, Mount McKinley National Park, and Fairbanks. The highway system serves these areas and also provides access south to the Kenai peninsula and west to Glenallen. The highway system connects with the Canadian highway system, joining Anchorage to the continental United States.

Anchorage is located on the polar air routes that connect Asia, North America, and Europe. Eleven commercial airlines and numerous private carriers serve Anchorage. Many of the private carriers use Merrill Field and the Lake Hood/Spenard seaplane base, which is the largest floatplane base in the world.
Table 16: Anchorage Resident Recreation Participation Survey

<table>
<thead>
<tr>
<th>Activity</th>
<th>Regularly</th>
<th>Just a few times</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycling</td>
<td>31.4%</td>
<td>26.3%</td>
<td>42.3%</td>
</tr>
<tr>
<td>Camping</td>
<td>29.0</td>
<td>36.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Hiking</td>
<td>30.0</td>
<td>33.5</td>
<td>36.6</td>
</tr>
<tr>
<td>Fishing</td>
<td>39.1</td>
<td>30.8</td>
<td>30.1</td>
</tr>
<tr>
<td>Hunting</td>
<td>18.4</td>
<td>18.9</td>
<td>62.7</td>
</tr>
<tr>
<td>Picnicking</td>
<td>37.6</td>
<td>44.1</td>
<td>18.3</td>
</tr>
<tr>
<td>Swimming</td>
<td>11.5</td>
<td>23.6</td>
<td>63.3</td>
</tr>
<tr>
<td>Sightseeing/Driving</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Boating/Sailing/Kayaking</td>
<td>9.4</td>
<td>21.7</td>
<td>66.1</td>
</tr>
<tr>
<td>Golf</td>
<td>2.6</td>
<td>8.7</td>
<td>88.6</td>
</tr>
<tr>
<td>Tennis</td>
<td>12.2</td>
<td>21.7</td>
<td>66.1</td>
</tr>
<tr>
<td>Running</td>
<td>19.8</td>
<td>28.8</td>
<td>51.9</td>
</tr>
<tr>
<td>Alpine Skiing</td>
<td>12.1</td>
<td>12.9</td>
<td>74.9</td>
</tr>
<tr>
<td>Cross-country Skiing</td>
<td>16.5</td>
<td>21.3</td>
<td>62.2</td>
</tr>
<tr>
<td>Walking</td>
<td>49.6</td>
<td>36.4</td>
<td>14.0</td>
</tr>
</tbody>
</table>

Source: Human Resources Study (Human Resources Planning Division, Municipality of Anchorage, 1977).
Anchorage has 3,343 hotel rooms, three museums, three college/university campuses, a public transit system, and numerous radio and television stations.

**Fairbanks.** Fairbanks is in the interior of Alaska on the Chena River. It is approximately 265 miles from the Tokositna study area by way of Parks Highway, or about a 5½-hour drive.

In 1976, the population of the Fairbanks North Star Borough reached 72,000, and the city of Fairbanks, 34,500. Since the completion of the pipeline, the populations of the borough and city have dropped to 56,000 and 25,000 people, respectively (Alaska Department of Labor 1979).

The population of Fairbanks tends to be young, like Anchorage. The 18-to-20 age group is the largest group, and in 1970, 57 percent of the population was under age 30. The young age of the population results in a high propensity for active recreation and travel. Despite the high cost of living in Fairbanks, residents allocate a significant portion of their income for leisure activities.

Tourism is a valuable asset to the Fairbanks economy. In 1977, 23 percent of Alaska tourists visited Fairbanks (Parker Research Corporation 1978).

Fairbanks is the transportation center for interior Alaska. Because roads and railroads in the interior are limited, air travel is important, and airports in the Fairbanks area form the heart of the air transportation system in the Yukon region. International carriers and major commercial carriers use the Fairbanks International Airport. The interior Alaskan highways converge on Fairbanks, and it is the end point of the Alaska Railroad and Parks Highway. It is connected to the lower 48 states via the Alaska Highway, and to Valdez via the Richardson Highway.

Fairbanks has 1,165 hotel rooms, a public transit system, and a university campus.

**Local Communities.** The Susitna Basin area was first settled in the early 1900s by miners and trappers who came up the Susitna River. The frontier spirit that first drew settlers to this area lives on in the local communities. Some homes are miles from the nearest road, and placer-mining operations, moose hunting, old roadhouses, and trap lines still exist.

The local communities are limited to Talkeetna, Trappers Creek, Peters Creek, and Petersville. The large semiwilderness area consisting of four townships between the study area and the Parks Highway is referred to as the Tokosha community.

Talkeetna is on the Susitna River, about 30 air miles southeast of the study area; the present population is about 160 people. Talkeetna has two public airports, a school, a
low-density residential area, a state highway maintenance facility, a communications
facility, a public park, several small lodges, restaurants, a building supplies store, and a
general store that sells groceries and sporting goods. The larger airport has a gravel
airstrip 4,040 feet long; the smaller one has a gravel strip 200 feet long. The economy
of Talkeetna is supported by tourism, government (the airports and highway
maintenance facilities), subsistence agriculture, sport hunting, sport fishing, and
mining.

The community of Trappers Creek is centered around the junction of Parks Highway
and Petersville Road, and it includes the land 2 miles on each side of the Petersville
Road for its first 11 miles. About 125 to 200 people live in Trappers Creek. It consists
of farmlands, a low-density residential area, two schools, a highway patrol
headquarters, a gasoline station, a restaurant, a private recreation area, a lumber
products store, a church, and a liquor store.

The communities of Peters Creek and Petersville, along the Petersville Road, are very
small, with only a few people in each. Peters Creek consists of one building, the Forks
Roadhouse. Petersville consists of several small private buildings used in connection
with placer-mining operations in the area. Land uses along the Petersville Road consist
of a gravel airstrip and scattered residential development. Activities include sport
hunting, fishing, and cross-country skiing.

Planning Considerations
Local and nonlocal people expressed their opinions and concerns about the Tokositna
project at three public meetings held in January 1979 in Anchorage, Fairbanks, and
Talkeetna. Specific comments made at the meetings are included in appendix C.
Throughout the course of the study, people have expressed their concerns individually
at the Division of State Parks office in Anchorage.

Local and nonlocal people share many of the same concerns, but their emphases are
different. Nonlocal people (those at the Anchorage and Fairbanks meetings) tend to be
more concerned about the financial impact of the development as it relates to their
taxes. The majority of the comments were received from local people at the Talkeetna
meeting, and they were concerned about the direct effects of the development on their
present lifestyles.

Residents at these meetings generally favored the concept of developing facilities on
the south side of Mount McKinley. However a low-key development with rustic or
traditional Alaska-style architecture was particularly stressed.

Major local public concern focused on access to the study area. Access from Parks
Highway could be developed using either portions of the Petersville Road or a new
alignment north of the Petersville Road (see Alaska Department of Transportation and
Opposition to upgrading Petersville Road came mainly from placer gold and platinum miners south of the study area in Cache Creek. Because Petersville Road passes through this mining area, miners are concerned that upgrading it for access to the Tokositna site would result in increased recreational use and adverse effects on their mining operations (such as vandalism to their equipment and liability if people were injured on their property).

Landowners and small business owners along Petersville Road support upgrading the road because it would increase land values and economically boost their businesses. These residents also pointed out that private and borough lands along the Petersville Road corridor would provide an opportunity for private enterprise to construct housing and support facilities for the proposed development. These residents claim that Petersville Road could be put to more uses than other road alignments, for example, to provide access for future land disposal programs.

Residents of the Tokosha community also support upgrading Petersville Road, but for a different reason. They claim that other roads would not make sense economically, socially, or environmentally. Also, they claim that the people along Petersville Road would not be affected by the development or by road access to the study area, whereas a new road through the Tokosha community area would ruin their rustic lifestyles. Impacts of a new road would include noise and viewscape deterioration from construction and automobile traffic, and greater environmental damage. Many of the people in the Tokosha community are seasonal residents, a number whom work in Anchorage part of the year.

**LAND STATUS AND USE**

**Land Status**

The ownership of Alaska lands is currently under resolution among federal, state, and private interests. Competition is very strong for lands that are high value resources or that can support development.

Two federal statutes — the Alaska Statehood Act, which makes 104,450,000 acres available to the state, and the Alaskan Native Claims Settlement Act, which permits conveyance of 40 million acres to Alaskan natives — provide the mechanism for the disposition of lands. In addition the Alaska Municipal Code permits each borough to select, for municipal purposes, 10 percent of the vacant unappropriated, unreserved state land located within its boundaries.

The state receives land from the federal government in a three-step process. First, the state applies for land, which is classified as “state selections application.” When the U.S. Department of the Interior approves transferring this land to the state, the land is...
referred to as "state selections tentatively approved." Finally, when the land is conveyed to the state, it is called "state selections patented." When the land becomes patented to the state, and if it is unreserved for a particular use, a borough can select land from the state through a similar process.

Despite the uncertainty of landownerships, people are continuing to use the lands in question. Federal, state, and local governments are managing the lands and issuing regulations despite uncertain ownership. As a result, residents often find themselves using lands they are not permitted to use because the ownership boundaries have not been decided. Confusion will remain until the state and the native corporation land is patented.

Landownership in the vicinity of the study area consists of large areas of federal and state lands and smaller areas of borough and private lands (see Land Status map). Study area lands have to date only been selected for ownership by the state, and ownership still rests with the federal government. Nonetheless, these lands were added to Denali State Park by state legislation in 1976.

Federal lands in the vicinity are under the jurisdiction of two U.S. Department of the Interior agencies — the National Park Service and the Bureau of Land Management. The National Park Service administers Denali National Monument and Mount McKinley National Park, which are north of the study site. The national park was established by Congress in 1917, and the national monument, which surrounds most of the park, was established under the 1906 Antiquities Act by President Carter in December 1978. The Bureau of Land Management manages land in a 6-square-mile area surrounding the town of Petersville and containing mining claims that soon may be patented.

Most of the other lands surrounding the study area are being claimed by the state and are classified as selected, tentatively approved, or patented. Most lands east of the site are within Denali State Park and have been tentatively approved. Lands south of the study area are mostly state patented, and there is a scattered pattern of lands under borough and private selection. Lands west of the study area are only state-selected lands.

The Matanuska-Susitna Borough lands within and near the study area are under land transfer categories similar to state lands — selected, tentatively approved, and patented. The borough land pattern generally follows the Petersville Road and Parks Highway. Only a small amount of borough land is patented; this is contained in two parcels, one close to Swan Lake and the other along Parks Highway. The borough has received tentative approval on most of its land along the highway. Although none of the borough selection land is adjacent to the study area, the total amount of borough land classified as selected, tentatively approved, or patented amounts to about 10 square miles in the vicinity.
Cook Inlet Region, Inc., has applied for selection of state-owned lands near Talkeetna.

Some privately owned and leased land is found at three locations near the study area — along the Petersville and Parks Highway road corridors and in the Tokoshia community area (which was opened to acquisition under the Open-to-Entry program). Approximately 40 to 100 primitive homesteads are located in this area. The state is currently selling certain lands in the vicinity of Swan Lake under the state land disposal program.

Numerous state and/or federal mining claims are present in the study area vicinity. Although it appears that some of these claims are valid, the issues of exactly which ones and whether they are under state or federal regulations are unresolved at this time. Major questions arose when these lands were selected by the state and subsequently added to Denali State Park prior to being patented. Mining claims are not normally allowed in state parks unless, as in this case, the claims were staked prior to the establishment of the park. (See the “Mining, Oil, and Gas Development” section for further discussion related to mining claims.)

Land Use
Residential and Commercial Use. The limited residential and commercial development in the vicinity of the study area is concentrated on private and borough lands. Commercial development is confined to the Parks Highway and Petersville Road corridors, and facilities include several roadhouses, numerous gas stations, several landing strips, and a campground. Residential use is also concentrated along these roads, with an additional area of scattered residential development in the Tokoshia community.

The Alaska Department of Transportation has upgraded the first 7 miles of the Petersville Road and is tentatively scheduled to upgrade the road to milepost 10.5 in 1982. This upgrading will result in some realignment and a 28-foot-wide gravel roadway, and it could increase pressure for development along the road.

Mining, Oil, and Gas Development. State selected, state patented, and Bureau of Land Management lands south and west of the study area are open to mineral entry and development. Coal prospecting and oil and gas leases exist on the state patented lands, but current activity related to the development of mineral entry rights is limited to placer gold and platinum mining operations (see Land Status – Study Area map).

In the past, virtually all lands in the Dutch and Peters hills, including the study area, were covered by federal mining claims administered by the Bureau of Land Management. However, following state selection of the study area lands and other lands to the south and west on January 12, 1972, the area was closed to additional federal mining claims. The miners who filed appropriate letters of protest at the time
STATE SELECTION APPLICATION
STATE SELECTION PATENTED
NATIONAL PARK-SERVICE
BUREAU OF LAND MANAGEMENT
PRIVATE LAND
MINING CLAIM COMPLYING WITH STATE AND FEDERAL LAW
MINING CLAIM MAY COMPLY WITH STATE AND FEDERAL LAW

STUDY AREA
LAND STATUS
TOKOSITNA
DENALI STATE PARK
ALASKA
of state selection will probably be permitted to continue operation under federal regulations.

Information on the location of mining claims filed under federal regulations is not available at this time. However, the Bureau of Land Management posted notices that miners who located claims prior to 1976 had until October 22, 1979, to file. Information about which claims in the study area were filed prior to state selection and are eligible for continuance under federal regulations will be available in the near future. To determine which of these filings are valid claims, they must be field checked to see if the claim has been properly staked and if the mineral prospect is adequate to ensure economic development by "a reasonable and prudent man." If the claim is determined to be valid under federal regulations, the claimant may obtain surface title to the land through patent under federal regulations.

Following state selection in 1972, the study area was open to filing of claims under state regulations until 1976. Mineral closing order number 66, filed under the authority of state mining laws, prevented the staking of new claims on March 29, 1976. Three miners staked claims under state regulations during the four years it was open. In some places, these state and federal claims overlap. Exact jurisdiction in these cases is unclear.

Legislation establishing Denali State Park, as amended by House Bill 185, specifically forbids the use of eminent domain powers to acquire lands for inclusion within the state park. If this pertains to mining claims as well, valid mining claims within the area would be allowed to continue.

**Denali State Park.** Denali State Park totals 336,480 acres. All of the park developments (campgrounds and waysides) are near Parks Highway. The vast majority of the land is undeveloped and is used for backpacking, hiking, cross-country skiing, bow hunting, and fishing.

**Denali National Monument and Mount McKinley National Park.** Lands within the national monument and park are set aside for their scenic and scientific values. Within the monument, there is no development, and public use is restricted to activities compatible with the preservation of the resources, such as hiking, backpacking, cross-country skiing, and mountain climbing.

**Planning Considerations**

An access corridor to the study area from Parks Highway would likely change neighboring land uses. If no controls were adopted and enforced, strip commercial and residential development could occur, especially where lands are not publicly owned. This type of development would not provide a scenic approach for visitors to the study area. However, since most of the land between Parks Highway and the study area is
state-patented land, not only the alignment of the access road, but also the use of adjacent lands could be controlled. Depending on the location of the access corridor, the traditional lifestyles of homesteaders in the Tokosha community area could be altered. The provision of access into the study area would open the vicinity for additional hunting use and other recreational activities.

Extensive valid mining claims may be located in the study area, and they may prevent development at the optimum locations. Furthermore, mining operations could cause a visual intrusion in the area, which would detract from the scenic experience of visitors. The status of these claims must be resolved prior to the completion of any development plan for the study area.

EXISTING RECREATIONAL ACTIVITIES

Description
Alaskans are extremely outdoor-oriented in their recreational pursuits, which include fishing, backpacking, skiing, and snowmobiling. Many visitors from other parts of the United States and the world come to participate in these activities. (Recreation use patterns and trends by in-state and out-of-state users are covered in the “Market Analysis/Economic Feasibility Report.”)

Float Trips. Float trips are made down Peters Creek and Kroto Creek, and access to these creeks is by way of Petersville Road. Fishing is a popular sport pursued in conjunction with taking float trips. Float trips are occasionally made down the Tokositna River from Home Lake to the Chulitna River. This route affords opportunities to view moose, bear, trumpeter swans, eagles, and various marsh birds, and it also offers views of the Tokosha Mountains and Peters Hills. Other float trips are made down Bunco Creek to the Tokositna River, and down the major watercourses, including the Chulitna, Susitna, and Talkeetna rivers (see the Recreational Activities map).

Cross-Country Skiing. Extensive cross-country skiing takes place in the Tokosha community; however, use data are not available. Several area residents operate cross-country ski-touring businesses that utilize trails and cabins in the area.

An unknown number of skiers tour the Tokositna River valley in the study area. Access is by ski-equipped planes and cross-country skiing from adjacent areas. Parties also ski from the Ruth Amphitheater down the Ruth Glacier to its terminus. Access to the amphitheater is by means of ski-equipped planes, and skiers must camp out and know about glacier travel. Ski tours are also made down the Tokositna Glacier and in the Dutch and Peters hills. Touring through the Peters Hills is often limited by wind-blown snow.
Hiking. Probably the most common hiking route in the study area is through the Peters Hills from the Petersville Road to Long peak. The route is approximately 7 miles and requires six to eight hours to hike with packs. Views from points along the trail are spectacular and include Mount McKinley, Dutch Hills, Peters Hills, and the Susitna Valley. On a clear day the Kenai, Talkeetna, Chugach, and northern Aleutian chain mountains are visible from points along the trail. This trail is partially within Denali State Park and partially on lands under the jurisdiction of the Bureau of Land Management.

Other hiking trails are in the Peters Hills to the south of the Long peak trail. These trails are used primarily by a local backpacking guide and are on land administered by the Bureau of Land Management. Other commonly used trails occur just south of Denali State Park on state-patented land. Trails and routes begin at points along Parks Highway and terminate at Swan Lake and other lakes in the area. Hiking trails and routes also extend into Denali National Monument, but these are not commonly used.

Hiking trails somewhat removed from Tokositna, but still within Denali State Park, occur east of the Chulitna River. One poorly defined trail passes through private land near Mary Carry’s Mountain View Lodge on Parks Highway and continues to the top of Curry Ridge within the state park. This trail provides a good, but distant, view of Mount McKinley. North of this trail, and connected to it by a hiking route, is the Troublesome Creek trail. There are also good trails near Byers Lake.

Technical Mountain Climbing. Technical mountain climbing routes are most common in Denali National Monument; however, only a few hikers use these routes. The major mountains—Mounts McKinley, Foraker, and Hunter—have all been climbed numerous times. Many of the lesser peaks that have been climbed include Mount Barrille, Mount Huntington, the Roosters Comb, the East Buttress, Mount Silverthrone, Mount Brooks, Explorers Peak, and the Mooses Tooth.

Sport Hunting. Hunters gain access to the Tokositna area by means of airplane, helicopter, automobile, all-terrain vehicle (ATV), and boat. The use of airplanes in combination with boats and/or ATVs appears to be increasing. The use of ATVs has grown since 1972, and the trend is expected to continue. The detrimental effects of ATVs on the environment may outweigh the benefits of distributing hunting pressure over a wider area.

Moose hunting occurs on all suitable lands south of Denali State Park and Denali National Monument. Illegal hunting does occur in park areas, but to what extent is not known. The Tokositna vicinity is located in game management units 16A and 13E, with the study area itself mostly in 13E. Because the study area is parkland and the discharge of firearms is prohibited, most of the sport hunting takes place in 16A, which includes most of the land around Petersville Road. The moose harvest in 1976 for 16A
was 99; in 1975 it was 43. Probably a significant number of moose killed in 16A are killed near the study area.

Black bears are hunted in the vicinity of the study area, and the harvest was somewhere between 15 and 20 bears per year from 1973 to 1977 for all of unit 16A. Brown-grizzly bears are also hunted, and the harvest for units 16A and 16B ranged between 18 and 43 bears per year from 1961 to 1977 (ADFG 1979).

Other species hunted in the area include ptarmigan, waterfowl, spruce grouse, and snowshoe hare.

**Sport Fishing.** Sport fishing for grayling, rainbow trout, burbot, white fish, dolly varden, and also for king, coho, chum, sockeye, and pink salmon, occurs in or near the study area.

**Planning Considerations**
Existing skiing and hiking trail routes could be easily made into more formal trails for a development at Tokositna. Private ski tour guides south of the study area might also provide tours to remote cabins.

Heavy ATV use could detract from the scenic qualities of the area and have a detrimental effect on the area's vegetation and wildlife. Consequently, ATV use in the area should be zoned.
APPENDIXES

A: LEGISLATION

LAWS OF ALASKA

AN ACT

Relating to state parks and establishing the Denali State Park.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. AS 41.20.020(6) is amended to read:

(6) establish, in accordance with the Administrative Procedure Act, rules and regulations governing the use and designating incompatible uses within the boundaries of state park and recreational areas to protect the property and to preserve the peace;

* Sec. 2. AS 41.20 is amended by adding new sections to read:

ARTICLE 8. DENALI STATE PARK.

Sec. 41.20.300. DECLARATION OF PURPOSE. The purpose of secs. 300 - 320 of this chapter is to restrict state owned lands and waters described in sec. 310 of this chapter to use as a state park. Under the provisions of AS 38.05.300 state land, water or land and water containing more than 640 acres may be closed to multiple use only by act of the legislature. Because the area described in sec. 310 of this chapter exceeds 640 acres, secs. 300 - 320 of this chapter are intended to provide for the closing of the described lands and waters to multiple use in conformity with AS 38.05.300 and their designation as a special purpose area in accord with art. VIII, sec. 7 of the Constitution of the State of Alaska.

Sec. 41.20.310. DESIGNATED STATE LANDS AND WATERS RESTRICTED TO USE AS A STATE PARK. The state owned lands and waters and that acquired in the future by the state lying within the parcels described in this section are
designated as the Denali State Park. These lands and waters are reserved from all uses incompatible with their primary function as park area. Lands covered by secs. 300 - 320 of this chapter are those within the following described parcels:


Sec. 41.20.320. ACQUISITION OF PRIVATE LANDS. The state may not acquire by eminent domain privately owned land for inclusion in the Denali State Park.

Approved by governor: June 23, 1970
Actual effective date: September 21, 1970
AN ACT
Expanding Denali State Park.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

Section 1. AS 41.20.310 is amended to read:

Sec. 41.20.310. DESIGNATED STATE LANDS AND WATERS RESTRICTED TO USE AS A STATE PARK. The state-owned lands and waters and that acquired in the future by the state lying within the parcels described in this section are designated as the Denali State Park. These lands and waters are reserved from all uses incompatible with their primary function as park area. Lands covered by secs. 300 - 320 of this chapter are those within the following described parcels:


(2) T29N, R7W; Sections 1-27 and 34-36, T29N, R8W; containing approximately 42,240 acres, all in the Seward Meridian.

Approved by governor: June 8, 1976
Actual effective date: September 6, 1976
AN ACT

Making a special appropriation to the Department of Transportation and Public Facilities for preconstruction planning and engineering studies of the Petersville Road; and providing for an effective date.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. The sum of $85,000 is appropriated from the general fund to the Department of Transportation and Public Facilities for the purpose of preconstruction planning and engineering studies of upgrading to federal aid secondary standards 26 miles of the Petersville Road, and for the preconstruction planning and engineering studies necessary to extend the Petersville Road six miles to the site of the proposed Tokositna lodge and visitor center in Denali State Park.

* Sec. 2. The unexpended and unobligated portion of this appropriation lapses into the general fund June 30, 1979.

* Sec. 3. This Act takes effect July 1, 1978.

Approved by the Governor: June 17, 1978
Actual Effective Date: July 1, 1978
AN ACT

Making a special appropriation to the Department of Natural Resources for a feasibility study of the proposed Tokositna Lodge and Visitor Center in Denali State Park; and providing for an effective date.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. The sum of $220,000 is appropriated from the general fund to the Department of Natural Resources for a study in coordination with the Department of Transportation and Public Facilities, of the feasibility of constructing a lodge and visitor center complex in Denali State Park at a site overlooking the Tokositna River.

* Sec. 2. The unexpended and unobligated portion of this appropriation lapses into the general fund June 30, 1979.

* Sec. 3. This Act takes effect immediately in accordance with AS 01.10.070(c).

Approved by the Governor: July 8, 1978
Actual Effective Date: July 9, 1978
RELATING TO THE DEVELOPMENT OF NATIONAL AND STATE PARKS.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Mount McKinley National Park is the oldest national park in Alaska and encompasses the northern and western flanks of the Denali massif; and

WHEREAS the Secretary of the Interior has withdrawn federal lands to the south of Mount McKinley National Park for inclusion within the park under authority of the Antiquities Act; and

WHEREAS the Secretary's withdrawals abut lands selected by the State of Alaska and included within the Denali State Park by Act of the Alaska Legislature; and

WHEREAS Mount McKinley National Park and Denali State Park are major tourist attractions offering unparalleled opportunities for views of North America's highest peak, wildlife, and for recreational uses; and

WHEREAS the Mount McKinley National Park - Denali State Park units are centrally located between Alaska's principal cities, readily accessible by both road and rail, and present a significant challenge for joint planning involving the National Park Service and the Alaska Department of Natural Resources; and

WHEREAS the planning and development of access and facilities for tourism and recreational use on the south flank of Denali, and the provision of headquarters facilities for both the federal and state agencies concerned with McKinley Park - Denali Park resource management, offer one opportunity to develop the economy of the northern portion of the Matanuska-Susitna Borough;
BE IT RESOLVED that the Alaska State Legislature endorses further consideration of the concept of a recreational complex in the Denali State Park and Mt. McKinley National Park area; and be it

FURTHER RESOLVED that the Alaska State Legislature respectfully requests the governor to initiate discussions with the National Park Service regarding the joint planning of national and state parks after resolution of the Alaska lands issue; and be it

FURTHER RESOLVED by the Alaska State Legislature that a special committee be appointed to include a member appointed by the president of the senate, a member appointed by the speaker of the house, and a member appointed by the governor, to meet periodically to review, propose, and recommend contracts or agreements for study and research concerning potential park and recreational development in the Denali State Park - Mt. McKinley National Park area, serve as a point of contact for parties interested in park and recreational development opportunities for this area, and continue efforts to secure joint planning for the national park and the state park under a master plan involving both units; and be it

FURTHER RESOLVED that the committee complete a report of its work with recommendations and present it to the Twelfth State Legislature not later than January 20, 1981.
BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS consideration is being given to building a new road to parallel the existing Petersville Road; and

WHEREAS it has not been demonstrated that building a new road is more beneficial than upgrading the existing road; and

WHEREAS the impact on the environment of building a new road is considerably greater than the impact of upgrading the existing road; and

WHEREAS the cost of building a new road may exceed the cost of upgrading the existing road, without a corresponding benefit;

BE IT RESOLVED that the Alaska State Legislature respectfully requests the governor to direct the commissioner of transportation and public facilities to, as nearly as possible, construct the Petersville Road along its existing alignment.
B: MEMORANDUM OF UNDERSTANDING

Mount McKinley National Park is recognized as the State of Alaska's foremost visitor attraction. It has been resolved that visitor facilities to accommodate both existing and projected levels of recreational use of the Mount McKinley area should be cooperatively studied by the Federal Government (U.S. Department of the Interior, National Park Service), the State of Alaska (Department of Commerce and Economic Development, Division of Tourism, and the Department of Natural Resources, Division of Parks) and the Matanuska-Susitna Borough. Federal, State and Matanuska-Susitna Borough lands may all be allocated to the purposes of achieving visitor facilities and programs focusing upon Mount McKinley National Park, thus necessitating cooperative planning and, eventually, cooperative management.

The government agencies stated above have met and agree to the following purposes and objectives:

1. The State of Alaska, U.S. National Park Service and the Matanuska-Susitna Borough are committed to fully investigating the need and the economic and environmental feasibility of constructing and operating a visitor facility on the south side of Mount McKinley, focusing upon Denali State Park's Peters Hills area, and possibly other sites.

2. The primary attraction of this potential development location is the outstanding natural phenomena presented by the Mount McKinley massif itself. Structures, facilities and possible visitor programs should be constructed in the spirit that nature is the premier attraction, and that the scope and scale of developments here should not attempt to portray mankind's triumph over nature.

3. Any development and program planned for this site should consider a wide range of visitor (economic) means and desires, from tent camping to modest as well as first class overnight accommodations, and from active to passive recreational activity opportunities.

4. It is agreed that State, Federal and Borough governments should assume the responsibility for planning this development.

5. Feasibility investigations will consider that a demand may develop for some winter activities at this location.

6. Primary access to the proposed development site should be planned around a public transportation system utilizing the general location of the Petersville road; however, multi-modal transportation methods should be considered where feasible. New transportation routes should also be fully explored where cost-benefit and energy savings can be realized over the long range period of use.
7. The parties will prepare environmental impact documentation with respect to any development proposed in the plan, and that no such development will be undertaken in advance of such environmental analysis.

This memorandum of understanding is not intended as a specific work plan, but rather as a document expressing concurrence on the part of the National Park Service, State of Alaska and the Matanuska-Susitna Borough that visitor, tourism and recreational facilities can be constructed on the south side of Mount McKinley in Denali State Park.

Concur

Jan B. Hammond, Governor
State of Alaska

Date Sept. 9, 1978

Concur

Cecil D. Andrus
Secretary of the Interior

Date 11-17-78

Concur

Ron Larson, Mayor
Matanuska-Susitna Borough

Date Sept. 27, 1978
C: PUBLIC COMMENTS ABOUT POTENTIAL DEVELOPMENT AT TOKOSITNA

Numerous citizen comments on the Tokositna development were recorded during three public meetings held in January 1979. This appendix contains a list of the most frequently mentioned and highlighted ideas at each meeting.

Anchorage — January 8, 1979, 80 persons attending:

- Facilities should be developed for viewing Mount McKinley on the south side.
- Development should be low cost, with traditional style architecture. A controlled-environment city should not be built.
- Private enterprise and not public funds should be used to fund the planning and development of the site.
- A development site on a north-facing slope, like the Tokositna site, would be too cold, windy, and sunless for recreational facilities.
- Use of potential development sites along Parks Highway should be explored, because development costs would be substantially less.
- Miners expressed concern that upgrading the Petersville Road would have adverse effects on their mining operations in Cache Creek.

Fairbanks — January 9, 1979, 7 persons attending:

- To reduce development pressures within Mount McKinley National Park, facilities should be constructed on the south side of the park.
- The facilities should provide opportunities for year-round recreation; however, caution should be exercised in the development of a downhill-skiing area to ensure that it does not dominate the landscape.
- A transportation study designed to analyze various makes of transportation should be conducted.
- In selecting an access route, upgrading the existing Petersville Road should be considered.
The development character should be rustic; not a controlled-environment city.

The development should provide for buffer areas between incompatible use areas.

Since a major part of the site is above timberline, planning and design should consider site sensitivity.

Talkeetna — January 10, 1979, 70 persons attending:

A visitor use complex should be developed on the south side of Mount McKinley.

The development should be rustic in character; not a controlled-environment city.

A road should not be developed through the existing roadless area; rather vehicular access to the site should be provided along the existing Petersville Road corridor. Bypasses around existing small communities along the road should be considered to minimize impacts.

A railroad spur to the study area should not be developed.

Care should be taken to ensure that the development does not overload the existing power source.
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DIXON, M.

ECONOMIC RESEARCH ASSOCIATES

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UNIVERSITY OF ALASKA, ARCTIC ENVIRONMENTAL INFORMATION AND DATA CENTER

WEST, FREDERICK HADLEIGH


STUDY TEAM

This study was jointly undertaken by the Alaska Division of State Parks and the National Park Service. Several public agencies served as consultants.

ALASKA DIVISION OF STATE PARKS

Vicky M. Sung — Project Manager; Regional Planner/Landscape Architect
Vincent Radosevich — Environmental Research Analyst
Dave Johnston — Denali State Park Ranger
Jerry Ward — Research Assistant
Chris Sumislawski — Research Assistant

NATIONAL PARK SERVICE

Paul Kalkwarf — Project Coordinator; Landscape Architect
Paul Zenisek — Engineer
Bob Lopenske — Architect
Steve Hodapp — Natural Resource Planner/Wildlife Biologist
Craig Davis — Historical Archeologist

CONSULTANTS

Bob Bennett — Geoprocessor Application Specialist, Alaska Department ofNatural Resources
George Clagget — Snow Scientist, Soil Conservation Service, U.S. Department ofAgriculture
Jack Didrickson — Game Biologist, Alaska Department of Fish and Game
Lloyd Egan — Geoprocessor Systems Manager, Alaska Department of NaturalResources
Larry Engle — Fish Biologist, Alaska Department of Fish and Game
Al Feulner — Geologist, Geological Survey, U.S. Department of the Interior
Clarence Furbush — Soil Scientist, Soil Conservation Service, U.S. Department ofAgriculture
Marc Little — Hydrologist, Soil Conservation Service, U.S. Department ofAgriculture
William Long — Hydrologist, Alaska Division of Geological and GeophysicalSurveys
Brian Okonek — Outdoor Recreation and Mountain Guide, Tokosha Community
Ken Taylor — Game Biologist, Alaska Department of Fish and Game
Rodney Schulling — Planner, Matanuska-Susitna Borough Planning Department
Dr. Bradford Washburn — Director, Boston Museum of Science
Jim Wise — Meteorologist, Arctic Environmental Information and Data Center, University of Alaska

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