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ENVIRONMENTAL ASSESSMENT REPORT

ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

PREPARED BY
COMMONWEALTH ASSOCIATES INC.

ALASKA POWER AUTHORITY

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1982

**ANCHORAGE - FAIRBANKS TRANSMISSION INTERTIE
ALASKA POWER AUTHORITY**

ENVIRONMENTAL ASSESSMENT REPORT

**Prepared by
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I. SUMMARY

The Alaska Power Authority (APA) proposes construction of the Anchorage-Fairbanks Transmission Intertie to provide economic benefits to the Railbelt area in south-central Alaska. It is recommended that the line be constructed at 345 kV, although initially energized at 138 kV to interconnect existing transmission systems presently in service.

Selection of a preferred route for the Intertie by Commonwealth Associates Inc. (Commonwealth) was made which balanced concerns for environmental resources, public interests, economics and reliability. In achieving this goal substantial input was required of both the public and private sector, including the Railbelt communities through the Public Participation Program, the resource management agencies through informal meetings and formal presentations and the participating Alaskan Utilities through the Technical Review Committee. Completion of the route selection process in 1981 concluded with acceptance by the APA Board of Directors of the recommended route, IB-19. While not equally satisfying all objectives established in routing process, the alignment is generally responsive to those objectives of consistent importance throughout the project.

The preferred route is approximately 170 miles long and is generally aligned east of the Susitna River, as it proceeds north from the Willow Substation avoiding most of the local communities along the Parks Highway and Alaska Railroad. Routed north near Chulitna Butte, through Broad Pass and Windy Pass, the preferred route avoids Nenana Gorge and is situated in the Moody and Montana Creek drainages before reaching the Healy Substation. Notable features of the route selected include:

- no crossings of the Parks Highway

- only two crossings of the Alaska Railroad (near Indian River)
- no crossing of Denali National Park and Preserve
- one crossing of Denali State Park (near the Susitna River)

The environmental assessment report (EAR) contained herein provides the results of environmental studies with respect to the preferred route and alternative route segments which were evaluated. Information detailing modes of construction, cost estimates and engineering considerations can be referenced in the Route Selection Report (Commonwealth Associates Inc., 1982).

At the time of its preparation the EAR addressed the preferred route as presented to the Board of Directors. Route refinements in the final right-of-way will be taking place throughout the project and will constitute minor alterations generally less than one mile.

II. PURPOSE AND NEED

INTRODUCTION.

The five electric utilities that serve the Anchorage area and the Kenai Peninsula now operate interconnected. Likewise, the two utilities that serve the Fairbanks area are interconnected. However, Anchorage and Fairbanks are electrically isolated, one from the other. The practice of interconnection tends to maximize service quality and minimize power costs. Preliminary investigation suggested that extending this practice to unite the two areas might yield significant advantages. In July of 1980, APA therefore engaged Commonwealth to study the technical and economic feasibility of providing an electrical intertie between the Anchorage and Fairbanks utility systems.

The utilities in the Anchorage area are:

- Anchorage Municipal Light and Power
- Chugach Electric Association
- Matanuska Electric Association
- Homer Electric Association
- Seward Electric System

Those in the Fairbanks area are:

- Golden Valley Electric Association
- Fairbanks Municipal Utility System

The customer demands and the generating capability of the Anchorage and Fairbanks areas are projected to be as follows:

	<u>Peak Load, MW</u>		<u>Generation, MW</u>	
	<u>1984</u>	<u>1993</u>	<u>1984</u>	<u>1993</u>
Anchorage	526	731	731	731
Fairbanks	156	217	292	292

The existing Railbelt transmission systems terminate at the Willow Substation approximately 60 miles north of Anchorage and at the Healy Generating Station approximately 110 miles south of Fairbanks. The intertie necessary to bridge the gap between Willow and Healy will be about 170 miles in length as shown in Figure 1. The proposed project would utilize existing transmission lines to the maximum extent possible.

Given this new transmission line, substantial economic benefits can be derived by economy energy interchange and by reserve sharing that tends to defer future generating capacity additions. The nature of these economic benefits is described in more detail in the following sections.

FEASIBILITY ANALYSIS

The feasibility study of the Anchorage-Fairbanks Transmission Intertie included an economic evaluation of five alternative plans. These alternatives involved voltages of 138 kV, 230 kV and 345 kV, and are shown in Exhibit 4 of the Feasibility Report submitted by Commonwealth in May of 1981 (Commonwealth Associates, 1981).

Based upon economic, environmental and engineering considerations, Plan 1B-19 was selected. Plan 1B-19 involves the construction of a transmission

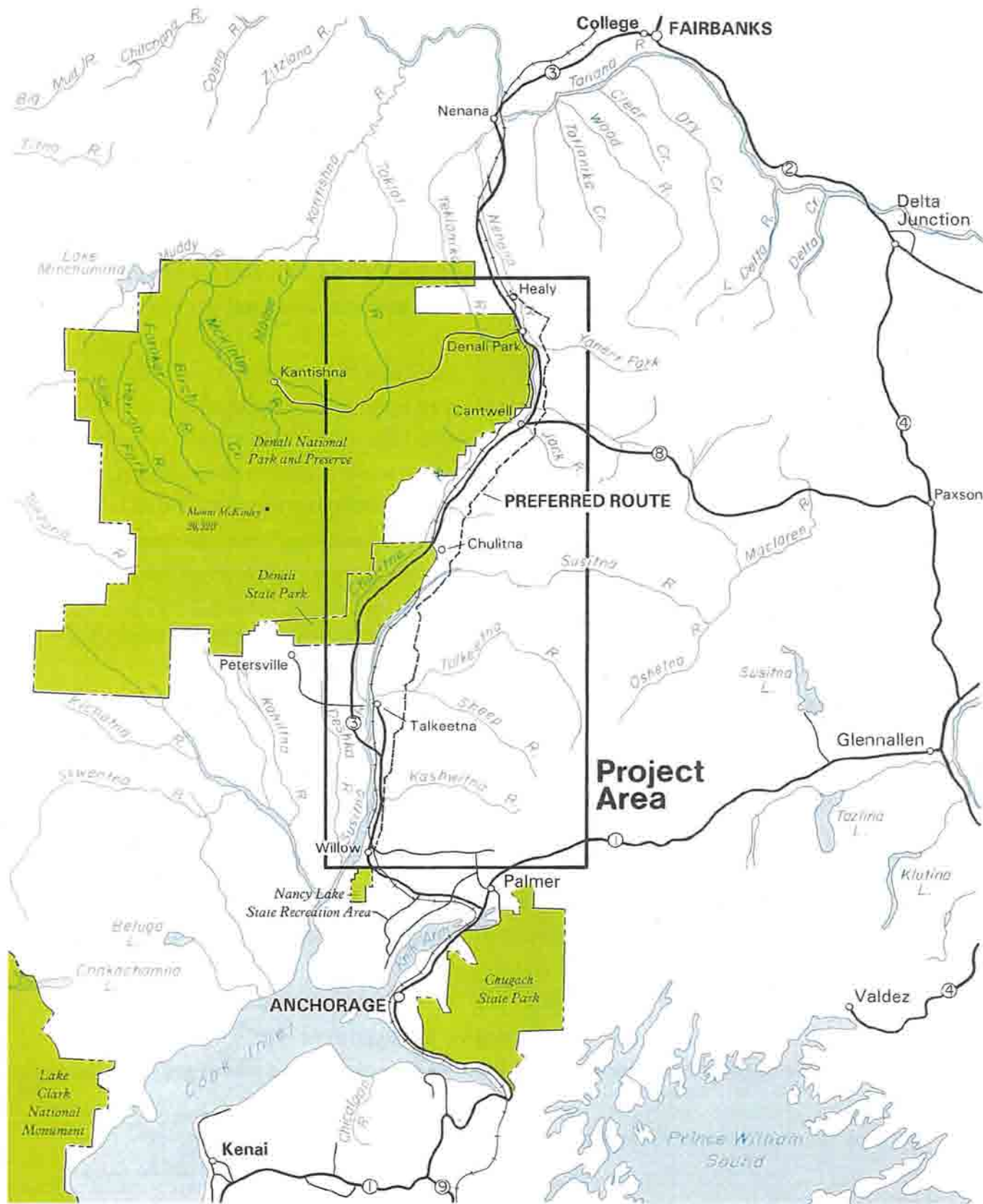


FIGURE 1

Alaska Power Authority **ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE**

Regional Location

0 30 60 Miles
0 30 60 Kilometers

Gilbert/Commonwealth



line between Willow (in the Anchorage area) and Healy (in the Fairbanks area) designed for future 345 kV operation but initially operated at 138 kV. The design for future 345 kV operation provides for longer range transmission needs in the Railbelt area. Plan 1B-19 offers a 1.9 ratio of benefits to costs, among the highest of the alternative plans considered. The estimated capital cost of this plan is \$130.8 million.

The benefits and costs of all alternative plans were evaluated based on a 35-year project life. The costs included fixed charges on investment, retirement and rededication credits and operation and maintenance expenses. The estimated benefits resulted from economy energy interchange and reserve sharing between the Anchorage and Fairbanks areas as described above. Table 1 provides the most recent estimate of life cycle benefits and costs for the Intertie project.

ECONOMY ENERGY BENEFITS

The fuel used for generation in the Anchorage area is natural gas, and in the Fairbanks area coal and oil are used. Economy energy benefits will accrue from the transfer of available energy (beyond the requirements of the local load) from the Anchorage area to the Fairbanks area, resulting in expensive oil consumption in the north being partially displaced by less costly gas consumption in the south.

The life-cycle benefits for Plan 1B-19 derived by transporting economy energy from Anchorage to Fairbanks are estimated at \$132.5 million (see Table 1).

RESERVE SHARING BENEFITS

One of the advantages of interconnected operation is that utilities can defer adding future generating units by sharing reserve generating capacity.

As can be seen in Table 1, the life-cycle reserve sharing benefits as a result of the Intertie are estimated at \$11.3 million.

TABLE 1
LIFE-CYCLE COSTS AND BENEFITS (a)
OF THE ANCHORAGE - FAIRBANKS INTERTIE
INCLUDING FUTURE NEED FOR 345kV INTERCONNECTION (b)

Intertie Voltage (kV)			Line Const. Option	Capital Investment (\$ Millions)	Costs (\$Millions)					Benefits (\$Millions)			Ratio of Benefits To Costs
Config.	Operation	Design			Fixed Charges (c)	Retirement Credit (d)	Rededication Credit (e)	Operation & Maintenance	Total	Economy Interchange	Reserve Sharing (f)	Total	
1A	138	138	19	92.8	139.6	-27.3	0.0	5.6	117.8	130.9	11.3	142.2	1.2
1B	138	345	19	130.8	196.7	-6.4	-122.2	5.8	74.0	132.5	11.3	143.8	1.9
2B	230	345	19	142.4	214.2	-5.4	-138.8	6.0	76.0	135.6	11.3	146.9	1.9

- (a) Present worth of additional annual expenses and benefits during the period 1984 to 1993, inclusive.
- (b) Assuming that in 1994 it will be necessary to raise the intertie voltage to 345kV in order to provide for transmission of power from Susitna or other new generating plants within the Railbelt, and/or provide general systems growth.
- (c) For a 35 - year amortization period.
- (d) Deduction for facilities retired in 1994.
- (e) Deduction for facilities rededicated to 345kV transmission in 1994.
- (f) Including the advantages of load diversity.

FUTURE TRANSMISSION NEEDS

The Anchorage-Fairbanks Transmission Intertie is to be so designed that after its first decade of operation it can be raised to 345 kV operation, extended and supplemented so as to provide for greater power transfer capacity between Anchorage and Fairbanks. It is foreseeable that growth of customer demand and consequent major additions to generating capacity will necessitate this move by the early 1990s. By using the line at 138 kV initially and providing for its future conversion to 345 kV, substantial economy can be achieved as shown by comparing Plans 1A-19 and 1B-19 in Table 1.

III. ALTERNATIVES

NO ACTION

If the Anchorage-Fairbanks Transmission Intertie is not built, the electric utilities in the two areas would lose the economic benefits that result from interconnected operation. The non-dollar benefits that accrue from economy energy interchange and reserve sharing can be summarized as follows:

1. It is estimated that a yearly average of 260,000 MWh of economy energy can be sent to Fairbanks between 1984 and 1993. This would result in avoiding the use of approximately 400,000 barrels of oil per year for generation in the Fairbanks area.
2. The Railbelt utilities can potentially avoid installing between 18 MW and 125 MW of new generating capacity in the 1985-1993 time frame by sharing installed reserves.

CONSTRUCTION OF A TRANSMISSION INTERTIE

To assist in the evaluation of the construction and operation of the Intertie, the following information is provided: 1) Preferred Route Alignment; 2) Facilities; 3) Construction Procedures, 4) Conceptual Access Plan and 5) Construction Schedule. The resultant environmental effects described herein have been predicated on these assumptions.

Preferred Route Alignment

The alignment preferred for the Intertie is 170.1 miles in length with a right-of-way 400 feet in width. Figure 2 depicts the general location of the line which consists of links 1s,3s,6s,7s,9s,12s,13s,15s and 16s. It can generally be described as paralleling the Matanuska Electric Association right-of-way north 19 miles from the Willow Substation. Near the village of Montana the route

proceeds north and east near Bartlett Hills 5 miles east of Talkeetna, where it crosses the Talkeetna River. The route generally merges with the Alaska Railroad north of Deadhorse Creek, crossing the Susitna River near Indian River and passing east of Chulitna Butte. Proceeding northeast, the route is situated along the eastern portion of Broad Pass, through Windy Pass and becomes aligned along the Montana and Moody Creek drainages before entering the Healy Substation north of the Healy River.

X Of the numerous objectives established in the routing process that of minimizing visual impact was strongly influential in selection of the preferred route. One comment consistently noted in public informational meetings was to avoid visibility of the line from existing homes and communities. Additionally, resource management agencies, through numerous meetings with Commonwealth and APA actively participated in the review and analysis of routing options. Agency involvement included Department of Natural Resources, Divisions of Forest, Land and Water Management, Parks, Land and Resource Planning and Research and Development and the Department of Fish and Game. Objectives similar to those identified by the public were identified (minimize visual impact and impact to land use) and resulted in their endorsement of a more remote alignment along several portions of the Intertie's preferred alignment, particularly in the area east of Talkeetna. Consequently, the preferred route has been selected to avoid paralleling the Parks Highway, existing park boundaries and community and individual settlements to the extent possible.

Concurrence of this alignment by the participating utilities was also achieved, although ground access along the right-of-way was considered essential to insure proper maintenance and reliability of the transmission facilities.

The alignment shown is that approved by the APA Board of Directors on November 19, 1981, with several refinements which have been included as a result

of subsequent field reconnaissance and property status reviews. The methodology utilized in the selection of the preferred route is provided in Appendix A. This methodology was influenced in its development by the Public Participation Program described in Appendix B.

Precedent for the alignment selected east of Talkeetna and the Susitna River in the vicinity of 3s and 6s has been established prior to Commonwealth's investigations. The Railbelt has been the subject of numerous studies for energy development (hydroelectric, fossil fuels, tidal) and several investigations have specifically included the project area identified for the Intertie. A brief synopsis of those studies delineating transmission corridors and their general conclusions is provided.

1. Proposed Plan for Power Development in the Railbelt Area of Alaska. U.S. Department of the Interior, Bureau of Reclamation, Alaska District. October 21, 1959.

This report identified major hydroelectric projects and an associated power grid. The transmission line route generally paralleled the Alaska Railroad to the east through the project area.

2. Alaska Power Generation and Transmission Study. The Ralph M. Parsons Company. 1962.

Future power requirements and present and prospective power resources were analyzed in this report to the Central Alaska Power Pool. Transmission systems were generally depicted east of the Susitna River south of Chulitna Pass and east of the Chulitna River further north in the project area.

3. Generation and Transmission Interconnection Studies Between Interior and South-central Alaska. Starr, Tallman and Butler, Bonneville Power Administration, U.S. Department of the Interior. 1969.

A summary of six system plans for generation and transmission of bulk power in the interior and south-central portions of Alaska were presented. Conceptual layouts of new transmission lines were shown to be located generally east of the Susitna River then proceeding north to Healy and Fairbanks.

4. South-central Railbelt Area, Alaska Upper Susitna River Basin, Interim Feasibility Report, Appendix 1, Part 2, Hydroelectric Power and Related Purposes. U.S. Army Corps of Engineers, Alaska District, 1975.

An environmental assessment of alternative transmission line corridors was conducted from Anchorage to Fairbanks. In the project area, alternative routes included a parallel of the Parks Highway, a second corridor east of the Susitna River and a third route aligned along the drainage of the Talkeetna River. The route situated east of the Susitna River was identified as least affecting the environment.

5. Anchorage-Fairbanks Transmission Intertie, Economic Feasibility Study Report. International Engineering Company, Inc., and Robert W. Retherford Associates, December 1979.

A feasibility study of a transmission intertie between Anchorage and Fairbanks identified system configuration, cost estimates and selection of a route. The alignment recommended generally paralleled the Susitna River to the east, avoiding Denali State Park and proceeded north paralleling the Alaska Railroad.

Review of these documents offers prior historical support for a transmission line route aligned east of the Susitna River and the Alaska Railroad in the central portion of the project area.

Facilities

The basic structure concept selected for the project is a guyed steel pole "X." There will be two structures of this configuration; one will have line angle capabilities up to 3 degrees and the other up to 8 degrees. Figure 3 depicts the general appearance of the "X" structure. Four additional structures will be required to provide for the remaining line angle and terminal capabilities. These are as follows:

<u>Designation</u>	<u>Line Angle</u>	<u>Concept</u>
Medium Angle	8° to 30°	3 Poles Guyed
Tangent Dead End	0° to 8°	3 Poles Guyed
Heavy Angle Dead End	8° to 50°	3 Poles Guyed
Max. Angle Dead End	50° to 90°	3 Poles Guyed

Figure 4 illustrates the medium angle structure. The structure shown in Figure 5, Heavy Angle Dead End, is representative of the other structures noted above.

There will also be an alternate structure type series of the single pole concept shown in Figure 6. The single pole structure has been designed with arms placed on each side to take advantage of side hill locations. The heavy angle dead end structure in this series will be similiar in appearance to the 3 pole structure shown in Figure 5 except without guys.

All structures will be tubular and made from steel that will provide a rusty appearance to blend in with the environment and reduce its visibility.

There will be two basic series of structures based on wind loading requirements. The first series will be used for areas where wind velocities of 130 MPH (gust) are

the maximum expected. The second series will be used in areas where the wind gust velocity is expected to exceed 130 MPH.

All structures will be designed to equal or exceed the requirements of the National Electrical Safety Code (NESC), 1981 Edition.

The foundations for all structures, except the single pole on side hill locations, will consist of steel piling or concrete pedestals anchored to rock. Several types of guy anchors may be used. These would include helix anchors, rock anchors and piles with the type selected depending on economics, soil capability or other constraints.

The standard foundation for the single pole structure is expected to be a concrete pedestal anchored to rock or a concrete cylinder approximately 6 feet in diameter and 25 feet deep in standard clay or sandy soils.

In all cases the material removed from the foundation excavations will be spread over the structure site to match existing grade contours. Rods will be driven adjacent to concrete foundations in standard soils to electrically ground the structure. They will be driven so the top of the rod is below grade.

The conductor selected will be a bundle of two subconductors of 954 kcmil (Code name Rail) spaced horizontally 18 inches apart for each of the three phases. Each subconductor will be 1.165 inches in diameter, will weigh 1.075 pounds per foot, and will consist of a seven strand, galvanized steel cable wrapped with three layers of aluminum strands (for a total of 45 aluminum strands). The ultimate breaking strength of each subconductor is 25,900 pounds. The surface will be dulled to produce a nonspecular finish.

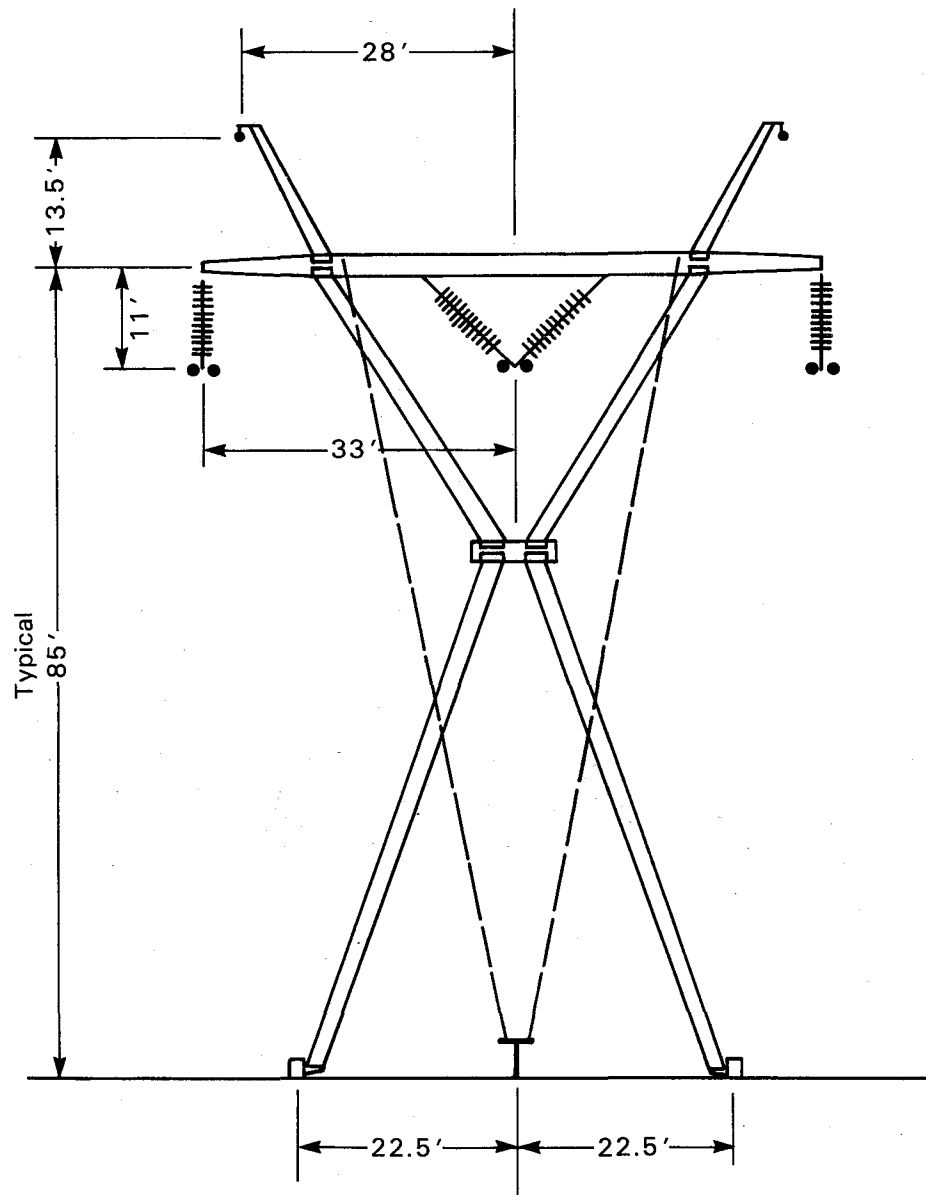


FIGURE 3

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

345kV Tangent or
Light Angle Structure

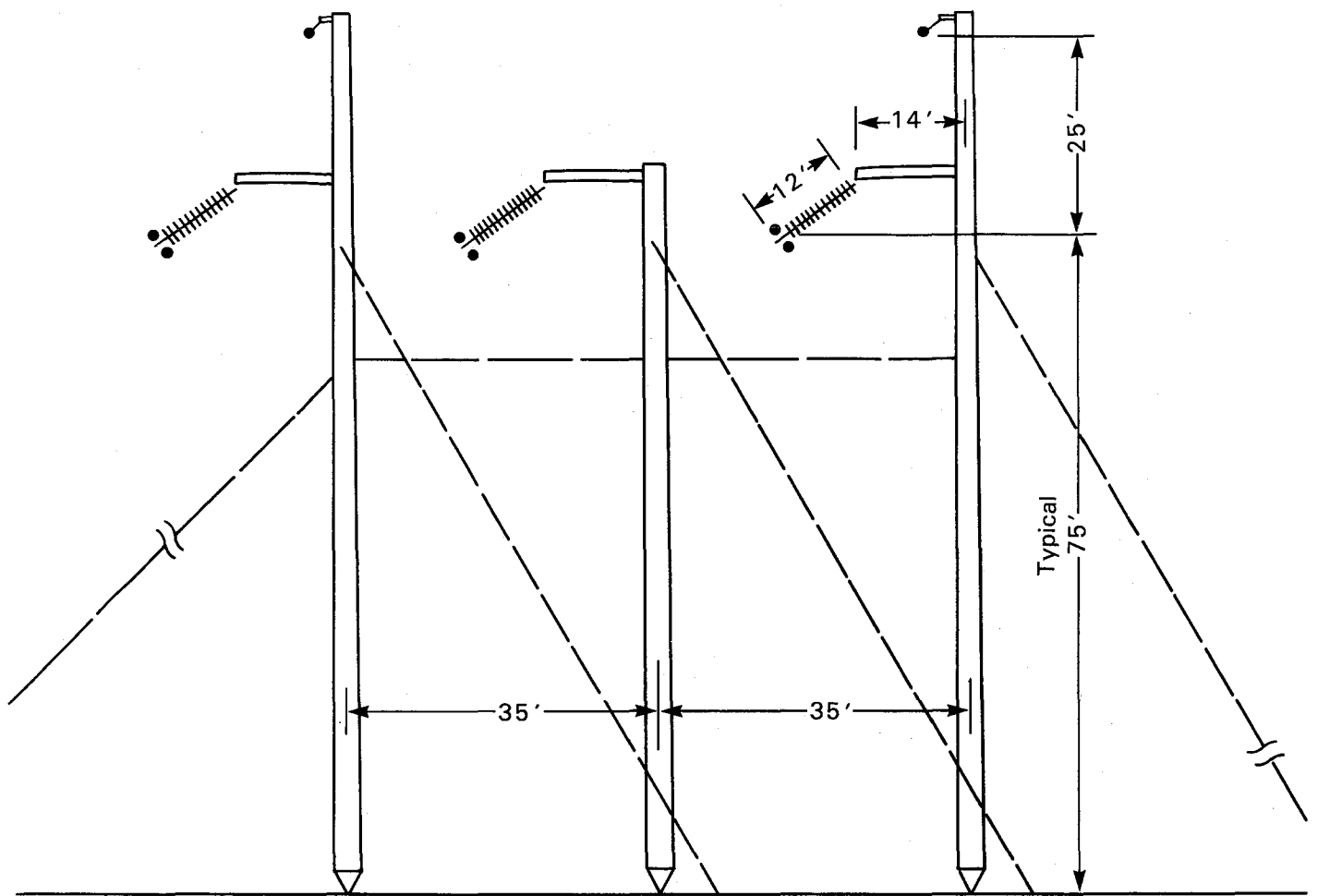


FIGURE 4

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

**345kV Medium Angle
(8°-30°) Structure**

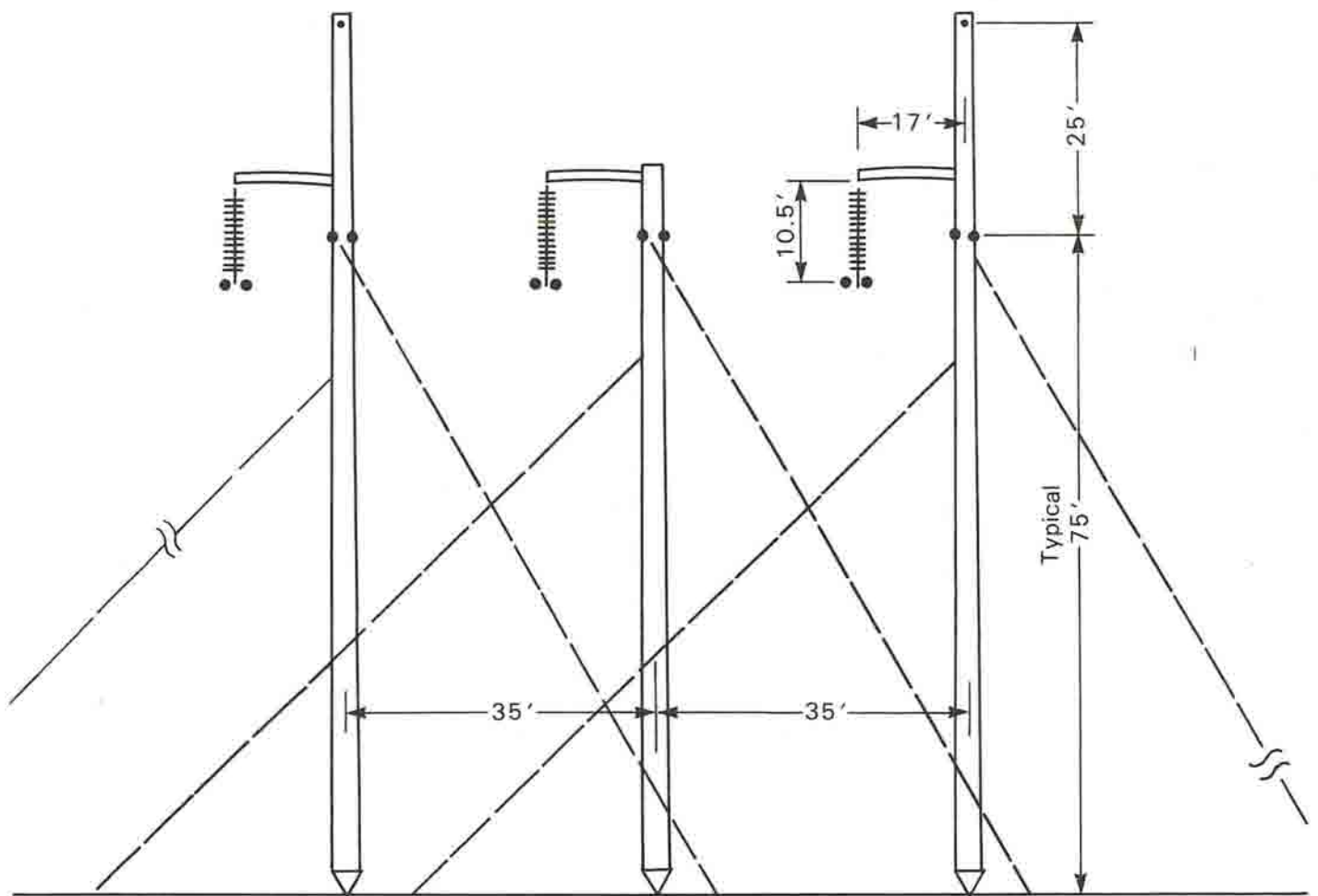


FIGURE 5

Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

**345kV Heavy Angle
(8°-50°) Dead End Structure**

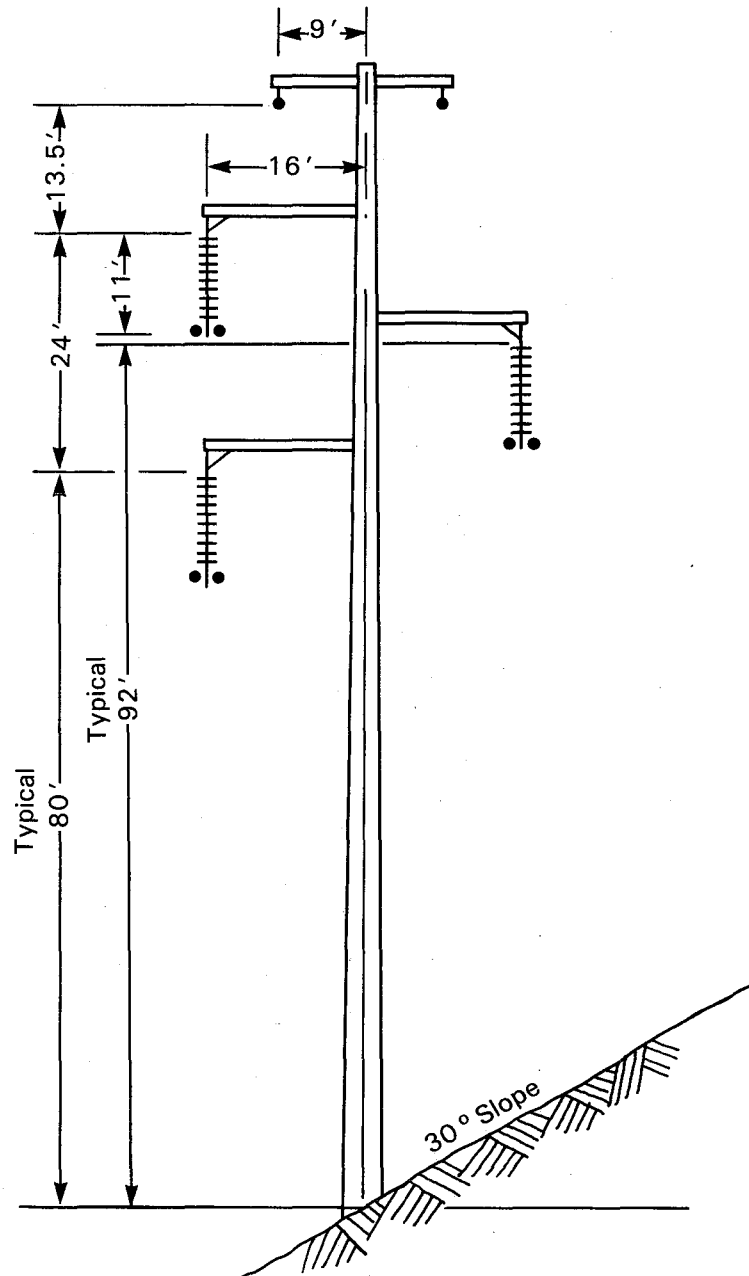


FIGURE 6

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

345kV Single Circuit
Tangent Pole

The shield wire will be 3/8-inch seven strand Extra High Strength (EHS) galvanized steel. The shield wire will be 0.360 inches in diameter and will weigh 0.273 pounds per foot. The ultimate breaking strength of the shield wire is 15,400 pounds. The surface of the wire will be dulled to produce a nonspecular finish.

The insulators which support the conductor in the tower will consist of a single suspension string of 17 units for each of the outside phases and a Vee string of 34 units for the center phase. The deadend assemblies (insulator assemblies which take the full tension of the line) consist of strings of 19 units per phase. The typical insulator units will be approximately 5.75 inches long by 10 inches in diameter and constructed of either glazed porcelain or glass, depending upon the supplier. Porcelain insulators will be brown, blue or gray, depending upon strength; glass insulators will be blue-green.

The average span between towers will be approximately 1200 feet. A minimum ground clearance of 30 feet will be maintained to the conductor under extreme operating temperatures. This exceeds the NESC requirement. A right-of-way width of 400 feet is being acquired which will provide for future installation of two comparable transmission lines.

Construction Procedures

Several distinct tasks will occur during the construction of the transmission lines, including surveying, clearing, foundation installation, tower erection, conductor and shield wire installation and cleanup. The tasks will occur in sequence and will be separated, in time, by several days to several months. A description of the tasks follows:

1. Surveying

The transmission line survey will be accomplished by a combination of aerial and ground methods. Surveying on the right-of-way will be required for locating centerline and structures. This survey work on the right-of-way will involve limited cutting of trees and vegetation for line-of-sight staking and distance measuring. No new roads will be established during surveying, since only men and small items of survey equipment will be involved. Section, quarter-section and property corners may have to be located. Some structure locations may have to be restaked by the surveyors if destroyed.

2. Clearing

Selective clearing will be performed as required to protect the integrity of the line. This means that only the vegetation on the right-of-way, which falls under any of the following categories, will be removed by the clearing contractor:

Trees and brush which may fall into a structure, guys or conductors. This requirement will include danger trees. (Danger trees are trees located outside the limits of clearing which are of sufficient height to come in contact with the structure, guys or conductors if the tree were to fall.) Special permission will be obtained from the landowner for removal of danger trees outside the right-of-way.

Trees and brush into which the conductor may blow during high winds.

Trees and brush within 20 feet of the conductor and trees within 55 feet of the line centerline will be cleared.

Trees or brush that may interfere with the assembly and erection of a structure.

The dimensions used for these criteria include the anticipated 10 year future growth of the vegetation, particularly in bottomlands and other spruce-hardwood forests. In areas where existing trails cannot be used, additional clearing will be required for a construction trail.

Trees and brush on the right-of-way will likely be cut using a Hydro-axe, vehicle-mounted tree shears, bulldozer or hand methods, such as saws. Additional equipment will be required for the movement and disposal of vegetation within the right-of-way. Bulldozer use will be restricted to minimize damage to the land. Any earthmoving will be subject to site-specific approval by the controlling agency or landowner.

After cutting, stumps may be chemically treated with a spray approved by appropriate government agencies. Shrubs should be allowed to resprout.

Material will be disposed of in compliance with local ordinances and in accordance with the landowner's request. Gates will be installed and grounded, as required, in existing fences located on the right-of-way. In all cases, existing fences and gates will be grounded. Construction access trails will be established where existing access roads are inadequate.

3. Foundation Installation

Soil borings will be made at specified locations along the line to determine the engineering properties of the soil. The borings will be approximately 4 inches in diameter, will average 50 feet deep and will be backfilled with the excavated material upon completion. Soil borings will be made adjacent to

existing access roads whenever possible or by helicopter access. The soil boring work will take place prior to clearing.

Foundations will normally consist of steel H-piles supporting the structures with helix anchors for the guys. Piles will likely be driven by a pile driver and the helix anchors installed with a vehicle-mounted torquing device.

4. Structure Erection

The tubular sections or members of a structure will be shipped to marshalling yards along the line route by either rail or truck. From the marshalling yard they will be either assembled or transported to specific sites for assembly. The amount of assembly prior to transportation to the site will be based on the mode of construction being used.

5. Conductor and Shield Wire Installation

The placing of conductors and shield wires on the structures is called stringing. Stringing will start after the structures have been erected for several miles (approximately 80 structures). The first process will be to place the pulling lines in the previously hung stringing blocks. The pulling line will be used to pull the conductor and shield wire off the reels and through the stringing blocks. The puller and tensioner will be located at either end of the stringing operation, which will likely result in a separation of approximately 8,000 to 36,000 feet. The puller will pull the wire off the reels and through both the tensioner and stringing blocks, taking up the pulling lines on reels as the wire is installed. The tensioner will control the tension being applied to the wire as it is pulled off the reels by the puller. This method of stringing is called tension stringing, because sufficient tension is maintained in the wire during stringing to prevent it from coming in

contact with the ground and to avoid obstructions. Temporary guard structures generally of wood pole construction will be erected on the right-of-way to prevent the wires from coming in contact with main roads, telephone lines, power lines and other similar objects. Temporary anchors may be necessary to hold the stringing equipment, shield wires or conductors. These temporary guys, anchors and guard structures will be removed once stringing is completed.

6. Cleanup

The cleanup operation will be performed as the construction activities are completed. Normal cleanup at each site will leave little cleanup effort for the final phase, since the process is continuous. All waste and scrap materials will be removed from the right-of-way and deposited in local landfills in conformance with local ordinances and in accordance with landowner's request. Ruts and holes due to construction activities around structures and along the right-of-way will be recontoured and left in a stabilized condition.

Restoration of the right-of-way will be done by the construction contractor who will be responsible to APA for performance in accordance with the construction specifications and constraints stipulated by the controlling agencies or landowners in the grant of right-of-way or other authorizations. The construction manager, who is the APA representative on the right-of-way during construction, inspects the work to see that the contractors comply with the specifications and stipulations.

Existing roads, bridges, field roads and trails will be used for access down the right-of-way and to tower sites. Where this is not possible, construction trails will be built to and along the right-of-way. These construction trails

will be approximately one vehicle width; grade and alignment will follow the contour of the land wherever possible. Where running streams are forded by existing roads and trails used for the project, or crossed by a construction trail, appropriate measures will be taken to avoid or minimize degradation of water quality. Newly established construction trails will be graded and reseeded after use. Existing roads and trails will be kept in repair during use by the construction contractor and returned to essentially the same or as good a condition as existed prior to construction.

Material marshalling yards for the purpose of storing construction materials, structure assembly and servicing of equipment will be located along or near railroad spur tracks or highways in the vicinity of the project area. The marshalling yards identified at this time are located approximately every 10-20 miles and will vary in size. After construction is completed, all debris and unused materials will be removed and the marshalling yards returned to essentially the same or as good a condition as existed prior to construction by the construction contractor.

Conceptual Access Plan

Need for Access

The Intertie project will have a construction force of approximately one hundred to one hundred fifty construction specialists actively employed and working on one hundred and seventy miles of right-of-way through a spectrum of topography. This force of workers will be responsible for receiving, assembling and installing approximately twelve thousand tons of material fabricated and shipped from suppliers.

Materials will be delivered by truck or by railroad to selected marshalling yards along the Parks Highway or the Alaska Railroad. This material as well as the contractors' equipment, tools and supplies must then be transported from the

marshalling yards to the line right-of-way, then along the line right-of-way to the installation locations. In addition the contractors' work force will travel daily from work camps or assembly points to the right-of-way.

Access to the right-of-way from established transportation corridors and marshalling yards will be required on a daily basis. Construction activities will have seven distinct requirements for access to and travel on the right-of-way: 1) surveying, 2) clearing, 3) delivery of materials, 4) installation of foundations, 5) assembly and erection of structures, 6) stringing of conductor and static wires and 7) cleanup and final acceptance.

Ideally, the machines and equipment required for foundations, structures and wire stringing activities are brought onto the right-of-way at the point of access and travel down the right-of-way until job completion. Where natural obstacles to continuous construction such as rivers, canyons or steep slopes prevents this, then exit from the right-of-way must be planned in advance and another access established.

Nature of The Access

During the planning of this project careful consideration has been given to the use of helicopters for transport of men, materials and equipment. The helicopter has proven to be a very useful tool on many transmission construction projects and it is expected that it will be used to a great extent on this project. However, the size, weight and volume of equipment and material required for this project, coupled with the limitations of helicopters as transportation vehicles, makes it impractical to specify them as the sole means of access except in very limited locations where difficult terrain or environmental impacts make their use imperative. The limitations of helicopters include high cost, limited load carrying capacity, availability and operational limitations due to weather, temperature and available daylight. In addition, prudent planning for maintenance and restoration

of the line to service following natural disasters requires provisions for ground access to the line. Such natural disasters most frequently occur during periods of severe weather. Being forced to depend solely on helicopters as the means of transport for service restoration presents an unacceptable risk. A carefully planned construction access plan can therefore enhance the maintainability and reliability of the line with the least possible impact on the environment and land use.

Proposed Access Plan

A conceptual access plan has been prepared based on the following criteria:

1. Existing and planned roads and trails will be used to the maximum extent possible.
2. The contractors will be permitted to build construction trails from existing roads and trails or from proposed marshalling yards to the line right-of-way and on the right-of-way so that they have ground access to the entire line right-of-way except as noted below.
3. The contractors will be required to construct the Moody Creek - Montana Creek portion of the line by helicopter.
4. The contractors will be required to prepare an access plan acceptable to APA and the controlling agencies or landowners.

5. The contractors' adherence to the approved access plan will be monitored by APA.

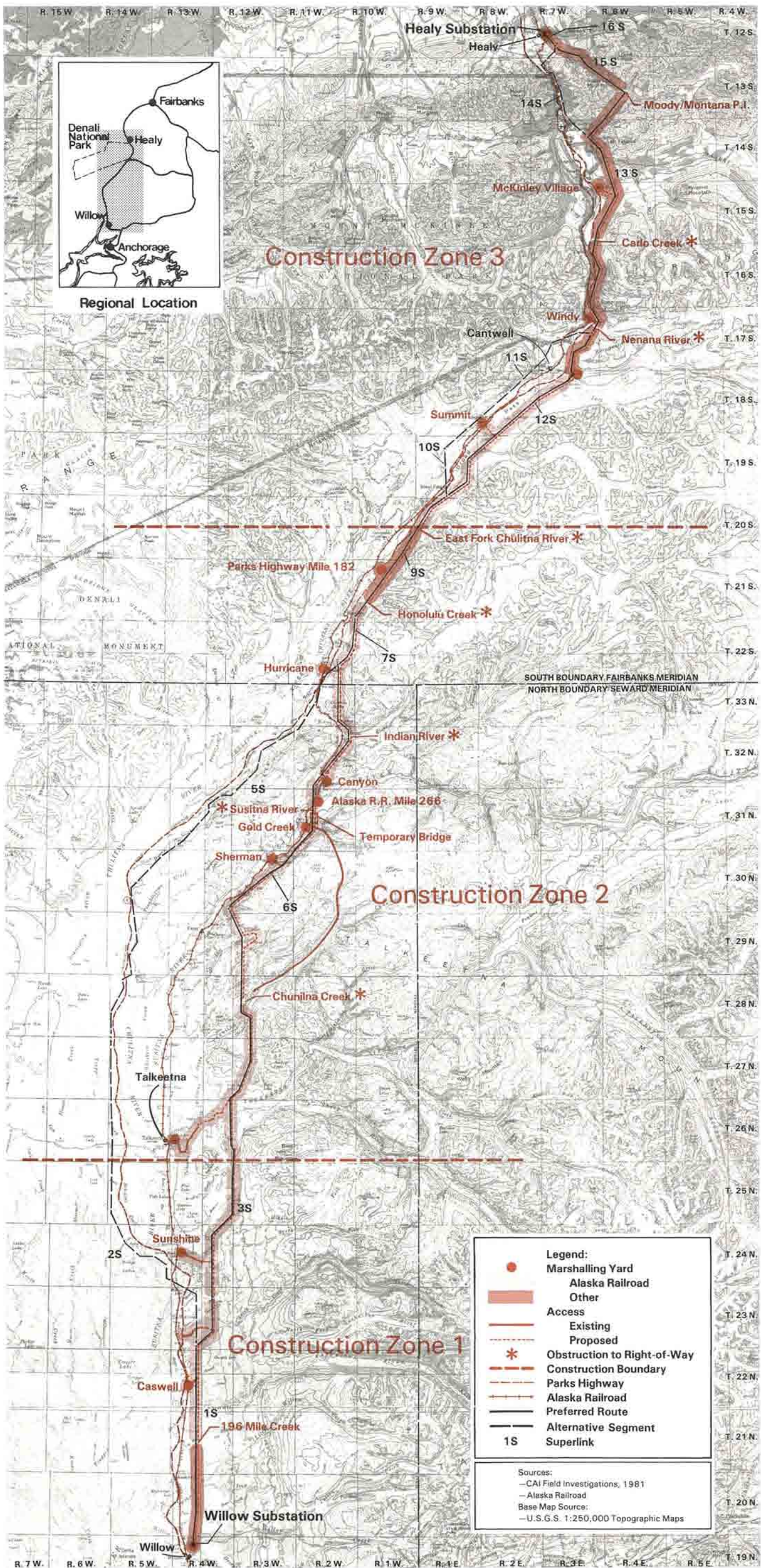
To limit right-of-way traffic and to provide for minimal "haul time", a series of marshalling yards have been initially proposed on or adjacent to the right-of-way. The distance between these yards and individual location was determined by nearness to established transportation facilities, site availability, line length and limitations of access. The Conceptual Access Plan shown in Figure 7 provides for marshalling yards that are on or adjacent to the Alaska Railroad or Parks Highway right-of-way where storage facilities can be made available. With these locations, the materials can be loaded on trucks or rail cars and directly shipped to a selected yard with a minimum of handling, resulting in minimal damage and loss.

Environmental considerations have been incorporated in the preparation of the conceptual access plan. Proposed access has been recommended to utilize rights-of-way, trails and other existing means of access to the extent possible. Introduction of access into areas where none previously existed has been planned to minimize stream crossings, extensive switchbacks on steep topography and heavy clearing of vegetation. The location of residences and private property will be taken into account as more detailed studies are initiated to determine the final location of access into the right-of-way.

Construction Schedule

An estimated schedule for construction of the Intertie is shown on Figure 8. The period of construction is anticipated to extend from the fall of 1982 to the summer of 1984.

Anticipated manpower requirements are depicted in Figure 9. The work force is approximated from 100 to 150 personnel.



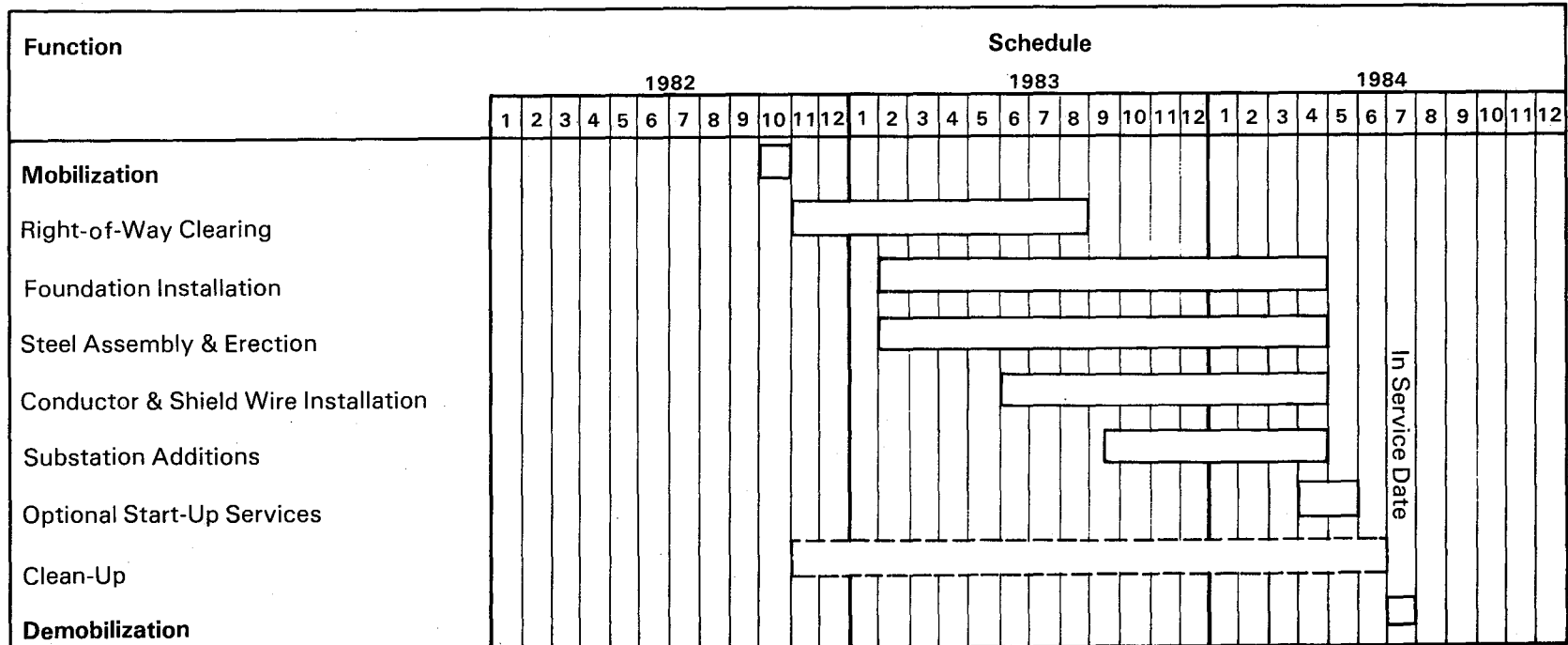
Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Conceptual Access Plan

Proposed Construction Schedule

Alaska Power Authority
ANCHORAGE—FAIRBANKS TRANSMISSION INTERTIE



 Gilbert/Commonwealth

FIGURE 8

Field Construction Personnel

Alaska Power Authority
ANCHORAGE—FAIRBANKS TRANSMISSION INTERTIE

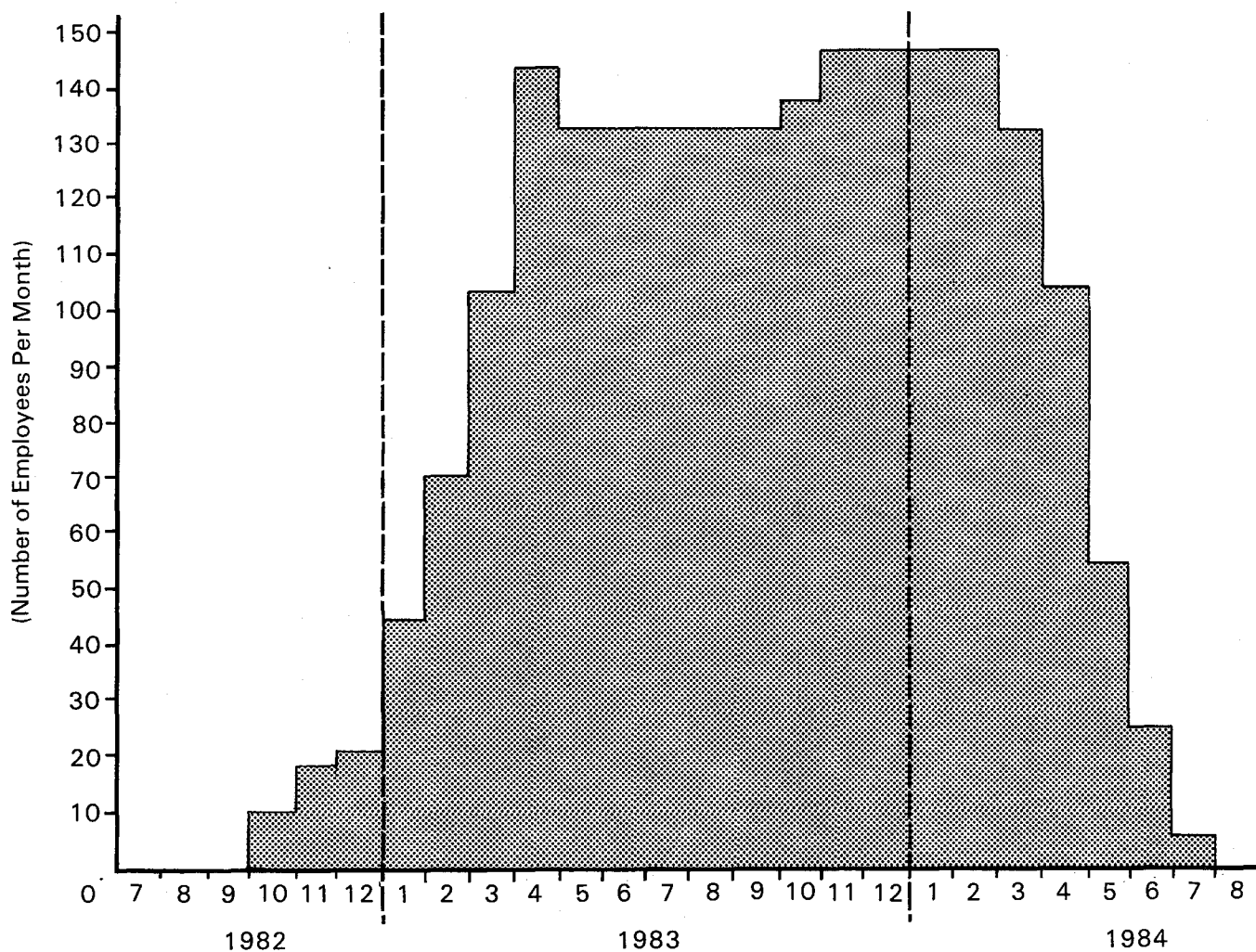


FIGURE 9

ALTERNATIVE CONSTRUCTION MATERIALS

The main concern for alternate materials involves the structures. Ten types were considered and are described as:

Structure Type

Self Supporting Steel Lattice Tower

Self Supporting Steel Pole

Self Supporting Steel Pole H-Frame

Self Supporting Wood Pole H-Frame

Guyed Steel Pole "X"

Guyed Steel or Aluminum Lattice "X"

Guyed Steel or Aluminum Lattice Delta

Guyed Aluminum Lattice Wye

These ten types reflect the overall variety of considerations for structures to be used for 345 kV transmission lines.

Concrete structures were excluded from consideration because of their extreme weight which makes transportation and installation impractical for the area considered.

The structures made up of steel and aluminum were considered to have a service life of 50 years. The Wood Pole H-Frame was considered to have a 35 year service life. Costs were developed for a life cycle of 100 years to provide comparative costs of the steel and aluminum structures with the wood structure.

Considering the primary aesthetic objectives of: simplicity of design, color, scale, screening potential and structure span, it was concluded that the Self-Supporting Steel Pole is the most aesthetically pleasing structure. The Self-Supporting Steel

Pole H-Frame, the Guyed Steel Pole "X" and the Self-Supporting Wood Pole H-Frame respectively, were also considered acceptable to reduce visual impact.

The Type "X" structures provide relief from guy dependency, allows for simple foundation construction, frost heaving adjustment and resistance to fires. The tubular steel, while weighing the same as the lattice, also allows for flexibility, is less subject to vandalism and provides less area for avalanche or flood debris loading. The tubular steel along with the aluminum would not require painting. Based on these considerations, the Type "X" structures are the most desirable.

Structure replacement must address both areas of ready access and remote locations. The area of ready access would allow emergency replacement of any structure type whereas remote areas require consideration for transportation such as the number of pieces, weight and distance. In an area that may not be accessible by helicopter due to certain periods of bad weather, structures may have to be stored along the line for ready availability if replacement should be required. The type of material, number of components, the weight of each and the complexity of assembly are major considerations for the operation of replacement. The Guyed Steel Pole "X" provides all the advantages required for the replacement operation.

The material cost for lattice steel is approximately one half that for pole steel. The combined assembly and erection cost on a per pound basis, however, is more than double when comparing lattice steel to pole steel.

The material cost for lattice aluminum is more than four times that for lattice steel and does not include deglaring. The total labor cost, however, is only slightly lower for aluminum. This results from a similar complexity involved in assembly, even though there is a large difference in total weight.

The Guyed Steel Pole "X" was thus selected as the basic structure for the project. This recommendation was based on the above considerations for acceptable aesthetics, reliability, maintenance, constructability and economics.

ALTERNATIVE INTERTIE CONFIGURATIONS

Voltage levels of 138 kV, 230 kV and 345 kV were investigated for the Anchorage-Fairbanks Transmission Intertie. Five alternative plans encompassing these voltage levels were formulated. Plan 1B-19 was selected for implementation on the basis of having the highest ratio of potential benefits to costs.

NEW GENERATION IN AREA

The proposed Intertie will be utilized in two phases. In the first 10 years of operation at 138 kV, it will be used to export economy energy from Anchorage to Fairbanks and for reserve sharing. In the second phase, the Intertie will be raised in voltage and augmented to provide a much higher power transfer capacity between the two areas as is foreseeably needed. The higher voltage system would also accommodate future generation associated with the potential hydroelectric development at Susitna or the installation of coal fired generation at Healy or Beluga.

COAL AS AN ALTERNATIVE FUEL FOR NEW POWER PLANTS

If it is assumed that future power plants in the Railbelt region will utilize coal to the exclusion of oil or gas, it was found that the reserve sharing benefits increased almost nine times. This is because the capital cost of coal-fired steam generators is much higher than oil or gas-fired combustion turbines. The reserve sharing benefits which result from deferral of future generating capacity therefore increase proportionately.

ALTERNATIVE FUELS IN FAIRBANKS

There are only two fuels that reasonably could be substituted for oil to generate power in Fairbanks: liquified natural gas (LNG) imported via rail cars from Cook Inlet or natural gas imported via a new pipeline from the North Slope.

Study indicates that LNG is not sufficiently less costly than oil to diminish the need for the Intertie. Assuming that the existing oil-fired generating units in Fairbanks are converted to burn LNG by 1987, the Intertie is still justified by a 1.5 ratio of benefits to costs, without recognizing the cost of converting the existing units to burn the new fuel.

If natural gas can be imported from the North Slope by 1987, the ratio of Intertie benefits to costs becomes approximately 1.0, again ignoring any costs to convert the generating units to burn the new fuel or to bring it to the various generating plant sites in Fairbanks in condition suitable for consumption. The uncertainty as to when the necessary pipeline from the North Slope to Fairbanks may be constructed appears to preclude this as a reliable alternative to the Intertie.

PURCHASED POWER

Recently passed legislation permits U.S. military installations to sell excess electrical generating capacity to the local utilities. The utilities in the Fairbanks area, therefore, have an opportunity to purchase 5 MW at Fort Wainwright and 5 MW at Eielson Air Force Base. This is not a substantial amount of power and does not significantly impact the need for the Intertie between Anchorage and Fairbanks. This generating capacity is coal-fired, but affects only slightly the economy energy and the reserve sharing benefits. There is no other source from which the Railbelt utilities could purchase power.

ALTERNATIVE LINE ROUTES

Line routes alternative to the preferred route were identified during the route selection process. As the final network of links (reference Figure 2) was evaluated, several links were found to be common to all alignments as a result of

naturally or culturally imposed constraints (1s,7s, 13s,16s). Thus, alternative line routes were, more specifically, alternative route segments. To assist in a concise review of environmental effects, the alternatives have been structured in the following manner:

<u>Alternative Route Segment</u>	<u>Link Substitution</u>	<u>Length (Miles)</u>	<u>Net Change (Miles)</u>
Parks Highway Alternative	2s,5s for 3s,6s	176.5	+6.4
Broad Pass Alternative	10s,11s for 12s	170.5	+0.4
Nenana Gorge Alternative	14s for 15s	167.2	-2.9

Other segments of the final network, links 4s and 8s, were not incorporated into alternative route segments as a result of substantive environmental impacts. Link 4s, established as a partial alternative to the Parks Highway segment, crosses both the Chulitna and Susitna Rivers, migratory corridors for waterfowl and shorebirds. Major wildlife impacts along 4s would be habitat alterations since most of the alignment is forested, bird collisions and increased human accessibility. While visibility of 4s would be reduced, the alignment would pass in the vicinity of the communities of Lane Creek, Curry and Chase and was not supported by these communities during public meetings.

Link 8s crosses the Chulitna River near the confluence of the East and Middle Forks. The alignment passes less than a mile from a recent trumpeter swan nesting location. The major impacts sustained would be habitat alterations, loss of bottomland vegetation and an immense potential for bird collisions. The potential for impacts to air navigation would be substantially higher as a result of two crossings of the Parks Highway. Right-of-way within the Denali National Park and Preserve would also likely be required. Neither 4s nor 8s offered significant environmental advantages off-setting potential impacts to warrant further consideration.

UNDERGROUND

Underground construction of the Intertie was considered as an alternative to overhead in two specific locations within the project area. A 6 mile segment through Windy Pass and a 10 mile segment through Nenana Gorge were specifically evaluated to determine engineering constraints, cost estimates and environmental effects.

Facilities

Cable

The high pressure, oil-filled, pipe-type cable systems (HPOF) consist of three cables insulated with high-quality, oil-impregnated paper insulation (1.035 inches thick at 345 kV or 0.505 inches thick at 138 kV), which are installed in a steel pipe. The pipe is received from the manufacturer in approximate 40 foot lengths. Many lengths are then welded together and placed in a trench about three to four feet deep. Manholes are provided at intervals of about 3000 feet. Sand is placed all around the pipe (about a 12-inch layer) in the bottom of the ditch to assure adequate heat transfer characteristics and to prevent damage (as from sharp rocks) to the pipe coating during installation. Three insulated cables are then pulled into the pipe and splices are made in the manholes. The underground to overhead transition is accomplished at each end of the underground section by means of above-ground porcelain terminations, or "potheads." Surge arresters are also installed at each end to protect the somewhat vulnerable cable from lightning and switching surges. The space requirement for this transition is approximately 100 feet by 300 feet and includes the: termination structures (14 feet in height), potheads (an additional 12 feet in height) and the pumping plant building (approximately 20 feet by 9 feet by 9 feet). A low voltage power supply (240 or 480V) is required which must be provided by a local electric system, either presently available or to be constructed. Additionally, a 15 KW generator would also be provided in case of an interruption in the main power supply. After the cable has been installed, the entire system is filled with a special low-viscosity polybutene or mineral oil.

Cable Routing

The most optimistic assumptions possible were made pertaining to the cable route. It has been assumed that an agreement could be reached with the Department of Transportation and Public Facilities so that the cable could be located in the Parks Highway road shoulder throughout its length, including attachments to the Nenana River bridges.

Such routing would probably permit a large proportion of machine digging, minimize blasting, avoid access road construction, greatly mitigate elevation differentials, avoid many permanent environmental effects and would result in the lowest possible installed cost. There would be a major traffic disruption, probably requiring localized one-way operation, for a period approaching three months in the summer season. The road would have to be closed for blasting operations, should they be necessary. Traffic interruptions would re-occur if major maintenance is ever necessary.

Materials Requirement

In a comparison of materials required for overhead and underground transmission lines it should be noted that 78 percent more steel, twice as much conductor material (expressed on a common base) and 225,000 gallons of high-quality, low-viscosity polybutene or mineral oil would be needed for the two underground systems. An underground system would also use a large volume of extra high quality paper insulation which is difficult to compare to the suspension insulators of the overhead lines.

It is evident the use of resources would be much greater for an underground line.

Engineering Considerations

The underground cable will require special design and construction procedures to be implemented in certain areas to minimize impacts from geologic and natural conditions. Costs associated with special procedures that would have to be implemented are not included at this time and would probably increase the costs for underground cable construction, as presently defined. The underground cable system has to be protected for differential movements which may result from frost heave, slides, fault movement and liquification of soils due to earthquakes or thawings. Also, the underground cable must be designed and constructed to prevent scour and erosion at surface water drainage crossings. These requirements would be much less if road right-of-way is employed.

The cable at Windy Pass would cross over the geologically-active Denali Fault, south of Windy at the McKinley strand (refer to Figure 10). The "maximum credible earthquake" magnitude at this location has been estimated to be 8.5 on the modified Mercalli scale. This would be a very violent earthquake, with buildings shifted off foundations, masonry buildings destroyed, conspicuous cracks in the ground and underground pipelines broken. The fragile pumping plants and potheads would probably also be put out of service. Even a lesser earthquake could easily result in a pipe rupture due to slumping and subsidence. The Denali Fault is a strike-slip fault characterized by a scissoring reversal of vertical displacement and rather independent of general topography.

While it is also probable that an overhead transmission line would be brought down by an earthquake as described above, temporary repairs can be made, and the line restored to service much quicker than would be the case for an underground cable system.

The underground cable system would need to dissipate heat on the order of 35 watts per lineal foot at peak loading and 10 watts per lineal foot at off-peak

loading, or about 11 watts peak for the loads projected for the early years of operation. It is not considered practical nor economically feasible to dissipate the heat using a refrigerated cooling system so the heat has to be dissipated into the soil and rock. The underground cable system would have to incorporate special backfill in areas of permafrost or where thawing of frozen soils could adversely affect foundation conditions around the cable, the road subgrade or trigger slides at the toe of slopes.

Environmental Considerations

General

There are impacts to natural systems inherent in any underground transmission line constructed outside the urban setting. These impacts would be very similar to those for any pipeline. Soil disruption and compaction would be the most obvious changes. This disruption may include damage to the root systems of trees and shrubs adjacent to the right-of-way. In some cases a loss of vigor would occur and in severe cases mortality could result. Impacts of soil compaction may adversely effect vegetation re-establishment, while increased runoff may cause erosion problems. The soil microenvironment would also be effected by changes in soil temperature gradients. These impacts to soil integrity and changes in soil temperature would not be associated with overhead transmission lines except at the tower footings. Soil compaction would be associated with overhead transmission lines, and probably to the same degree as undergrounding.

Actual physical damage to vegetation would include loss of large and small woody (i.e., trees and shrubs) and herbaceous species. Initial losses to woody vegetation would be similar to underground lines with overhead lines requiring more clearing. However, the underground line right-of-way should be kept substantially free of all woody species to permit maintenance access, while shrubs and small trees can be permitted to reinvade the overhead right-of-way. Some

loss of herbaceous species would result from constructing an overhead line, but not to the extent of loss associated with undergrounding. Mitigation of this impact would require reseeding as soon as practical upon completion of construction. A secondary impact to vegetation from an underground line would be soil disposition. A certain percentage of soil will completely cover some species during construction and backfill operations. Excess material associated with pipeline construction and backfill requirements would be left over, and, if deposited on vegetation, damage would result. This excess soil, if left in place may be eroded into nearby streams. A proper disposal area (i.e., existing roadside gravel pits) should be utilized to mitigate this problem.

There will be some disruption of wildlife populations associated with both overhead and underground transmission lines. These would be short-term and temporary in nature; however, the loss of small trees and shrubs would be more long-term with undergrounding. The farther from an existing corridor (i.e., the Parks Highway) the right-of-way is, the more disruptive the facility would be to wildlife populations. Increased secondary impacts associated with human activities would severely affect species which are, at least sometimes, sensitive to human encroachment. Bird collisions are not associated with underground transmission lines as they are with overhead lines.

The potential for erosion and subsequent sedimentation of streams would be much greater with undergrounding than with overhead lines. Where the pipe comes out of the ground to cross streams, or if the line is buried under the streambed, the watercourse would undergo an increase in silt load. This increase would be temporary, providing appropriate mitigative measures are undertaken immediately after construction. Some of the route to be traversed would require excavation of bedrock, with attendant blasting concussion and noise - effects which exert negative influence on wildlife. Other parts of the route would require ditching in permafrost areas. Care must be taken to assure that thaw settlement

and sloughing of thaw does not result in unstable cut and fill slopes in the warm season. A route should be located that yields the shortest distance, consistent with gentle longitudinal slopes, absence of steep-sided valleys, and scarps so far as possible. Care must be exercised to prevent a long-term thawing process which sometimes occurs due to construction activity.

The 345 kV cable system would contain a total of 88,000 gallons of oil in the pipe for the Windy Pass segment and 137,000 gallons in the pipe for the Nenana Gorge segment. Two terminal pumping station reservoirs would also be required for each segment (7000 gallons each). Oil leaks would be immediately detected and alarm signals sent to the manual operating center. The oil flow would be reduced manually to a "trickle," barely adequate to prevent water or air ingress to the pipe until the repair process could begin. In this way, the loss of oil in the event of a leak would be minimized.

Windy Pass

Vegetation crossed in Windy Pass includes two cover types. These are upland spruce-hardwood and shrublands, with shrublands making up 55 percent of the route length. Both of these communities would require extensive clearing. The removal of shrubs in these communities will result in the permanent loss of wildlife cover. The shrublands community provides an important source of food and cover for several big game species such as moose and bear.

Land use impacts would be minimal because the system is located within the Parks Highway right-of-way. Since this is an area having residential development and with the Division of Forest, Land and Water Management encouraging it to continue along this area rather than in the more scenic adjacent areas; any additional right-of-way clearing could make some land within the Pass less desirable for residential growth.

Visual impacts of overhead transmission facilities would be reduced in the use of an underground segment through Windy Pass. The segment would be confined to the Parks Highway right-of-way. Initially, any additional clearing required beyond the disturbed right-of-way would help to accentuate the segment especially to local residents. In time however, it would be perceived as a part of the disturbed highway right-of-way. Facilities at each terminal would be conspicuous in the absence of vegetation or topography for screening. Additional distribution lines required along the Parks Highway would be clearly visible.

Additionally, an underground line paralleling the Parks Highway would require crossing the Nenana River as well as five smaller streams. The probability of erosion increases with each stream crossing. Additionally, a break in the pipe would create an oil spill which could temporarily foul the waters of any of the streams as well as the Nenana River. Increased sediment load in this area would affect the immediate area as well as the Nenana River.

Nenana Gorge

Vegetation crossed in the Nenana Gorge includes two cover types. These are upland spruce-hardwood and shrublands, with shrublands making up 45 percent of the route length. Both of these communities would require extensive clearing. The removal of shrubs in these communities would result in the permanent loss of wildlife cover. The shrubland community provides an important source of food and cover for several big game species such as moose and bear.

An underground line paralleling the Parks Highway will require crossing the Nenana River twice, as well as eleven smaller streams with the probability of erosion increasing at each stream crossing.

Land use affected by the underground segment would be attributed primarily to Denali National Park and Preserve. An overhead segment once

crossing the Nenana River enters the eastern boundary of the national park. From this location the line reaches the southern underground terminal near mile post 235 and would proceed north along the Parks Highway through the park until again crossing the Nenana River in the vicinity of mile post 238. The overall length of both overhead and underground transmission facilities would require right-of-way for approximately 5.5 miles in the park. The presence of this additional land requirement would result in further congestion and facility development in the vicinity of the park entrance area.

Visual impacts in the vicinity of the Nenana Gorge and the entrance to Denali National Park and Preserve could be reduced through the use of underground transmission. An alignment closely paralleling the Parks Highway would eventually result in the cleared right-of-way being perceived as an extension of highway right-of-way. Overhead facilities at each terminus of the underground segment would be clearly visible from the Parks Highway, although appropriate siting of the facilities would lessen their overall visibility. In the vicinity of Nenana Gorge, a significance visual resource with little vegetation or opportunities to mitigate visual effects of overhead transmission, the underground segment would substantially reduce visual impact.

Cost

Cost estimates were made for the 345 kV HPOF cable systems. The cost in 1984 would be expected to be in the order of \$24,072,000 or about \$4,012,000 per mile for the Windy Pass segment and \$33,997,000 or about \$3,400,000 per mile for the Nenana Gorge segment.

Cost comparisons between 345 kV overhead and underground systems were also made. For Windy Pass the overhead cost is estimated to be \$3,974,000, resulting in an underground to overhead cost ratio of 6.06:1. The Nenana Gorge overhead construction cost is estimated to be \$8,024,000, resulting in an underground to overhead cost ratio of 4.23:1.

Summary and Conclusions

Analyses of underground segments through Windy Pass and Nenana Gorge have been completed in the selection of a preferred overhead alignment. Based on the preceding information the following conclusions have been established:

1. Any underground transmission line segment through Windy Pass and the Nenana Gorge should be located on highway right-of-way to minimize cost and avoid major, lasting damage to the environment. However, continuous excavation through permafrost and blasting in bedrock would be required.
2. Construction of an underground system on highway right-of-way would result in major traffic disruption and inconvenience for a period of about three months. If any blasting were to be required for excavation, traffic would have to be stopped. Approximately five miles of construction and operation would be required in the Denali National Park and Preserve.
3. The estimated construction cost of a 10-mile long underground 345 kV cable system through Nenana Gorge is \$33,997,000, or \$25,973,000 more than an overhead line. The underground/overhead cost ratio would be more than 4/1. The estimated construction cost of a six mile segment in Windy Pass is \$24,072,000 or \$20,098,000 more than a comparable overhead line. The underground/overhead cost ratio would be about 6/1.
4. The Windy Pass route passes over the McKinley strand of the geologically active Denali Fault with a "maximum credible earthquake" rated at 8.5 on the modified Mercalli intensity scale. An earthquake of such magnitude would almost surely cause pipe breakage and destruction of terminal facilities.

The increased cost, greater potential for environmental impact, additional resources committed and little appreciable increase in reliability have resulted in the deletion of this alternative from further study.

IV. AFFECTED ENVIRONMENT

The project area for Anchorage-Fairbanks Transmission Intertie is comprised of a corridor extending from the Willow Substation north to the Healy Substation, the southern and northern terminals respectively of the proposed Intertie project. The corridor generally encompasses areas in the vicinity of and parallel to the Parks Highway and the Alaska Railroad.

TOPOGRAPHY

As shown on U.S. Geological Survey (USGS) topographic maps, the topography of the project area is dominated by the generally north to south river valleys of the Susitna, Chulitna and Nenana Rivers and the gradually to sharply rising Alaska Range to the west and north.

North from Willow the broad level to rolling Susitna River valley floor gradually rises from an elevation of 150 feet above sea level to about 900 feet at the confluence of the Susitna and Chulitna Rivers near Talkeetna. The project area is entirely on the wide multi-channel floodplain in this area.

About 10 miles north of Talkeetna, the Susitna and Chulitna Valleys are separated by Curry Ridge which attains 4000 to 4500 feet in elevation. To the east and west of the two river valleys the foothills and lower ridges of the Alaska Range mountains rise to heights of 3500 to 4500 feet in elevation within the project area and ultimately to over 10,000 feet at further distances. The two river valleys narrow to five to eight miles wide along the base of Curry Ridge and the valley floors continue to slope gradually upward to 1400 feet in elevation at the north end of Curry Ridge.

North of Curry Ridge the project area leaves the Susitna River valley and continues to the northeast in the Chulitna River valley. The valley floor

gradually rises and eventually reaches about 2300 feet in elevation at Broad Pass before sloping downward toward the Nenana River drainage, 35 miles north of Curry Ridge. In this area the level valley floor averages 4 to 6 miles wide and is bordered by the moderately sloping foothills and sharp ridges of the Alaska Range.

The Nenana River flows northward for 30 miles through two narrow gorges between rocky escarpments rising to peaks as high as 5800 feet in elevation, 3800 feet above the stream channel. Between the two gorges, the river course opens into a small valley a few miles wide at the confluence of the Yanert Fork with the Nenana River near Denali National Park and Preserve. The valley floor in this area is about 1800 feet in elevation. North of the second gorge at the northern edge of the project area near Healy, the valley floor is about 1500 feet in elevation.

GEOLOGY

Physiography

The proposed Intertie crosses four major physiographic provinces in south-central Alaska. From the Cook Inlet-Susitna lowland near Willow the alignment runs through the Broad Pass Depression, through the Alaska Range and on into the Northern Alaska Range Foothills province which includes the town of Healy.

The broad Susitna lowland is the landward extension of Cook Inlet. It is a structural basin with several major tributary rivers whose sediment is gradually filling Cook Inlet. The lowland is bounded on the west and north by the Alaska Range and by the Talkeetna Mountains on the east; Cook Inlet is to the south.

During glacial times, much of the Susitna lowland was a proglacial lake (Pewe, 1975); today, due to low slopes and the nature of the substrate, it remains a

poorly drained area with abundant small lakes and muskegs. In the northern portion of the lowland coarser-grained glacial deposits form low ridges with better drainage.

Further north the project area is dominated by the Broad Pass Depression, an eroded block which has been downdropped between parallel faults (graben) (Capps, 1940). From this natural feature the project area is narrowly constricted through Windy Pass and Nenana Gorge in the Alaska Range.

The Alaska Range is a steep crescent-shaped mountain range that has been heavily sculptured by recent glacial activity. Length of the range is approximately 600 miles and the average width is 50 to 80 miles. Relief is about 18,000 feet, ranging from over 20,000 feet at Mt. McKinley to approximately 2,300 feet where the corridor crosses the drainage divide. Several of the major mountain peaks support glaciers that extend 20 or 30 miles from their sources and spread out in piedmont lobes at the mountain fronts. The project area does not cross glacial ice.

The Northern Foothill Belt of the Alaska Range is composed of east-trending ridges and valleys. Streams occupying old glacial valleys have cut narrow gorges into the glacial drift and the underlying bedrock. The Nenana River gorge is an example of this kind of feature.

Regional Geology

Cook Inlet and much of the lower Susitna Valley occupies a structural trough underlain by rocks of Tertiary age and mantled by glacial deposits of Quaternary age. The Alaska Range in the area of the Intertie corridor is underlain by Tertiary, Mesozoic, Paleozoic and Precambrian rocks and is also mantled by glacial drift. Isolated masses of permafrost occur in much of the project area.

The topography along most of the Intertie has been determined by the depositional and erosional history of at least five glacial episodes during the last 1.8 million years (Quaternary Age) (Pewe, 1975). Proglacial lake deposits formed in the Susitna River lowland area during the last two glaciations when ice filled the northern part of the Cook Inlet trough and the constricted southeastern portion of the trough. This left the middle portion of the basin open for lake development. These lake deposits are laterally extensive and consist of silt and clay particles (Karlstrom, 1964).

During earlier glacial events ice lobes issuing from multiple ice cap areas in the Alaska Range and Talkeetna Mountains coalesced and filled the Cook Inlet trough to successively lower levels as the sequence of glaciations progressed to the most recent (Pewe, 1975). Glacial deposits from these earlier glaciations are not well exposed, where present, and in many areas have been removed by glacial scouring associated with subsequent glaciations.

Another important aspect of regional geology in this area is the nature of mountain building processes. According to Plate Tectonic Theory, the earth's crust is divided into a number of plates which move relative to one another. Plate boundaries are active areas and are often the site of earthquakes, fault movement and general mountain building activity. The project area spans one of these active boundary areas. New sea-floor is created at the mid-ocean ridges and plunges below other plates in areas called subduction zones. The project area is near where the Pacific plate is being subducted below the North American Plate. While sea-floor materials normally plunge beneath a continent, continental blocks may collide with a continental plate and may become a new part of this continental plate. Southern Alaska has developed by the accretion of several blocks that have drifted northwestward and collided with the existing continental materials. After collision these blocks were thrust several hundred kilometers onto the North American Plate (Csejtey et al., 1978).

The Talkeetna Mountains are an example of an accreted block and the Denali Fault zone is thought to be a suture boundary between accreted and older continental materials. There are two major strands of the Denali Fault within the general Intertie area. The Hines Creek strand trends along the drainages of Hines Creek and Montana Creek just south of McKinley Park Station. The McKinley strand crosses the Alaska Railroad just south of Windy. It is the McKinley strand that is currently active and has short-circuited movement on the Hines Creek strand. Average late Quaternary slip rate is thought to be at least 2 cm per year, based on the offset of various Recent deposits (Page, 1972).

Figure 10 is a geologic map of the project area showing the major rock units and their ages where known. This map can be used to infer the engineering properties of the rock units prior to detailed on-site studies.

Seismic Geology

South-central and southwestern Alaska are part of an intense seismic zone that circumscribes the Pacific Ocean. Most of the more than 150,000 earthquakes that occur worldwide each year occur in this Circum-Pacific belt and in a somewhat smaller belt which extends through southern Asia and the Mediterranean.

Major earthquakes have occurred and will continue to occur in the project area for the foreseeable future. Peak rock acceleration is 40 to 50 percent g with an exceedance probability of 10 percent and a project life of 50 years (DOWL Engineers, 1981).

Although the Intertie crosses the Denali Fault zone in the area of McKinley Park Station and Windy Pass, most of the major earthquakes in this area occur closer to Willow and along the Castle Mountain Fault. Past earthquake damage in the project area has been principally manifested in five separate forms which can act independently or in combination.

QUATERNARY

- Qs — Undifferentiated surficial deposits of Quaternary Age
- Qn — Drift of the Naptowne glaciation
- Qau — Quaternary alluvium undifferentiated
- Qal — Deposits in modern stream beds and alluvial fans
- Qol — Older alluvium-terrace gravels, outwash of Quaternary Age
- Ql — Quaternary lake clay and silts
- Qls — Landslide debris of Quaternary Age
- Qp — Peat
- Qt — Till and morainal deposits undifferentiated
- Qtrg — Talus and rock glaciers

TERTIARY

- Tgd — Tertiary granodiorite
- Tsu — Tertiary sedimentary rocks undifferentiated
- Tk — Sedimentary and volcanic rocks of Kenai Group
- Tn — Nenana Gravel
- Tcb — Coal-bearing formation
- Tsmg — Tertiary schist migmatite and granite
- Tv — Tertiary felsic igneous rocks

MESOZOIC

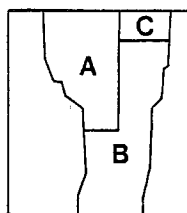
- um — Undifferentiated Mesozoic rocks
- mgn — Pre-Cretaceous greenstones
- Ki — Diabase, andesite and rhyolite intrusive rocks
- KJs — Undivided Cretaceous-Jurassic marine sedimentary rocks
- gr — Granitic intrusive rocks
- ba — Basalt dikes
- TRgn — Intrusive greenstone
- TRvs — Meta-basalt, slate, marble
- Kc — Cantwell Formation
- Mt — Totatlanika schist
- Mesozoic igneous rocks

PALEOZOIC

- smv — Devonian to Cretaceous undifferentiated sedimentary rocks
- DI — Devonian-Silurian limestone
- Dsb — Upper Devonian serpentinite, basalt, chert and Gabbro
- Pzv — Paleozoic metavolcanic rocks

PRECAMBRIAN

- pcbc — Precambrian Birch Creek Schist



Modified from the following sources:

A. Geologic Map of the Talkeetna Quadrangle, Alaska. Miscellaneous Investigations Series Map I-1174.

B. Reconnaissance Geologic Map and Geochronology, Talkeetna Mountains Quadrangle, Northern Part of Anchorage Quadrangle, and Southeast Corner of Healy Quadrangle, Alaska. Open File Report 78-558A

C. Alaska Regional Profiles

Yukon Region 1974

State of Alaska Division of Planning and Research. Juneau, Alaska.

Base Map Source: U.S.G.S. Topographic 1:250,000 Maps.

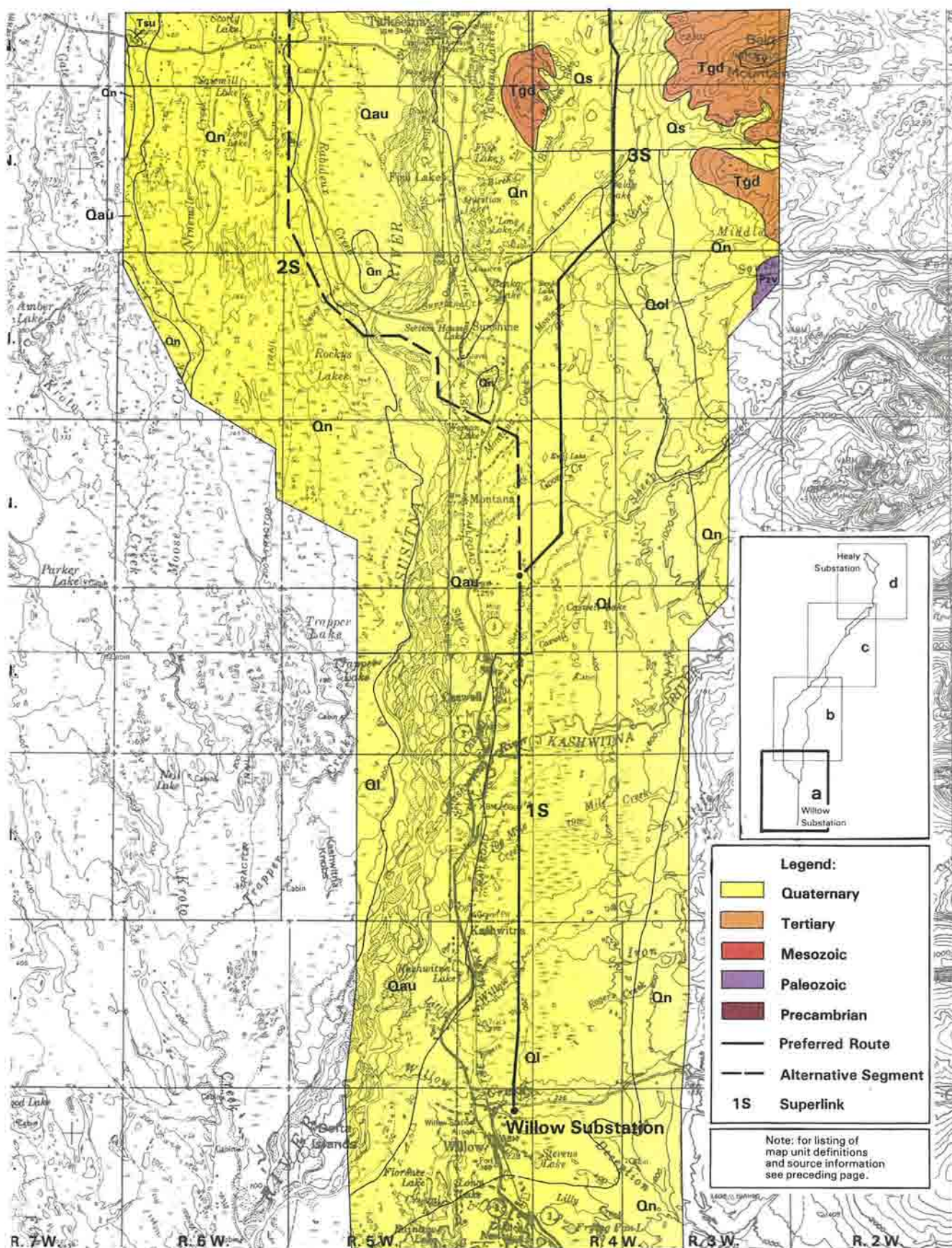


FIGURE 10a

Alaska Power Authority **ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE**

Generalized Geology

0 5 10 Miles
0 5 10 Kilometers



QUATERNARY

- Qs — Undifferentiated surficial deposits of Quaternary Age
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- Qt — Till and morainal deposits undifferentiated
- Qtrg — Talus and rock glaciers

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- Tn — Nenana Gravel
- Tcb — Coal-bearing formation
- Tsmg — Tertiary schist migmatite and granite
- Tv — Tertiary felsic igneous rocks

MESOZOIC

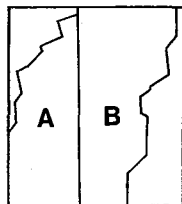
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 - Ki — Diabase, andesite and rhyolite intrusive rocks
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A. Geologic Map of the Talkeetna Quadrangle, Alaska. Miscellaneous Investigations Series Map I-1174

B. Reconnaissance Geologic Map and Geochronology, Talkeetna Mountains Quadrangle, Northern Part of Anchorage Quadrangle, and Southwest Corner of Healy Quadrangle, Alaska
Open File Report 78-558A

Base Map Source: U.S.G.S. Topographic 1:250,000 Maps.

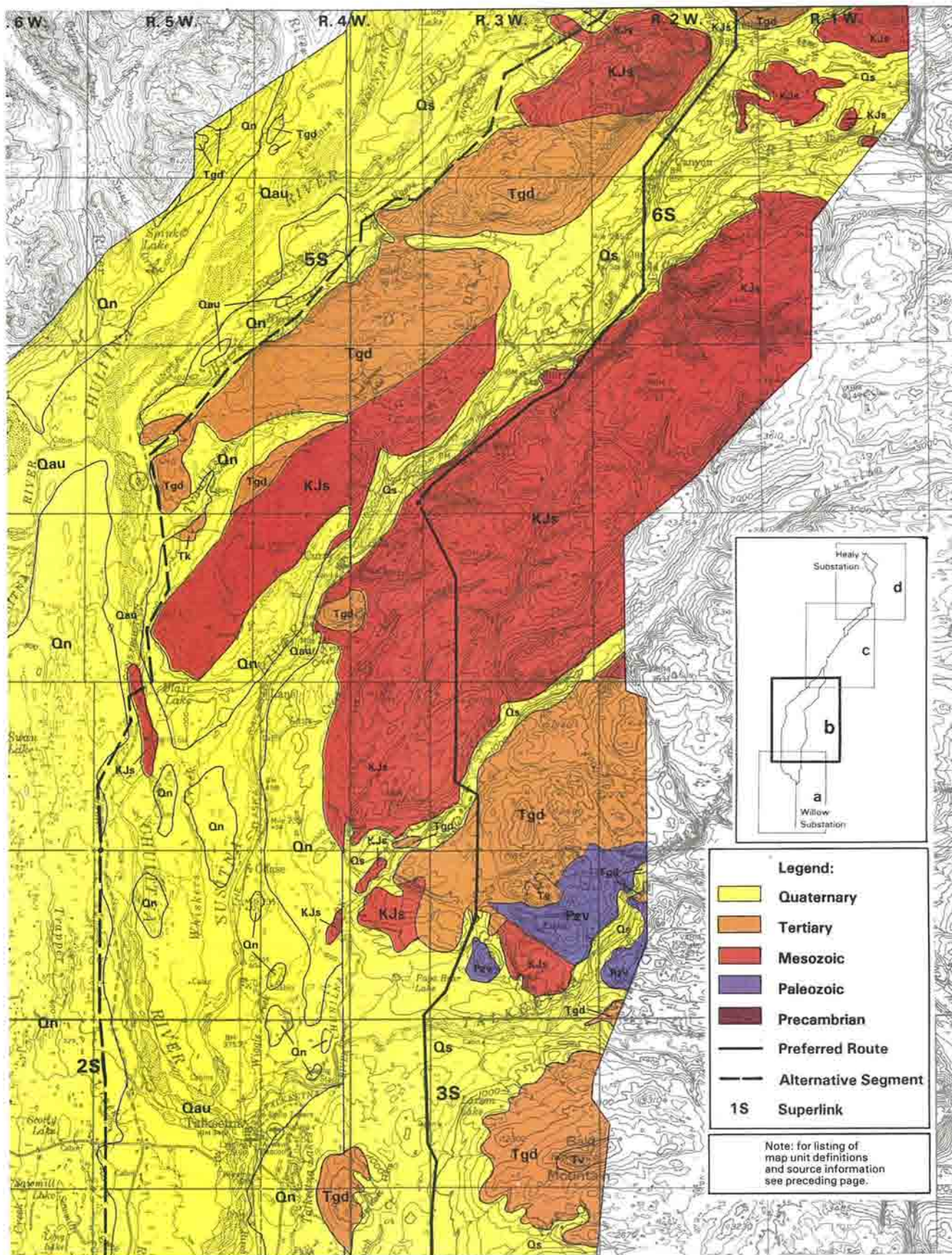


FIGURE 10b

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Generalized Geology

5 10 Miles
5 10 Kilometers



QUATERNARY

- Qs — Undifferentiated surficial deposits of Quaternary Age
- Qn — Drift of the Naptowne glaciation
- Qau — Quaternary alluvium undifferentiated
- Qal — Deposits in modern stream beds and alluvial fans
- Qol — Older alluvium-terrace gravels, outwash of Quaternary Age
- Ql — Quaternary lake clay and silts
- Qls — Landslide debris of Quaternary Age
- Qp — Peat
- Qt — Till and morainal deposits undifferentiated
- Qtrg — Talus and rock glaciers

TERTIARY

- Tgd — Tertiary granodiorite
- Tsu — Tertiary sedimentary rocks undifferentiated
- Tk — Sedimentary and volcanic rocks of Kenai Group
- Tn — Nenana Gravel
- Tcb — Coal-bearing formation
- Tsmg — Tertiary schist migmatite and granite
- Tv — Tertiary felsic igneous rocks

MESOZOIC

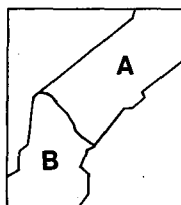
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- Pzv — Paleozoic metavolcanic rocks

PRECAMBRIAN

- pcbc — Precambrian Birch Creek Schist



Modified from the following sources:

A. Geologic Map of the Alaska Railroad
Region Matanuska Coal Field to Yanert Fork
Bulletin 907 Plate 2.

B. Reconnaissance Geologic Map and
Geochronology, Talkeetna Mountains
Quadrangle, Northern Part of Anchorage
Quadrangle, and Southeast Corner of
Healy Quadrangle, Alaska.
Open File Report 78-558A

Base Map Source: U.S.G.S. Topographic
1:250,000 Maps.

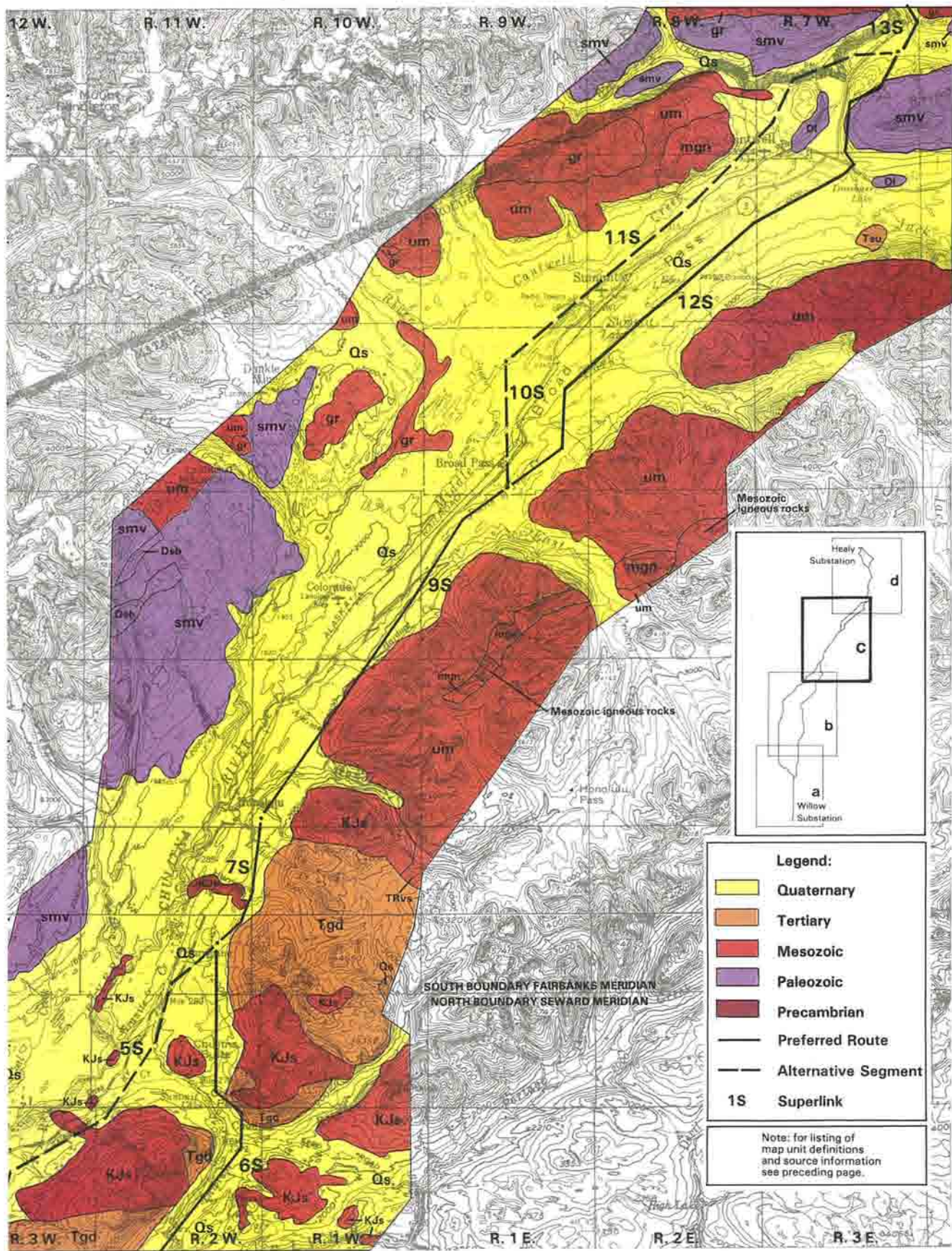


FIGURE 10c

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Generalized Geology

5 10 Miles
5 10 Kilometers



QUATERNARY

- Qs — Undifferentiated surficial deposits of Quaternary Age
- Qn — Drift of the Naptowne glaciation
- Qau — Quaternary alluvium undifferentiated
- Qal — Deposits in modern stream beds and alluvial fans
- Qol — Older alluvium-terrace gravels, outwash of Quaternary Age
- Ql — Quaternary lake clay and silts
- Qls — Landslide debris of Quaternary Age
- Qp — Peat
- Qt — Till and morainal deposits undifferentiated
- Qtrg — Talus and rock glaciers

TERTIARY

- Tgd — Tertiary granodiorite
- Tsu — Tertiary sedimentary rocks undifferentiated
- Tk — Sedimentary and volcanic rocks of Kenai Group
- Tn — Nenana Gravel
- Tcb — Coal-bearing formation
- Tsmg — Tertiary schist migmatite and granite
- Tv — Tertiary felsic igneous rocks

MESOZOIC

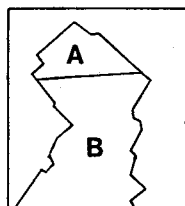
- um — Undifferentiated Mesozoic rocks
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 - Ki — Diabase, andesite and rhyolite intrusive rocks
 - KJs — Undivided Cretaceous-Jurassic marine sedimentary rocks
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PALEOZOIC

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- DI — Devonian-Silurian limestone
- Dsb — Upper Devonian serpentinite, basalt, chert and Gabbro
- Pzv — Paleozoic metavolcanic rocks

PRECAMBRIAN

- pcbc — Precambrian Birch Creek Schist



Modified from the following sources:

A. Map of the Alaska Range Between Longitude
147°30' and 150°00' West, Showing
Bedrock Geology.
Professional Paper 293 Plate 1.

B. Geologic Map of the Alaska Railroad
Region Matanuska Coal Field to Yanert Fork.
Bulletin 907 Plate 2.

Base Map Source: U.S.G.S. Topographic
1:250,000 Maps.

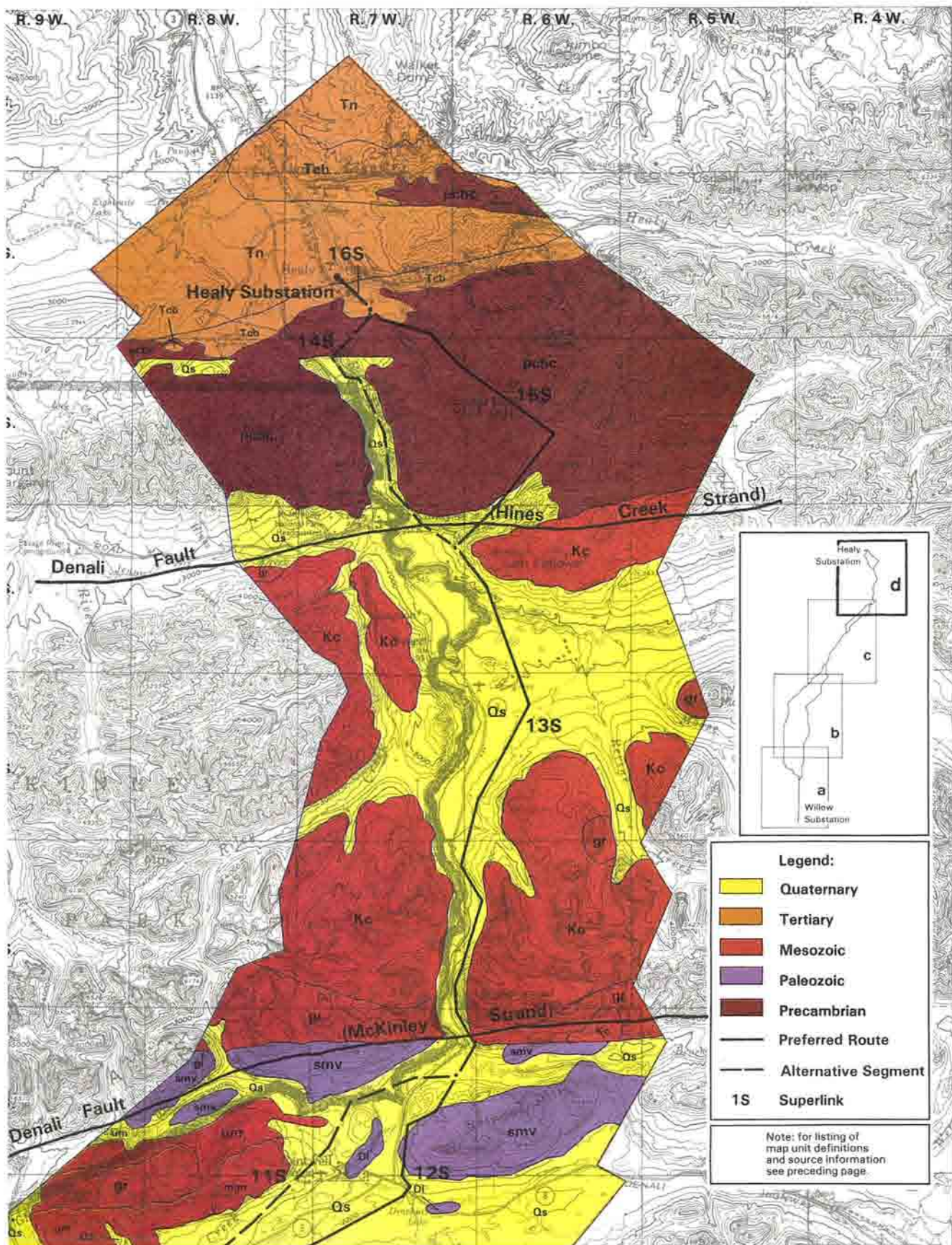
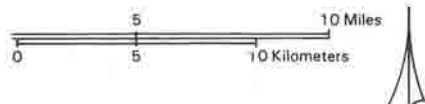


FIGURE 10d

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Generalized Geology



1. Surface faulting - the physical displacement of portions of the earth's surface along a line of surface rupture, or fault. The displacement of Quaternary glacial deposits along the Denali Fault is an example of the results of surface faulting.
2. Strong ground motion - the sensible shaking of the earth's surface during an earthquake.
3. Ground failure - physical adjustments of ground involving mass movement of volumes of earth material, such as landslides and slumps, or changes in volume, altitude and orientation of earth material due to compaction or consolidation. Ground failure is a common response of rock or sediment that is mechanically disturbed by strong ground motion.
4. Tilting - changes in attitude of the earth's surface without surface rupture or ground failure.
5. Seiches - long-period oscillations of enclosed water bodies, such as lakes or reservoirs.

Figure 11 illustrates historic earthquake epicenters which have occurred in the project area from 1899-1977.

MINERAL RESOURCES

Commercial quantities of metallic minerals are not known to exist in the project area. There are, however, a number of metallic mineral prospects in areas adjacent to the Intertie corridor (Alaska Regional Profiles, 1974).

Coal and gravel are the principal economic, non-metallic resources available in the project area. Coal has been mined at Healy since 1918 (Alaska Regional Profiles, 1974) and further exploration continues in this area. Coal is also

present in the Susitna basin and near Broad Pass. Gravel is available from the glacial deposits along much of the length of the line. It is normally used locally because of the high cost of transportation relative to its low unit value.

SOILS

For planning purposes soils are important in determining surface conditions and site responses to construction. A generalized exploratory soil survey has been prepared by the U.S. Soil Conservation Service (SCS, 1979) and portions of this survey have been reproduced in Figure 12. Pertinent soil characteristics are shown in Table 2 for the project area.

The parent material for most soils is the geologic substrate upon which the soil is formed and correlations with regional geology can be made (reference Figure 10). A review of soils should be made in conjunction with geologic information so that the potential responses of more deep-seated materials can also be identified. Surface sloughing for example, normally occurs within the soil horizons, whereas major landslides may involve the geologic formations beneath the soil. However, aerial deposits may also be significant. Glaciers using their load of debris scrape and grind away at bedrock materials forming very fine particles. These fine particles frequently become windblown, cover vast areas, and become a significant factor in soil formation. Volcanic ash is the other major airborne component in soils within the project area. Many of the soils near Talkeetna and in other areas in the project area have been formed with large amounts of windblown silt and volcanic ash (SCS, 1979). These soils are subject to severe surface erosion when they occur in upland areas.

From Willow to Sunshine lacustrine deposits exist which were formed when a proglacial lake occupied that area. In general these soils tend to be fine-grained silt or clay loam soils.

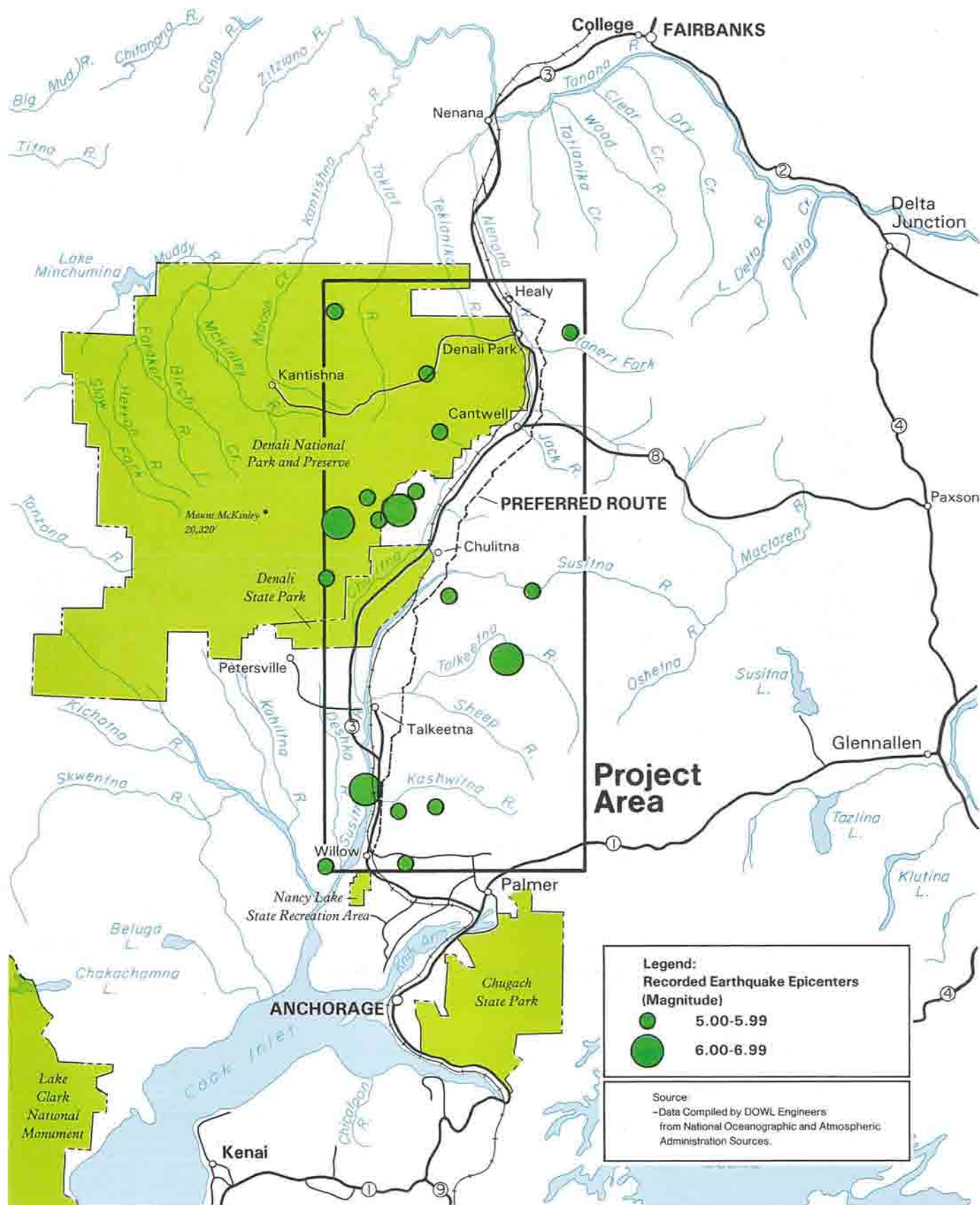
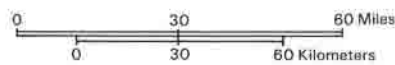


FIGURE 11
 Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Historic Earthquake Epicenters 1899 - 1977



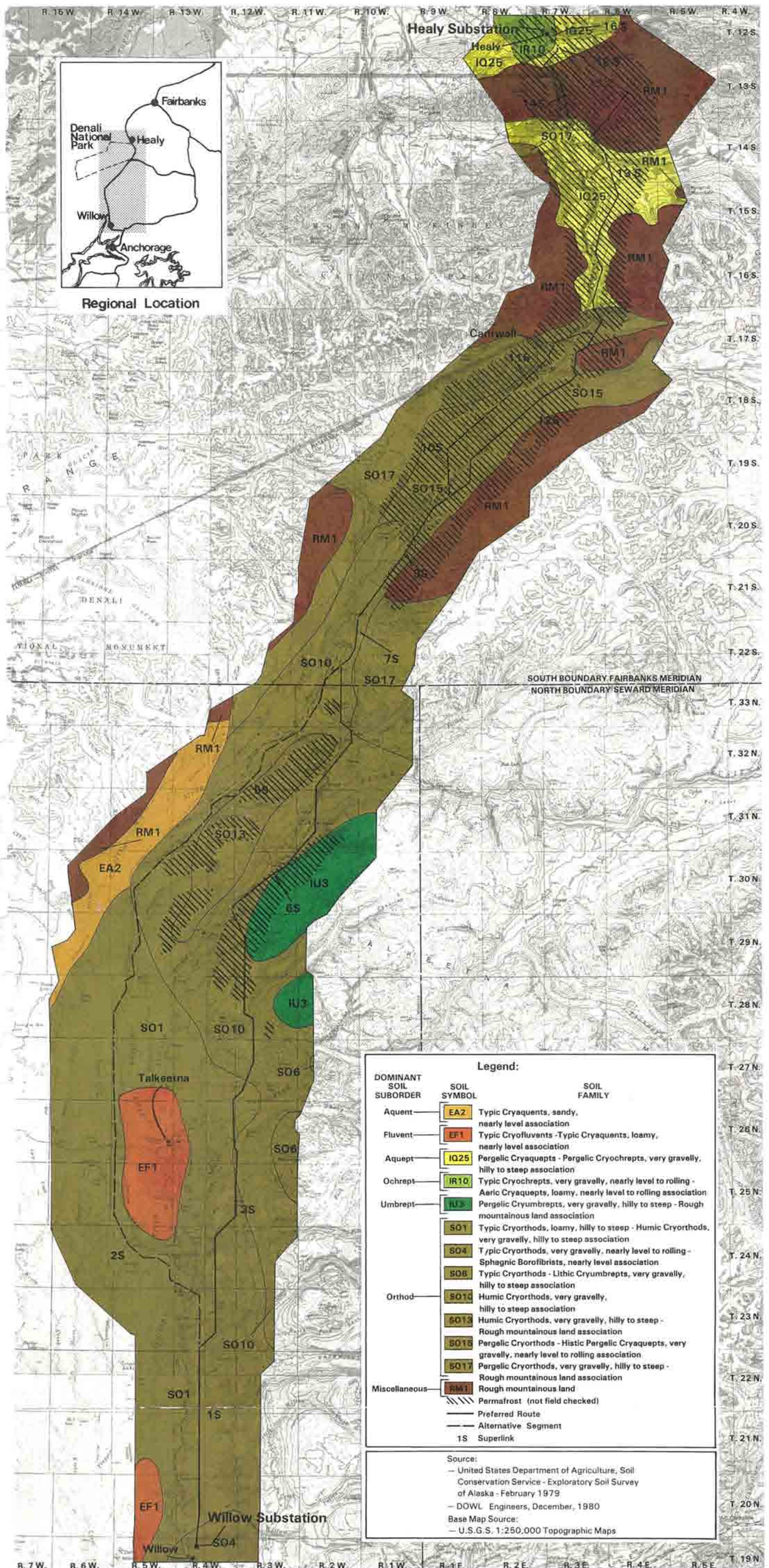


FIGURE 12

Alaska Power Authority | ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Soils

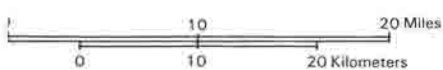


TABLE 2
SOIL CHARACTERISTICS

Map Symbol	Soil	Topographic Position	General Texture	Average Slope	Drainage	Permafrost	Hazards To Soil From Off Road Traffic	Remarks
EA2	Typic Cryaquents	Streams channels and outwash plans along Chulitna River	Sandy and gravelly	Nearly level	Poor	Not present	Severe due to wetness	Subject to flooding and stream channel changes.
EF1	Typic Cryofluvents- Typic Cryaquents	Stream channels and terraces west of Willow	Loamy and gravelly	Nearly level	Well to poor	Generally not present	Slight, severe in wet areas	Low or depressional areas subject to flooding.
IQ25	Pergelic Cryaquepts- Pergelic Cryochrepts	Foothills of Alaska Range above 1500 feet	Gravelly with rock outcrops	Sloping to steep	Poor to well	On broad ridges valleys and footslopes	Severe due to steepness and wet areas	Above timberline. Well drained in gravelly material at footslopes.
IR10	Typic Cryochrepts- Aeric Cryaquents	Terraces and foot- slopes around Healy	Silt loam over very gravelly sand	Nearly level to rolling	Well to moderately well	In depressions, drainageways, and seepages	Slight, to moderate due to dust and softness when wet	Forested floodplains with irregular areas of wet tundra and muskeg.
IU3	Pergelic Cryumbrepts- Rough Mountainous Land	Alpine plateaus, rocky slopes and ridges northeast of Talkeetna	Stony and gravelly loam with rock outcrops	Sloping to very steep	Well except poor in swales and seepage areas	In small swales or seepage areas at shallow depths	Severe to very severe due to steepness and rockiness	Soil material is too coarse to form perma- frost throughout.
RMI	Rough Mountainous Land	Upper portion of hills, mountains, ridges and peaks	Stony rock outcrops	Sloping to very steep	Well	Generally not present	Very severe due to steepness and rockiness	Barren upper slopes. icefields, and glaciers. Predomi- nantly tundra vegetation.
SO1	Typic Cryorthods- Sphagmic Borofibrists	Moraine hills, depres- sions, and broad river terraces	Silt over gravelly loam on moraines with moss and peat in depressions	Rolling hills and nearly level	Well on hills to very poor in depressions	Not present	Slight to very severe in wet peaty areas	Forested hills alter- nating with depressions filled by muskeg and lakes.
SO4	Typic Cryorthods- Sphagmic Borofibrists	Broad glaciated low- lands adjoining Cook Inlet	Silt over very gravelly sand or sandy loam with moss and peat in depres- sions	Rolling hills and nearly level	Well on hills to very poor in depressions	Not present	Slight to very severe in wet peaty areas	Forested hills alter- nate with depressions filled by muskeg and lakes. Limited to small area near Willow.
SO6	Typic Cryorthods- Lithic Cryumbrepts	Alpine benches, foot- slopes and deeply entrenched valleys in the western Talkeetna Mountains	Gravelly sandy loam to gravelly silt loam	Sloping to very steep	Well	Not present	Severe due to steepness and rockiness	Alpine shrubs and tundra in small area east of Talkeetna.

TABLE 2
(Continued)
SOIL CHARACTERISTICS

Map Symbol	Soil	Topographic Position	General Texture	Average Slope	Drainage	Permafrost	Hazards To Soil From Off Road Traffic	Remarks
SO10	Humic Cryorthods	Foothills and terraces of Susitna River Valley	Silt loam over stony sandy loam till	Hilly to steep	Well	Generally not present except in small areas at higher eleva- tions	Severe due to steepness and rockiness	Valley floor north of Talkeetna supporting forest and subalpine shrubs.
SO13	Humic Cryorthods- Rough Mountainous Land	Alpine ridges, benches and footslopes of Curry Ridge	Silt loam over gravelly and stony glacial till with rock outcrops	Hilly to very steep	Well except for a few depressions	Generally not present but may occur on some north facing slopes and swales on high ridges	Severe to very severe due to steepness and rockiness	Subalpine and alpine vegetation.
SO15	Pergelic Cryorthods- Histic Pergelic Cryaquepts	Low moraine hills and broad valley floor along the Susitna River	Thin loam over very gravelly glacial drift with peat in some areas	Nearly level to rolling	Well on hills and poor on depressions	On footslopes and in valleys were poorly drained peaty soils are present	Slight to severe in wet areas	Generally tundra and forest vegetation.
SO17	Pergelic Cryorthods- Rough Mountainous land	Alpine areas, ridges and peaks of the Alaska Range	Gravelly and stony silt loam with rock outcrops and peat in some areas	Hilly to steep	Well	On many north facing slopes and under peat deposits	Slight to very severe due to steepness and rockiness	Generally alpine tundra.

Source: USDA Soil Conservation Service, 1979.

In much of the area between Willow and Sunshine, especially in the northern portion, the lacustrine deposits are not of sufficient thickness to completely mask the glacial and glacial-fluvial (outwash) deposits. The glacial features appear as elongated ridges oriented in a north-south direction. Muskeg and peat bogs are prevalent between these ridges due to the poor drainage of the lacustrine deposits in the substrate and the low slopes.

In the active floodplain of the Susitna River and on older stream terrace deposits sandy and gravelly soils are predominant. These soils are well-drained and have high load-bearing capacity.

Above Sunshine the upland soils are predominantly soils derived from glacial till and windblown silt. Soils derived from till or morainal materials are highly variable mixture of sand, silt and gravel. These soils are very well-consolidated and have high bearing capacity when they are derived from till which has been overridden by glacial ice.

Soil on the steep hillsides is normally very thin or nonexistent in areas of bedrock exposure. Talus or colluvial soils may be found at the base of bedrock slopes.

At the Willow Substation, the soils are classified as being developed on the broad glaciated lowlands adjacent to Cook Inlet as shown in Figure 12, soil unit SO4. Immediately north of the substation along link 1s are the Susitna valley soils which contain many swampy areas (SO1). Link 2s continues entirely in SO1 soils. Within link 3s north of the Talkeetna River the slopes become steeper and the soil is classified as SO10. Most of links 5s and all of 6s and 7s are in the SO10 unit. The SO10 soils contain a mantle of silt over colluvial materials. The northern half of 9s and all of links 10s, 11s, and 12s are in soil unit SO15, a soil developed on glacial drift. Link 13s is predominantly in unit IQ 25 which is developed on glacial

till. Most of links 14s and 15s are on rough mountainous land (RM1) with small portions in IQ 25. Link 16s is on IR 10 a unit developed on well-drained terraces.

Permafrost is perennially frozen ground and is defined solely on the basis of temperature. North of Curry along the Intertie there are numerous masses of discontinuous permafrost (Ferrians, 1965) shown in Figure 12. The permafrost areas are chiefly in fine-grained sedimentary rocks. Depth to permafrost is controlled by the amount of vegetation, type of rock, drainage conditions and exposure to solar radiation. Three types of vegetation can be correlated with permafrost. (1) Under thick moss permafrost is typically within 1 to 2 feet of the surface. (2) Under open stands, spruce, brush and willows permafrost is generally 5 to 20 feet below the surface. Most of the mountain slopes and hills between McKinley Park Station and Healy fall in this category. (3) Under slopes of bare gravel, talus and bedrock, permafrost is generally at a depth of greater than 20 feet, if present (Wahrhaftig and Black, 1958).

CLIMATE

The south end of the project area lies in the broad Susitna River Valley. Temperatures here have a much greater range than at Anchorage, as the area is away from the moderating influence of Cook Inlet. In this area the estimated temperature extremes are 103°F and - 93°F for a 50 year period of return. The record high temperature at Willow is 90°F and the record low temperature is -56°F. Records were first recorded in 1963.

Further north, the Susitna and Chulitna River valleys are higher in elevation and subject to greater wind speeds. Temperatures are expected to be similar to those previously described, while the extreme gust wind speed is anticipated to be 120 mph for a 50 year return.

In Broad Pass the temperature extremes are 107°F and - 68°F for a period of return of 50 years. The once in 50 years wind is estimated to be 80 mph.

Through Windy Pass to the confluence of the Nenana River and Montana Creek, the Alaska Range forms a barrier to the low level movement of air. Under certain barometric conditions, wind is funneled through openings in this barrier at a much greater speed than would occur over flat terrain.

The Nenana Gorge is the main wind funnel for a 100 mile stretch of the Alaska Range. The canyon drops from an elevation of 2000 feet near Windy to 1500 feet at Healy, forming a 30 mile-long wind funnel bringing southeasterly Chinook winds to Healy. Consequently, Healy has recorded the highest wind speeds of any location in the project area. The extreme gust wind for the Healy area is anticipated to be 160 mph for a 50 year period of return. The extreme gust wind in the Nenana Gorge is anticipated to be 190 mph for a 50 year period of return.

Snow depths are generally not great along the project area. No special considerations for snow depth are being considered.

WATER RESOURCES

Surface Water

The Susitna, Chulitna, Talkeetna and Nenana Rivers are the major watercourses in the vicinity of the Intertie Project. All of these rivers are known to have significant floods. Location of these rivers and their tributaries is illustrated on Figure 1. Information regarding water resources was derived from the Alaska Regional Profiles (1974) and the U.S. Geological Survey (1981).

Average discharge for the Susitna River at Gold Creek is approximately 9,600 cubic feet per second (cfs). At this point, the river has a drainage area of 6,160 square miles. Maximum discharge was 90,700 cfs recorded June 7, 1964.

Specific samples taken during 1978 had suspended sediment ranging from one milligram per liter (mg/l) during low flows to 938 mg/l during high flows. Further downstream near Susitna Station the river has an approximate mean discharge of 42,000 cfs.

The Chulitna River near Talkeetna has an average discharge of approximately 9,000 cfs with a drainage area of 2,520 square miles. Maximum discharge was 75,900 cfs recorded July 20, 1967. The Chulitna flows south and joins the Susitna River near Talkeetna.

Average discharge for the Nenana River near Healy is approximately 3,500 cfs. Maximum discharge was 46,800 cfs recorded on July 25, 1967. The Nenana flows north and joins the Tanana River near Nenana.

The Talkeetna River near Talkeetna has an average discharge of 4,000 cfs and a drainage area of 2006 square miles. Maximum discharge was 67,400 cfs recorded August 10, 1971. The Talkeetna joins the Susitna River near Talkeetna.

Water quality in all of these rivers is good for most uses. During high flows and where glacial streams enter, suspended sediment may be high. However, community water supplies normally are derived from ground water wells.

Floods occur as a regular phenomenon on all major river systems and the rivers in the project area are no exception. Flooding occurs when the amount of water flowing down a channel exceeds the channel capacity. This can happen during excessive rainfall, unusual snowmelt conditions, glacial outburst conditions or combinations of these factors. Glacial outburst floods (jokulkaups) occur when lakes dammed by glaciers release their water suddenly as a result of glacial melting or channeling.

Ground Water

Near major streams and rivers unconsolidated sands and gravels commonly produce wells with flows of 100 to 1000 gallons per minute (gpm) and wells can be found with yields over 1000 gpm. Unconsolidated sediments further from major streams or with moderate clay or silt content typically yield 10 to 100 gpm. Deposits with very high clay or silt content yield 0 to 10 gpm.

Along the Intertie project area, virtually all wells have excellent water quality with total dissolved solids less than 250 mg/l.

BIOLOGICAL RESOURCES

Methods

A standardized methodology was employed which would accurately assess the project area for potential environmental impacts from construction and operation of the Intertie. The methodology developed and employed by the ecology field team consisted of three phases: literature review, agency contacts and field investigations. The first two phases enabled the project team to better assess principle project concerns by ensuring maximum data collection and to become more aware of major biotic communities.

The literature review was designed to gather information pertinent to the project area, to assess the direction of research and resource management within the project area and to identify gaps in information relative to the project area. A project library was established after consultation with APA and state and federal agencies (discussed below) which provided numerous reports and citations. In addition, several information repositories were visited for current information; included in these were the University of Alaska's Arctic Environmental Information and Data Center and the Bureau of Land Management's Federal Resource Center, both in Anchorage and the U.S. Army Corps of Engineer's Cold Regions Research Environmental Laboratory in Fairbanks.

In addition, authorities on specific areas of the local biotic communities were contacted during this literature review phase. These contacts enabled the project team to synthesize much of the literature and to pinpoint conditions most likely to be encountered within the project area.

To supplement the compiled literature, state and federal agencies and universities were contacted and meetings arranged for information exchange. Agencies contacted were those directly involved with natural resource management and research (vegetation, wildlife and fisheries). These meetings enabled the ecology team to discuss the project directly with the personnel whose areas of responsibility were within the project area. Agency meetings were conducted in the fall of 1980 and the spring of 1981, however, a dialogue was maintained throughout the project. During the initial series of meetings, contacted agencies were introduced to the proposed Intertie project. At this time major areas of environmental concern were discussed and background conditions within the project area were developed.

When the corridors and routes were selected, sets of base maps were sent to all involved agencies for their review prior to the second set of meetings. During this second set of meetings agencies contributed information and comments relative to the corridor selections or specific problem areas. Discussions also included mitigation of potential impacts.

The field studies involved two separate tasks, site selection and site investigations. Four reconnaissance trips (two by automobile and two by helicopter) were conducted in the project area to pinpoint potential sites for study. Individual study sites were selected using the criteria of: location of the line network, typical habitat types, unique habitat types, concerns of regulatory agencies on sensitivity and potential access. Selected study sites were then plotted on the base maps for field inspection and are shown on Figure 13.

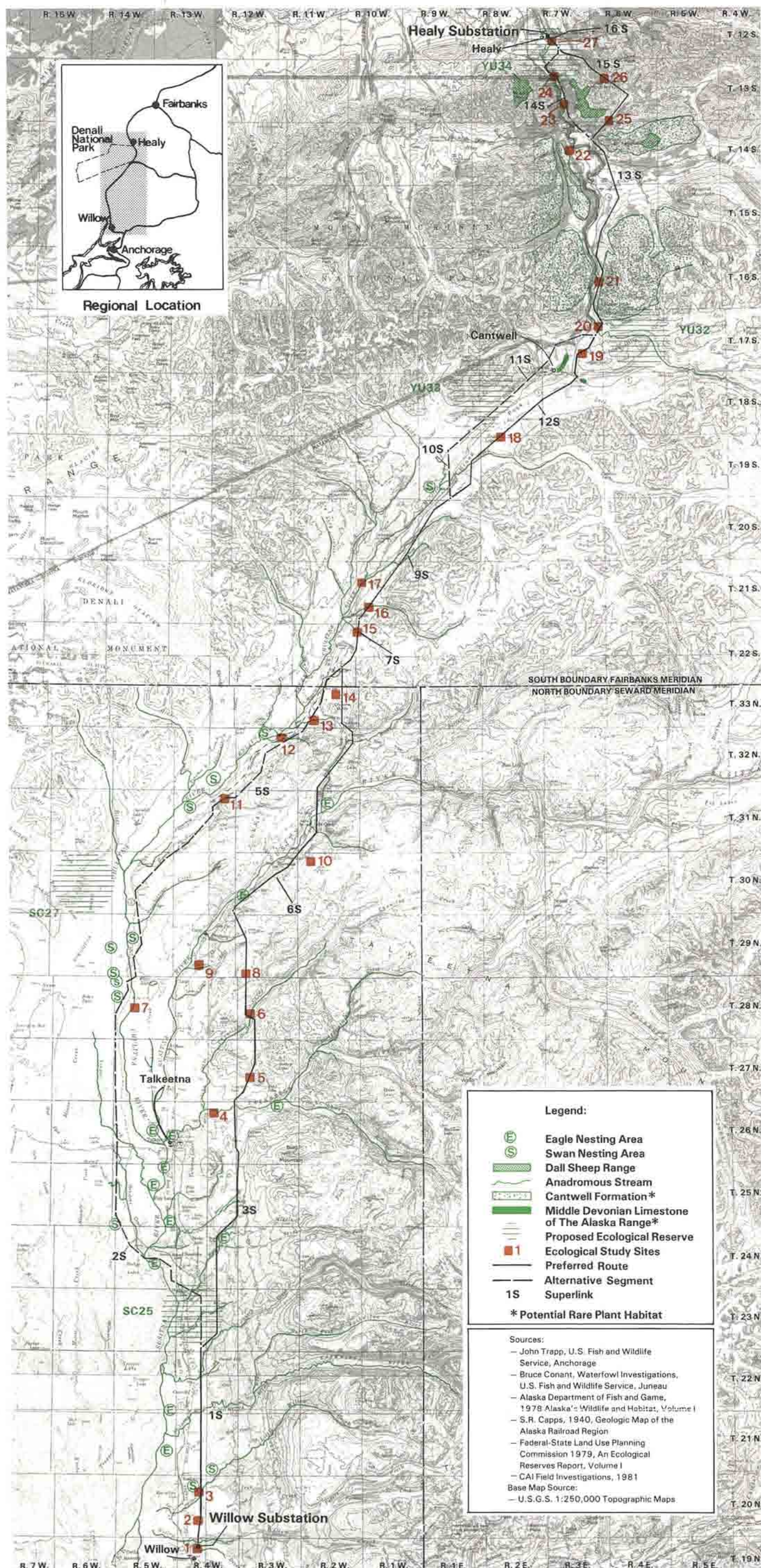


FIGURE 13
Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

0 10 20 Miles
0 10 20 Kilometers



Gilbert/Commonwealth

**Areas and
Species of Concern**

Site inspections were conducted during the fall of 1980, and spring and summer of 1981. Selected sites were visited in different seasons to obtain a broader view of the natural systems. Not all sites were visited in all three seasons. The ground investigations focused on foot surveys of the actual sites, accessed either from the Parks Highway or by helicopters. A brief description of the ecological situation at each of the ecological study sites which were field investigated is presented in Appendix C.

Data collection was based upon the existing environment during the season of inspection and was recorded separately for each major discipline: vegetation, wildlife and aquatic resources. Vegetation was investigated by major cover types at each site with the common plant species cataloged for each type. Special effort was made to document the occurrence of any threatened or endangered species when appropriate habitat was encountered. Given project scope constraints many plants were identified in the field, while some (i.e., grasses, birches, etc.) were grouped. However, when field identifications were impossible, representative specimens were returned to the Commonwealth laboratory in Jackson, Michigan for final identification. Spatial and temporal use of the project area by wildlife was documented by actual observations, tracks, nests, calls and sign. Habitat types were evaluated for occurrence and general quality. The data collected on the fisheries were restricted to type of water body (i.e., lake, pond, stream, river) potential resident and anadromous habitat resource, and temporal use of the site. Visual inspection was also made of the ecological study sites for evidence of human activity (accessibility) or previous disturbance.

Wildlife

The dispersion and interspersions of habitat types in the project area provide cover for many wildlife species. In Alaska, certain species or groups of species are considered more important than others. This importance is based on:

- 1) The recreational and/or commercial value of game species and furbearers. Big

game hunting contributes to local subsistence as well as having a high recreational value. Small game hunting and furbearer taking provide subsistence to many local residents. 2) The protection of certain species by International laws, which includes most migratory birds (i.e., the Migratory Bird Treaties between the United States and Canada, Mexico, Japan and the Soviet Union). 3) The role of some animals as indicators of a healthy ecosystem. Frequently, the presence of species in the highest trophic levels (i.e., raptorial birds or large carnivores) indicates the ecosystem they utilize is biologically healthy. 4) The importance of certain animals because of their dwindling populations. These species are usually protected through the Endangered Species Act of 1973, although this does not cover all wildlife species whose populations are imperiled.

Big Game

The project area lies in western portions of Game Management Units (GMU) 13 and 14 and in the southwestern portion of GMU 20 as designated by the Alaska Department of Fish and Game (ADFG, 1980). The principal big game species in GMUs 13 and 14 include moose, caribou, black and brown bear and wolf. The same big game species are also present in GMU 20, along with dall sheep (ADFG, 1978 and Terrestrial Environmental Specialists [TES], 1981).

Moose, an important recreation and subsistence game species, range throughout the entire project area, particularly at the lower elevations. In the southern portion of the project area, moose moving out of the Talkeetna Mountains in the fall and early winter will pass through the project area to spend the winter in the riparian habitats along the major watercourses (J. Didrickson, ADFG 1981, personal communication).

Moose also concentrate in the area from about Talkeetna to Broad Pass and from Panorama Mountain north to Healy (ADFG, 1978). Of the 27 sites inspected in the project area, only five did not have fresh moose sign (i.e., evidence of recent browsing, fresh droppings or tracks). In the north end of the project area, the riparian habitats along Moody Creek and major tributaries provide calving grounds for moose (L. Jennings, ADFG 1981, personal communication).

Caribou occur throughout most of the project area but are more common in the northern portions according to the ADFG (1978). The ADFG considers the project area to have at least two distinct caribou herds utilizing appropriate habitats (L. Jennings, ADFG 1981, personal communication). Field investigations found evidence of caribou on sites 10, 17, 18 and 24, all in the Broad Pass area or north. All the observations were made in early June and were at altitudes between 2400 and 3500 feet.

According to ADFG (1978), brown and black bear utilize the entire project area. Known denning locations are reported in "Alaska's Wildlife and Habitats" (ADFG, 1978). Areas of intensive spring use are shown in Figure 13. All the anadromous streams in the project area are suitable fishing waters for both bear species. Bear activity was noted at sites 9, 10, 15 and 18.

Although no evidence of wolves was found at any of the sites which were field inspected, the ADFG (1978) reports the wolf ranges throughout the project area. As the population density can be as high as only one wolf per 25 square miles (Stephenson, 1978), the possibility of a siting is limited.

Just south of Healy and east of Denali National Park and Preserve are the only reported locations of dall sheep in the project area. All of the habitat requirements of the sheep (i.e., mineral licks, winter cover, lambing grounds, etc.) can be found in the Sugarloaf Mountain area (L. Jennings, ADFG 1981, personal

communication). These sheep spend the late spring to early summer period after lambing on the west side of Sugarloaf Mountain within view of the Parks Highway (M. Paine, ADFG 1981, personal communication). Their winter range has not been well defined, however the National Park Service (1976) reports it to be west of the Parks Highway. Dall sheep were observed only at sites 23 and 24.

Small Game

The ADFG (1978) indicates seven upland game species occur in the project area. The snowshoe hare ranges throughout most of Alaska. Population levels fluctuate cyclically, but even during low periods, the species maintains a moderately dense population in isolated locations within the project area (ADFG, 1978). Recent evidence of snowshoe hares was observed at sites 16, 22, 23, 24 and 25.

The willow ptarmigan occurs throughout Alaska (ADFG, 1978) and is considered common in the project area (Armstrong, 1980). As the name implies, the species is closely associated with willows and depends on habitat consisting of willow, alder and birch, especially for winter cover (Johnsgard, 1975). Willow ptarmigan were observed at sites 6 and 18.

Armstrong (1980) lists the rock ptarmigan as common throughout most of Alaska, in suitable habitat, except in the extreme north. Treeless cover types are preferred habitat for the rock ptarmigan (Weeden, 1978), except during winter when they feed on birch and willow (Johnsgard, 1975). Rock ptarmigan were not observed in the project area.

The white-tailed ptarmigan is probably the least common ptarmigan in the project area and little information is available on it (ADFG, 1978). Armstrong (1980) considers it uncommon in central Alaska. This species relies heavily on alder for winter survival (Johnsgard, 1975) but spends the rest of the year in alpine tundra. No white-tailed ptarmigan were found in the project area.

Although sharp-tail and ruffed grouse occur in the project area (ADFG, 1978), none were found during field studies. The ruffed grouse utilizes deciduous woodlands while the sharp-tailed grouse is found in muskegs (Armstrong, 1980). Both habitats are present in the project area.

Armstrong (1980) lists the spruce grouse as common in the project area. Johnsgard (1975) describes the habitat as boreal coniferous forests throughout North America. Weeden and Ellison (1968) and Armstrong (1980) note that in central Alaska (the location of the project area) the spruce grouse utilizes spruce/hardwood and coniferous forests. Although spruce grouse were not observed in the project area, suitable habitat is common.

Migratory Game Species

Migratory game birds include nearly all the waterfowl, sandhill cranes, and snipe (ADFG, 1981). The most important waterfowl in the project area include pintail, green-wing teal, scaup, American widgeon and mallard (J. Trapp, USFWS 1980, personal communication). The river valleys in the project area provide a minor migratory corridor for many of the waterfowl nesting in northern Alaska (D. Timm, ADFG 1981, personal communication). Of the migratory and communication corridors in the project area, the Chulitna River is probably the most important. The paucity of fertile lakes in the project area results in a below statewide average of breeding ducks, about 23 per square mile (compared to 84 per square mile, statewide). Trumpeter swans do nest in the project area; over 800 nest in the Susitna basin (Trapp, USFWS 1980, personal communication). Dan Timm (ADFG 1980, personal communication) reports scattered summering trumpeter swans west of the Parks Highway from Willow to Cantwell and east of the highway from Talkeetna to Cantwell. These species are not hunted, but are protected because their populations are declining (T. Trent, ADFG 1980, personal communication). There are no geese nesting within the project area (D. Timm, ADFG 1981, personal communication). Sandhill cranes are common in the muskeg-bog

area in the southern portion of the project area, while the common snipe breeds in the muskegs and freshwater marshes throughout the project area (Armstrong, 1981). Waterfowl were observed at sites 1, 8, 9, 13, 18 and 24, sandhill cranes were noted at site 2, and common snipe were found at sites 5 and 9.

Furbearers

Furbearers in the project area include wolf, coyote, red fox, lynx, raccoon, wolverine, land otter, mink, weasel, marten, beaver, muskrat, squirrel and marmot (ADFG, 1981; Alaska Cooperative Wildlife Research Unit and TES, 1981).

The wolverine, coyote and red fox are found throughout the project area (ADFG, 1978). These three species have general cover requirements and are not restricted to certain habitat types. The lynx, the only native cat in Alaska, is also a facultative species, but it prefers woodlands (Murie, 1962). The short-tailed weasel and least weasel range throughout most of Alaska (ADFG, 1978) and are also not restricted to a specific habitat type. The marten and mink are found throughout the project area, usually in woodlands (Murie, 1962). The latter is most frequently associated with riparian habitats, while the former is most often noted in mature woodlands. The land otter, muskrat and beaver utilize areas containing water, either flowing or still. The hoary marmot generally digs in areas containing rock outcrops or on skree or talus slopes. Of these furbearers, the beaver was the only one found in the project area, and evidence was found at sites 4, 5, 6, 8, 9, 11, 13, 14, 17, 19 and 24.

Nongame Mammals and Birds

Nongame mammals in the project area include the smaller mammal species such as shrews and mice. The little brown myotis is the only bat species reportedly occurring in the project area (Hall and Kelson, 1959). The species is associated with wooded areas, but will roost in caves and rock crevices. Shrews, smaller rodents and the pika are distributed throughout much of Alaska, in

appropriate habitats. More detailed information on the distribution of these nongame species in the project area are listed in Burt and Grossenheider, (1964); Dice, (1921); Hall and Kelson, (1959); Manville and Young, (1965); and Murie, (1962).

The importance of certain birds is derived from their recreational or commercial value, as characteristics of certain habitat types (Kessel, 1979), or as indicators of the health of the ecosystem. Raptors, because of their trophic level, sensitivity to human disturbance and habitat requirements are frequently considered indicator species.

The more common raptors in the project area include the sharp-shinned hawk, the red-tailed hawk, the rough-legged hawk, the golden eagle, the bald eagle and the American kestrel (Armstrong, 1980).

Raptors noted in the area include all those previously mentioned, along with the goshawk, marsh hawk and gyrfalcon. The goshawk was noted overhead at the north end of Curry Ridge; the sharpshinned hawk was observed in-flight along the Parks Highway near Hurricane. The red-tailed and rough-legged hawks were noted in several locations in the project area. The golden eagle was identified near site 23 and the bald eagle was seen at site 1 as well as at several nest locations shown on Figure 13. A gyrfalcon nest was found at site 25 and the American kestrel was observed just north of Healy.

Nearly all the birds in the project area, except most of those in the orders Galliformes (grouse and ptarmigan) and Anseriformes (waterfowl), are considered nongame birds. Kessel (1979) described a habitat classification system for birds in Alaska; Kessel's types which are pertinent to the project area are listed in Table 3. This table shows the correlation between Kessel's habitats and the cover types identified in this study. The system allows suitable habitats to be

TABLE 3
AVIAN HABITATS FOUND IN THE
INTERTIE PROJECT AREA

<u>Habitat Type¹</u>	<u>Cover Type²</u>
Lacustrine Waters and Shorelines	Aquatic
Fluviatile Waters and Shorelines	Aquatic
Alluvia and Moraines	--
Cliffs and Block-fields	--
Wet Meadow	Low Brush, Muskeg-Bog
Dwarf Shrub Meadow	Tundra
Grass Meadow	Low Brush, Muskeg-Bog
Tall Forb Meadow	Tundra
Dwarf Shrub Mat	Tundra
Low Shrub Thicket	Shrublands
Medium Shrub Thicket	Shrublands
Tall Shrub Thicket	Shrublands
Mixed Deciduous-Coniferous Forest	Spruce-Hardwood
Scattered Woodland and Dwarf Forest	Low Brush, Muskeg-Bog

¹Source: Kessel, 1979

²Source: Commonwealth Associates Inc., 1981

identified and reduces the need for censusing bird species. Additionally, Kessel notes characteristic birds for each habitat type which allows for confirmation of individual habitats. This information was used in assessing impacts on the route selected.

A number of nongame birds were noted in the project area, and these are listed in Table 4. Noteworthy among these are the trumpeter swan in the SE1/4, Section 33, T.23N., R.4W., S.M. (Figure 13). Other species noted followed the habitat usage expected and described by Kessel (1979).

Endangered or Threatened Wildlife Species

The U.S. Department of the Interior Fish and Wildlife Service (USFWS) (1980) and the ADFG (T. Trent, 1980, personal communication) list only two wildlife species as endangered or threatened in Alaska. These are the peregrine falcon (Falco peregrinus tundrius) and the Eskimo curlew (Numenius borealis). The peregrine falcon nests in eyries which are usually located high on cliff ledges (seldom on top of a cliff) near shorebird and waterfowl habitat (Godfrey, 1979). The reason for this proximity to aquatic habitats reflects the falcons' utilization of shorebirds and waterfowl as a principal prey base (Bent, 1961). There are no nesting eyries reported in the project area, although peregrine falcons have been sighted along the Susitna and Nenana Rivers (White, 1974 and D. Benfield, USFWS 1980, personal communication).

The eskimo curlew formerly nested over much of northern Alaska, although its exact distribution is unknown. Nesting activities were only known from barren ground (Bent, 1969). Spring and fall migrations were principally in the Mississippi and central flyways (Bent, 1969 and Godfrey, 1979). The eskimo curlew was thought to have been nearly extirpated by the 1900s (Bent 1969) through over hunting. Current status is endangered throughout its range, and possibly extinct (D. Benfield, USFWS 1980, personal communication).

TABLE 4
BIRD SPECIES OBSERVED DURING FIELD INVESTIGATIONS

Common Name	Scientific Name	Location Observed*
Pied-billed grebe	<u>Podilymbus podiceps</u>	Near Talkeetna
Trumpeter swan	<u>Olor buccinator</u>	Near Montana
Mallard	<u>Anas platyrhynchos</u>	Near Willow
Pintail	<u>A. acuta</u>	13
Green-winged teal	<u>A. crecca</u>	8, 13, 19
Canvasback	<u>Aythya valisineria</u>	Near Willow
Lesser scaup	<u>A. affinis</u>	19
Common goldeneye	<u>Bucephala clangula</u>	9
Bufflehead	<u>B. albeola</u>	25
Halequin duck	<u>Histrionicus histrionicus</u>	1
Ruddy duck	<u>Oxyura jamaicensis</u>	Near Willow
Goshawk	<u>Accipiter gentilis</u>	Near Gold Creek
Sharp-shinned hawk	<u>A. striatus</u>	McKinley Park
Red-tailed hawk	<u>Buteo jamaicensis</u>	Near Hurricane
Rough-legged hawk	<u>B. lagopus</u>	8
Golden eagle	<u>Aquila chrysaetos</u>	22
Bald eagle	<u>Haliaeetus leucocephalus</u>	1
Marsh hawk	<u>Circus cyaneus</u>	Near Healy
Gyr Falcon	<u>Falco rusticolus</u>	26
Willow ptarmigan	<u>Lagopus lagopus</u>	19
Sandhill crane	<u>Grus canadensis</u>	2
Killdeer	<u>Charadrius vociferus</u>	McKinley Park
Lesser yellowlegs	<u>Tringa flavipes</u>	13, 14
Solitary sandpiper	<u>T. solitaria</u>	McKinley Park
Spotted sandpiper	<u>Actitis macularia</u>	Near Willow
Northern phalarope	<u>Phalaropus lobatus</u>	13
Common snipe	<u>Gallinago gallinago</u>	5, 7, 9
Long-billed dowitcher	<u>Limnodromus scolopaceus</u>	13
Mew gull	<u>Larus canus</u>	15, 21, 22, 27
Arctic tern	<u>Sterna paradisaea</u>	Susitna River Crossing
Mourning dove	<u>Zenaidura macroura</u>	McKinley View Lodge
Belted kingfisher	<u>Megasceryle alcyon</u>	1, 13
Common flicker	<u>Colaptes auratus</u>	Near Talkeetna
Alder flycatcher	<u>Empidonax alnorum</u>	4, 21
Olive-sided flycatcher	<u>Nuttallornis borealis</u>	2, 13
Horned lark	<u>Eremophila alpestris</u>	19
Violet-green swallow	<u>Tachycineta thalassina</u>	Hurricane Gulch
Tree swallow	<u>Iridoprocne bicolor</u>	4, 13
Barn swallow	<u>Hirundo rustica</u>	Near Willow
Gray jay	<u>Perisoreus canadensis</u>	14
Black-billed magpie	<u>Pica pica</u>	24
Common raven	<u>Corvus corax</u>	12, 20
Northwestern crow	<u>C. caurinus</u>	Near Willow
Black-capped chickadee	<u>Parus atricapillus</u>	1, 4, 9, 15, 23
Dipper	<u>Cinclus mexicanus</u>	5
American robin	<u>Turdus migratorius</u>	18, 23, 27
Varied thrush	<u>Ixoreus naevius</u>	19, 25
Hermit thrush	<u>Catharus guttatus</u>	Near Willow
Swainson's thrush	<u>C. ustulatus</u>	4, 12, 20, 22, 23
Gray-cheeked thrush	<u>C. minimus</u>	Near Talkeetna
Ruby-crowned kinglet	<u>Regulus calendula</u>	1, 5, 18
Golden-crowned kinglet	<u>R. satrapa</u>	7
Bohemian waxwing	<u>Bombicilla garrulus</u>	13
Northern shrike	<u>Lanius excubitor</u>	McKinley Park
Orange-crowned warbler	<u>Vermivora celata</u>	14
Yellow warbler	<u>Dendroica petechia</u>	McKinley Park
Yellow-rumped warbler	<u>D. coronata</u>	11, 15, 21
Blackpoll warbler	<u>D. striata</u>	2, 9, 13
Northern waterthrush	<u>Seiurus noveboracensis</u>	13
Wilson's warbler	<u>Wilsonia pusilla</u>	15
Rusty blackbird	<u>Euphagus carolinus</u>	14
Pine grosbeak	<u>Pinicola enucleator</u>	Susitna River Crossing
Gray-crowned rosy finch	<u>Leucosticte tephrocotis</u>	9
Common redpoll	<u>Carduelis flammea</u>	7, 15, 20
Pine siskin	<u>C. pinus</u>	9
Savannah sparrow	<u>Passerculus sandwichensis</u>	8, 11, 19
Dark-eyed junco	<u>Junco hyemalis</u>	3, 7, 9, 21, 22, 26
Tree sparrow	<u>Spizella arborea</u>	14, 22
Chipping sparrow	<u>S. passerina</u>	21
White-crowned sparrow	<u>Zonotrichia leucophrys</u>	1, 2, 4, 6, 7, 12, 20, 21, 22, 25, 26
Fox sparrow	<u>Passerella iliaca</u>	1
Lincoln's sparrow	<u>Melospiza lincolni</u>	3, 9, 13, 14

*Site numbers refer to Figure 13
Source: Commonwealth Associates, 1981

Vegetation

The project area is primarily covered by interior forests, muskegs, shrub communities and tundra. The first grouping is a northern extension of the North American boreal forest and is commonly called by a Russian term, "taiga." The latter type is associated with mountains or foothills and the other two are inclusions within or adjacent to the forest.

White spruce (Picea glauca) and paper birch (Betula papyrifera) dominate the drier landscape, while black spruce (Picea mariana) is primarily located on the poorly drained sites. Additionally, balsam poplar (Populus balsamifera) and white spruce develop on the floodplains. Within or adjacent to these areas thirty species of willow (Salix spp.) and several species of alder (Alnus spp.) are often dominant in the understory or in thickets with little or no overstory. Of particular importance in this area is the moss organic layer that usually covers the soil. Its importance lies in regulating the soil temperature (Zasada, 1976).

The southern two-thirds of the project area contains forested areas, while the northern portion consists mainly of open woodland, shrubs and tundra. For comparative purposes, Table 5 illustrates a more comprehensive picture of land cover within the region. The project area includes similar percentages but possesses less glaciers and ice field than is present within the region.

Treeline in Alaska fluctuates with exposure and latitude. The National Park Service (1976) indicated for the Denali area, tundra and forest separate at about 2500 feet (762.5 meters), while TES (1981) stated coniferous forests seldom occur above 3200 feet (975 meters). Also, the mixed forests located in the Susitna Valley, usually on southern exposures, are found below 2000 feet (100 meters) (TES, 1981).

TABLE 5
LAND COVER AND VEGETATION
IN THE INTERTIE
PROJECT AREA

	Susitna Valley ⁽¹⁾	Susitna Unit ⁽²⁾	Susitna Valley ⁽³⁾	
Total	5,610,000Acres	16,490,000Acres		
Forested	3,200,700	4,292,000	Coniferous	19.0%
			Mixed	2.5%
Commercial	1,295,000	2,023,000		
Forest	-	12,190,000		
Non Forest	-		Tundra	24.0%
Dry Meadow	-	2,547,000		
Tall Shrub	-	1,880,000		
			Shrubland	40.0%
Dwarf Shrub	-	1,047,000		
Wet Meadow	-	282,000		
Water	-	162,000		
Urban/Agriculture	-	110,000	Unvegetated	14.5%

(1) Hegg 1970

(2) Hegg and Dippold 1973

(3) TES, 1981

Nomenclature for herbaceous plants follows Hulten (1968), while Viereck and Little (1972) were utilized for woody plants. Common names were extracted from these sources as well as from Welsch (1974) and TES (1981). Additionally, previous studies were utilized in the cover-type discussions to show correlations or other points of interest. These studies and their associated region of study are outlined in Table 6.

During the course of this study plants were usually not collected but were identified in the field. In certain cases, where there were various problems of identification (i.e., Betula nana vs. B. glandulosa) the generic term was often utilized (TES, 1980 and Viereck, 1966).

Land Cover Types

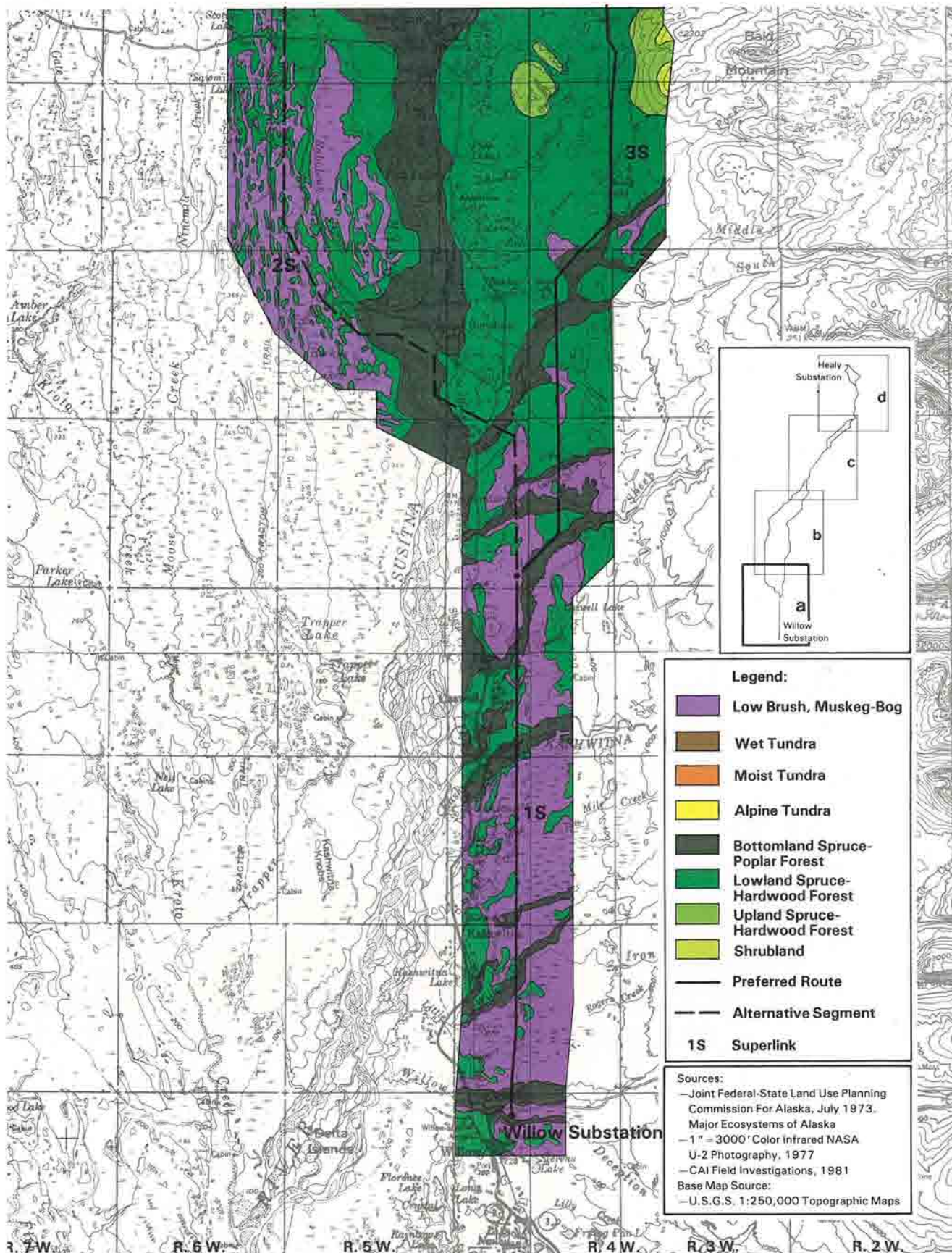
While the vegetation of an area can usually be described in a number of ways, for a project of this magnitude, the system developed by the Joint Federal State Land Use Planning Commission (1973) was utilized. Figure 14a,b,c,d, an adaption from their document, portrays the major vegetation types (land cover) within the project area. However, it has been modified to correlate with more recent information such as the map presented in the National Park Service (1976) document.

This figure has been prepared at a large scale so many of the finer definitions of community types (i.e., dense or open forests) apparent in the field have been lost. Also, small inclusions (i.e., forested islands in muskeg areas) have been grouped or omitted. Field conditions often show a mosaic pattern and many gradients are present, but for illustrative purposes the figure presents a basic representation of vegetation types as they exist in the project area. Because of this approach the ecological study sites described in Appendix C may encompass several vegetation types, although portrayed on Figure 14a,b,c,d as a single type. It should also be considered when reviewing Appendix D, where a series of Tables A-M compares Intertie vegetation studies with others, that some

TABLE 6
VEGETATION STUDIES DONE IN ALASKA
AND THEIR GEOGRAPHIC LOCATION

<u>Author</u>	<u>Location</u>
National Park Service (1976)	Denali National Park Area
Viereck and Little (1972)	Alaska
La Roi (1967)	Boreal Spruce-fir forest monograph (several sites in Alaska)
Woodward-Clyde (1979)	Healy Area
TES (1981)	Susitna Valley
Hettinger and Janz (1974) ⁽¹⁾	Northeast Alaska
Neiland and Viereck (1977)	Alaska
Dyrness and Grigal (1979)	Fairbanks Area
Viereck (1970) ⁽¹⁾	Fairbanks Area
Hanson (1953) ⁽¹⁾	Northeast Alaska
Shelton (1962)	Denali National Park

⁽¹⁾ Referenced in TES (1981)



Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Vegetation Cover Types

5 10 Miles
5 10 Kilometers



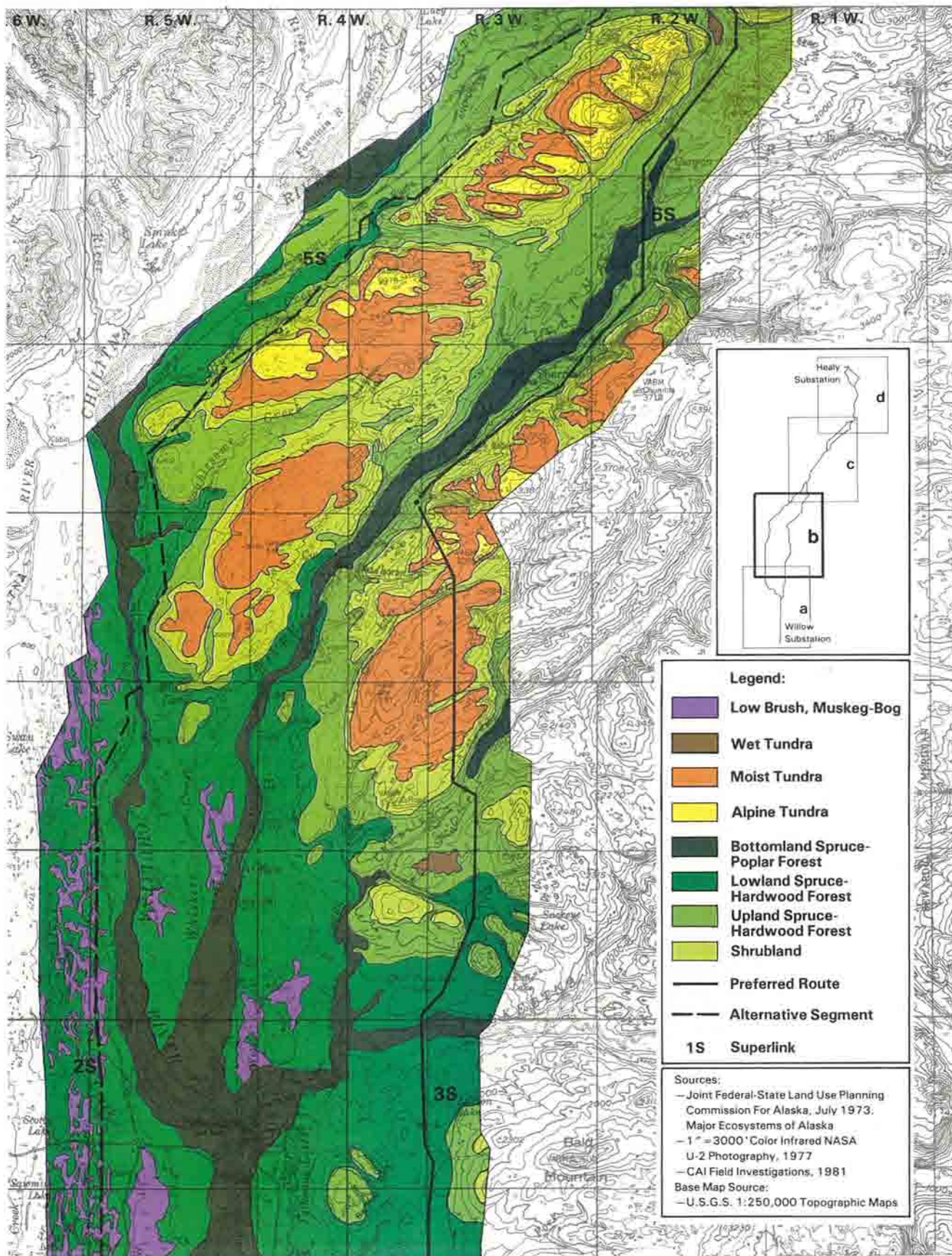
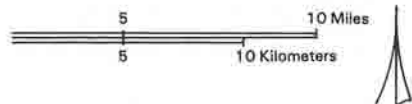
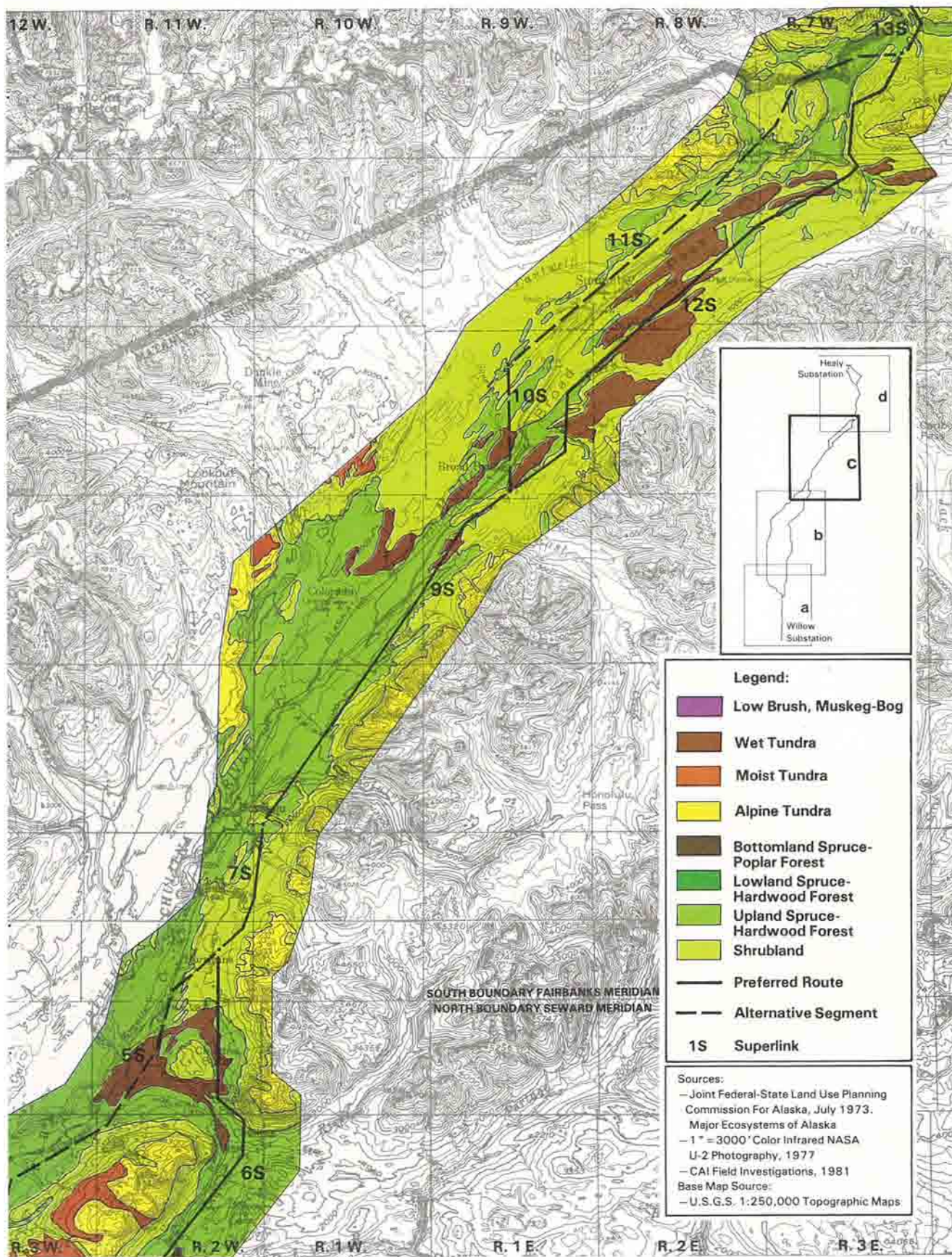


FIGURE 14b

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Vegetation Cover Types





Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Vegetation Cover Types

0 5 10 Miles
0 5 10 Kilometers

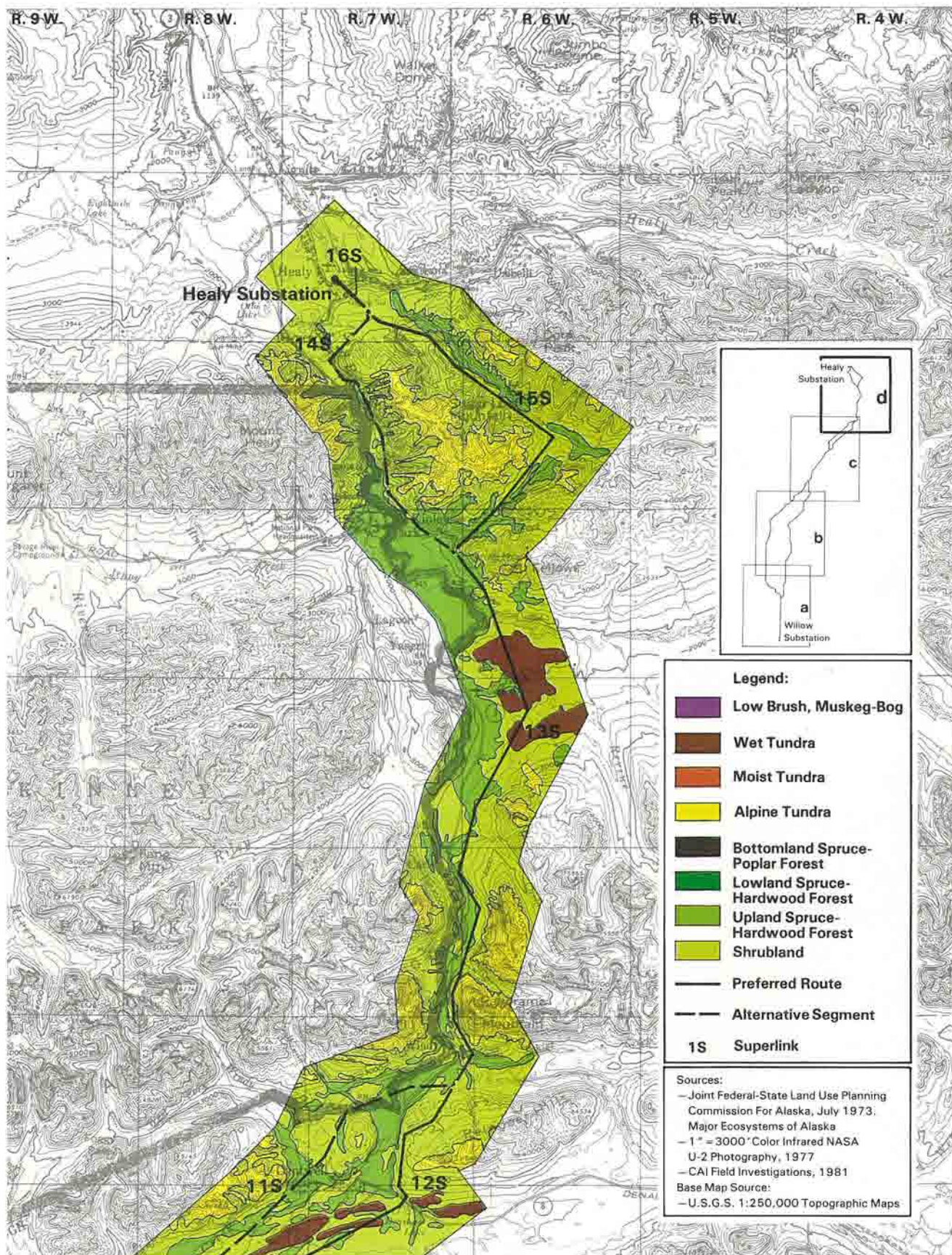
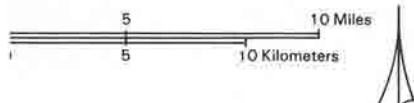


FIGURE 14d

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Vegetation Cover Types



researchers did not list many herbaceous plants or only listed important ones based on quantitative studies. Season of study will also influence species presence. The present study was purely qualitative in nature and many of the less "important" species were also recorded. Also included as part of Appendix D tables were subtypes, such as paper birch forests (Table D), which are part of the upland spruce-hardwood cover type. Appendix E lists species observed in the project area.

Bottomland Spruce-Poplar - This cover type is of primary importance in the floodplains within the project area but is occasionally found in small clumps at or near tree line. Possibly, both species (or subspecies) of poplar (balsam poplar; Populus balsamifera and black cottonwood; P. trichocarpa) are found within the project area but black cottonwood is restricted to the lower reaches of the Susitna River drainages and coastal areas. Without the seed capsule it is virtually impossible to differentiate between the two. Viereck and Little (1972) indicate that identification should be based on location, hence balsam poplar is used exclusively in this report.

White spruce is commonly associated with balsam poplar, although in many stands it may only be present in the understory. In other areas however, white spruce may dominate or be associated with black spruce. Also, black spruce may dominate specific stands. The mixed spruce stands encompass all phases of succession (Neiland and Viereck, 1977).

The understory may be quite dense in the balsam poplar stands (Viereck and Little, 1972), but in the spruce stands the shrubs and herbs decrease because of the increased depth of the organic layer (Neiland and Viereck, 1977). With this organic layer, which delays permafrost, and the frequent flooding, which adds nutrients, these floodplain areas become quite productive. This is particularly true of balsam poplar, as it may only account for 9.3 percent of the commercial forest in the Susitna Valley, but its volume per acre is comparatively high (Hegg, 1978).

Common plants in all the types vary somewhat with region. For instance, TES (1981) studied a bottomland spruce-poplar forest (Table A) but more of their species correlate with the bottomland spruce species listed on Table B. These two tables indicate some widespread species; Viburnum edule in the mixed forests and Vaccinium uliginosum in the conifer forest, and some restricted species. The two tables indicate the diversity that exists in the field when different regions are compared.

Ostrich fern, noted by Viereck and Little (1972) to be abundant in the Susitna Valley, was observed to take up large areas in several locations (sites 4 and 6) studied during field investigations. Interestingly, it was not listed in a floodplain forest studied by TES (1981). This provides further evidence for plant diversity based on local site conditions.

Lowland Spruce-Hardwood - According to the literature the lowland spruce-hardwood areas are composed of both spruces, tamarack and white birch, however, tamarack was not observed in the project area. This type is located on poorly drained lowlands many of which are located adjacent to the floodplain (bottomland) forest. Dominant species are usually black spruce and white birch. This cover type is generally categorized as noncommercial forest land. The black spruce areas often have many stems per acre which seldom exceed eight inches in diameter. Viereck and Little (1972) indicate a tree only two inches in diameter may often be 100 years old. In the report prepared by Hegg (1978) for the Susitna Valley, the lowland spruce-hardwood cover type is slightly greater in areal extent than the commercial forest land. Many researchers have mentioned standing water being present as well as an abundance of moss in a well developed organic layer, and permafrost. Often tussocks of cotton grass are evident on the landscape, especially in the very wet open stands. Tall shrubs (alders and willows) may be present but the lower layers are more important from the standpoint of coverage. Very often a continuous cover is provided by shrub birches and ericaceous shrubs.

Dyrness and Grigal (1979) studied an interior slope spruce forest and documented seven vegetation units that were strongly related to various site factors. Common species from two of the lower elevational units are listed in Table C along with species from other studies and three sites included in the field studies. No single species is common to all sites, although black spruce was documented in most. Several species on this table, for example Empetrum nigrum, are also common in other types (Tables E and I); consequently some species can be considered almost ubiquitous. Lowland spruce-hardwoods are scattered throughout the project area but are concentrated in the lower part of the project area along links 1s, 2s and 3s.

Upland Spruce-Hardwood - Within the project area characteristic species of upland spruce-hardwood cover types include spruce, balsam poplar and birch. Aspen, an associate noted in the literature, was occasionally observed but was only recorded at two locations (sites 22 and 23). Apparently aspen occurs in the Broad Pass area and north. Balsam poplar was recorded at only one upland site (15). The upland spruce-hardwood type, although similar to the bottomland spruce-poplar type in overstory species composition, is located at higher elevations.

While white spruce is generally the most abundant, it is usually found on south facing slopes and well-drained soil. Conversely, black spruce is located on north facing slopes and poorly drained flat areas. The hardwoods, especially paper birch, are generally found with white spruce, although even the spruces sometimes are found together. Neiland and Viereck (1977) indicate there is argument as to the climatic role of white spruce with some authorities considering it climax, while others feel it will be replaced by black spruce and bog even on the uplands.

Many commercial stands are located within the upland spruce-hardwood type and Hegg (1970) reports, for the Susitna Valley, that the best stands are located between 400-1200 feet elevation. Furthermore, 25.8 percent of the

commercial forest in the valley is classed in the white spruce type, while paper birch comprised 63.5 percent (Hegg, 1970).

Viereck and Little (1972) indicate paper birch is especially abundant in the Susitna Valley. They listed some associates including both spruces and many shrubs which compared somewhat well with the species listed in Table D. Hegg (1970) indicated that there is no trend toward spruce dominance in the valley and that openings were filled with grass and brush. Neiland and Viereck (1977) refined this observation by indicating that Calamagrostis canadensis was dominant in the openings with scattered Rosa acicularis and Viburnum edule. Viburnum edule and Vaccinium vitis-idaea were the species cited by most researchers (Table D) and by Viereck and Little (1972). The vegetation data gathered for the Intertie study seems to correlate most closely with the surveys performed by the U.S. Fish and Wildlife Service, Northern Office of Ecological Services (Table D).

Mixed forests (paper birch and white spruce subtype) have a well developed ground layer with Calamagrostis canadensis and Equisteum silvaticum abundant, while in the more open stands shrubs such as Salix novae-angliae and Vaccinium uliginosum are common (TES, 1981). Table E compares the species listed in the literature as well as from the present study. Widespread plants include Vaccinium spp., Empetrum nigrum, Spirea beauverdiana, Linnaea borealis and others. Three sites (5, 15 and 22) are located within this subtype.

Neiland and Viereck (1977) reported that mixed spruce stands are a complex vegetation pattern which has developed because of fire and topography. They further indicated these stands covered 19 percent of the state and were lower in productivity than the bottomlands. Common shrubs, according to Neiland and Viereck (1977), are similar to those in bottomland spruce stands (See Table B), however, the following three shrubs increase in abundance in black spruce stands: Ledum groenlandicum, Vaccinium vitis-idaea and V. uliginosum.

In the northern portion of the project area, the mixed spruce forests are open and park-like with an abundance of shrubs. Only in the alluvial areas (see Bottomland Spruce-Poplar) do they normally form the dense canopy that is usually attributed to spruce forests. Site 14 (Table E) is an example of an open surface forest which occurs in the middle portion of the project area at about 1700 feet in elevation. At higher elevations in the Denali area this type of forest is also present. Since the open spruce forest approaches treeline (2500-3000 feet), Table F presents a comparison of several studies from this perspective. Shelton (1962) indicated that treeline, based on species distribution, is not a sharp boundary.

Table G lists the species associated with these habitats. Because site conditions vary so widely, few species are common to all areas.

Black spruce (Picea mariana), according to Neiland and Viereck (1977), occurs in uplands, lowlands and slopes. These stands primarily differ from others in development of the deepest peat layer. Table H summarizes species lists of black spruce stands from several studies and indicates Ledum groenlandicum common to all sites. Neiland and Viereck (1977) indicate it is a complex and highly variable type.

Shrubland - Shrubland is usually associated with floodplain areas or near tree line. The former category is usually linear in nature while the other is somewhat broader but forms a transition zone between forest and tundra. In areas near tundra, if openings are present, characteristic tundra species will occur.

Neiland and Viereck (1977) described the successional trends for floodplain areas and indicated one general sequence occurs throughout the Alaskan taiga. However, some species may differ between regions. The sequence is initiated with the establishment of willow and alder shrub thickets with some

openings colonized by herbaceous plants (Moehringia lateriflora, Pyrola asarifolia and Carex garberi). Usually after 15 to 20 years balsam poplar seedlings have grown to form an open woodland but in some cases, due to physical constraints of the river, shrublands persist. Site 20 on Table I enumerates the species observed on one floodplain shrubland in the project area.

Extensive low shrublands occur on fairly level benches and are concentrated and abundant in the northern portion of the project area. TES (1981) reported shrublands were the most prevalent type in their project area. This type is also abundant in northeastern (Hettinger and Janz, 1974) and northwestern Alaska (Hanson, 1953). Shrublands are quite variable in the amount of cover and gradations that occur between birch and willow with the latter being concentrated in wetter areas. The important species noted in the literature and for Intertie project sites 8, 12 and 15 are presented in Table I.

Table I indicates that some of the areas studied are similar in species composition, for instance the NPS upland bogs and site 12. Also present on site 12 were stunted black spruce and Myrica gale; further indications of a bog.

Site 15 corresponds to a tall thicket community, a subtype mentioned by TES (1981). TES indicated Alnus sinuata dominated areas usually found on steep slopes above rivers. Their findings correlated closely with our observations in that Calamagrostis canadensis and Equisetum (they found E. sylvaticum) were abundant. Ribes spp. were also observed. In relation to other regions in Alaska, Hanson (1953) reported Calamagrostis canadensis was dominant and Spiraea beauverdiana, Vaccinium uliginosum and Betula spp. were important. Shelton (1962) indicated that few if any vascular plants were confined to the shrub zones on mountain slopes. Many of the species Shelton noted in his studies in Denali National Park also appear in Table I. In summary, he indicated these shrub areas occur over large expanses, in many open lowland areas and on mountain slopes.

Tundra - Within the tundra cover type, wet, moist and alpine tundra subtypes are interspersed in the project area. The differences are related to topography, slope, aspect and substrate. The moist tundra is found in the foothills and lower elevations of the mountains within the area, while alpine tundra is found at the higher elevations. Wet tundra is usually found in areas with no relief and shallow lakes such as Broad Pass (NPS, 1976). Quite commonly the moist and wet tundra are dominated by sedges, usually in tussocks, but with occasional willows and dwarf birch, while alpine tundra may be primarily barren with local populations of white mountain-avens, low heath shrubs, prostrate willows and dwarf herbs.

The TES (1981) study further divided tundra into several subtypes. The wet sedge/grass subtype apparently is the result of beaver activity and the herbaceous/sedge subtype appeared near glaciers. The mesic sedge/grass tundra described by TES occurred on rolling uplands (Carex bigelowii dominant), while the herbaceous/alpine tundra communities consisted of scattered individuals of Carex bigelowii. The mat and cushion tundra was found at higher elevations on dry windy ridges and was dominated by lichens and low shrubs. Common species to the TES study and other studies are tabulated in Table J and K. Not shown on the table was site 25 which was tundra interspersed with low shrublands. Betula spp., Dryas spp. and Diapensia lapponica were also present on site 25. Species from sites 10 and 19 are tabulated on Table J and represent gradations with low shrublands. Dryas and Empetrum seem to be the most widespread species.

Dryas octopetala was also highest in cover values on the south tundra slopes studied by Shelton (1962). He listed many other species several of which are not representative of the alpine tundra in the region. He attributed this to the possible presence of limestone in the substratum.

On the north slopes Shelton found more favorable growth conditions due to the importance of Cassiope, mosses and numerous other species. Cassiope is not

noted in Table J but was recorded on Table K and from treeline on site 26. As was stated previously, when considering species distribution, treeline is not a sharp boundary. The primary factor in limiting species distribution in these areas is probably moisture (Shelton, 1962). Species common to both Shelton's study and Tables J or K include Mertensia paniculata, Silene acaulis, Arctostaphylos alpina and Myosotis alpestris.

Low Brush, Muskeg-Bog - The low brush, muskeg-bog cover type is located within the boreal forest where local conditions are too wet for tree growth. Sphagnum mosses are especially abundant but are associated with grasses, sedges and some forbs. Viereck and Little (1972) list common shrubs and most belong to the heath, birch and willow families.

Often associated with the muskeg are islands or fringes of spruce/birch which occupy a distinctly better drained site. These islands are much too small to appear in Figure 14, but were quite evident in the field.

Many of the bogs within the project area exhibit a pattern of linear ridges which are oriented across the major slope. Drury (1956) indicated similar bogs occur across Eurasia and North America. In other areas of Alaska they may be more abundant as Drury indicates several thousand square miles of these bogs are located along the Tanana River south of Fairbanks, and he presents a rather complete floristic list of the bogs.

Neiland and Viereck (1977) also cited Drury's work but mentioned that Calmes (1976) identified three major types of bogs: sphagnum bogs, sedge/grass bogs and cottongrass bogs. These three, along with selected study sites are tabulated in Table L. Some correlations can be drawn between the sites. The major concentration of this type is along link 1s but other small areas are located throughout the project area.

Aquatic Plants, Stream Sides - Only freshwater systems exist within the project area with two major types, lacustrine (lentic) and riverine, being represented. The former would represent ponds and lakes, while the latter pertains to streams and rivers. Floating and submerged plants are much more common in lakes and ponds while emergent vegetation would be common to both. As the stream velocity increases, however, aquatic plants would decrease and eventually be restricted to emergents near the shore. Also, bogs and other cover types previously discussed contain aquatic or semiaquatic plants.

According to Viereck and Dyrness (1980) much work needs to be done on this category in Alaska. Consequently, this discussion is somewhat limited. Several ponds within the project area contain yellow pond lily and several sites (5, 8 and 11) observed (Table M) contained aquatic habitats. The streams (site 11) were fringed with alders and willows as were many of the ponds. A wet meadow, located below a beaver dam at site 8 contained many sedges, grasses and forbs. Another streamside meadow (site 5) was also observed.

Threatened and Endangered Species - Since the passage of the Endangered Species Act of 1973, approximately 60 plants have been officially listed by the U.S. Fish and Wildlife Service (USFWS). None of these occur in Alaska. However, many plants are currently under study (USFWS, 1980) and have been placed in various provisional categories. Consequently, they have become candidates for possible listing and the service indicates they should be considered in environmental planning (USFWS, 1980).

Table 7 lists the candidate taxa identified by the USFWS for Alaska. Initial review by the USFWS Anchorage office (Emerol, 1981 and Benson, 1980, personal communications) ascertained two could occur in the area; Smelowskia borealis var. villosa and Taraxacum carneocoloratum. Further consultation (Allan

TABLE 7
PLANT SPECIES CONSIDERED FOR
LISTING AS ENDANGERED OR THREATENED⁽¹⁾

<u>Species</u>	<u>Recommended Status</u>
<u>Cryptantha shackletteana</u>	Endangered
<u>Mertensia drummondii</u>	Endangered
<u>Eriogonum flavum</u> var. <u>aquilinum</u>	Endangered
<u>Oxytropis kobukensis</u>	Endangered
<u>Polystichum aleuticum</u>	Endangered
<u>Salix ovalifolia</u> var. <u>glacialis</u>	Endangered
<u>Smeloskia pyriformis</u> ⁽²⁾	Endangered
<u>Artemisia aleutica</u>	Threatened
<u>Artemisia senjavinensis</u>	Threatened
<u>Aster yukonensis</u> ⁽²⁾	Threatened
<u>Cares Jacobi-peteri</u>	Threatened
<u>Podistera yukonensis</u> ⁽²⁾	Threatened
<u>Oxytropis kokrinensis</u>	Threatened
<u>Montia Bostockii</u> ⁽²⁾ (prev. <u>Claytonia</u>)	Threatened
<u>Erysimum asperum</u> var. <u>angustatum</u>	Threatened
<u>Erigeron muirii</u>	Threatened
<u>Smelowskia borealis</u> var. <u>villosa</u> ⁽²⁾	Threatened
<u>Taraxacum carneocoloratum</u> ⁽²⁾	Threatened
<u>Thlaspi arcticum</u>	Threatened
<u>Draba muirii</u>	Threatened

(1) U.S. Fish and Wildlife Service, 1980

(2) Primary candidate species studies by TES

Batten, University of Alaska, 1981, personal communication) reaffirmed these species. Montia bostockii was added because of its habitat, although it was not known to the area. Mention was also made of Lysimachia ciliata a species newly added to the flora of Alaska.

The TES study (1981) included ten species for consideration and based the list on Murray (1980). Five species on which they concentrated occurred in alpine areas with two being located on calcareous substrates. Two other species are located in riparian areas, on rocky slopes (southern exposure) or low grasslands. The three remaining species, which they mentioned only as a possibility, are known from the Upper Yukon River and Eagle, Alaska. Six of the seven primary species are identified on Table 7. The other, Papaver alboroseum, is no longer being considered by the USFWS as a candidate (USFWS, 1980).

Primary emphasis was placed on discussions with the USFWS and the University of Alaska on defining the list of potential species. Both plants mentioned by the service, and the one added by the university, occur in alpine areas. Several of these representative areas were studied. Geological maps were consulted for appropriate rock exposures to locate habitat for the plants which are associated with calcareous areas. These areas are identified on Figure 13.

Fisheries

Aquatic resources within the project area will vary among different habitat types. The fisheries resources, generally thought to be the most important component of the aquatic system, is the trophic level most exploited by man. Therefore, this discussion will center on the fisheries of this area of Alaska. The Susitna River Basin and portions of the Nenana River Basin are important spawning grounds for the anadromous Pacific salmon as well as several common riverine species. These are fisheries of extreme economic importance for they support not only a commercial industry, but large sports fisheries and, to a lesser extent, subsistence fishing. Human harvest is not the sole use of this resource, as several species of wildlife depend upon the annual salmon runs for their existence.

The project area is situated in portions of two large river systems (Figure 1). Approximately 80 percent of the area lies within the Susitna River Basin to the south with the remaining 20 percent within the Nenana River Basin in the north. The watershed divide lies in Broad Pass. Each basin has similar habitat types; both containing riverine and lacustrine systems. The Nenana River flows north into the Tanana River at Nenana; the Susitna River flows south into Cook Inlet downstream from the project area. This orientation of the drainage patterns has given rise to somewhat different composition of the watersheds' respective fisheries. Table 8 lists the 25 species of fish reported by Morrow (1980) and McPhail and Lindsey (1970) to include the project area in their distribution: 21 from the Susitna River Basin and 15 from the Nenana River Basin. The proximity of the ocean, immediately to the south of the project area, allows several species of euryhaline fish such as the smelts, threespine stickleback and the coastrange sculpin to invade the lower reaches of the project area.

Susitna River Basin

Large rivers such as the Susitna River, Talkeetna River and Chulitna River serve as major migration corridors for anadromous species of Pacific salmon. The upriver migrations return these species to their natal streams where they conduct spawning activities. Generally, for the Pacific salmon as a group, spawning runs begin in May and June and continue into September. The returning fish migrate into such streams as Willow Creek (site 1), the Kashwitna River, Sheep Creek, Montana Creek, Troublesome Creek and Chuniilna Creek (site 6) to appropriate spawning facilities of fast moving currents and gravel substrates.

TABLE 8
FRESHWATER FISH FOUND IN THE SUSITNA RIVER AND NENANA RIVER BASINS
IN THE VICINITY OF THE INTERTIE¹

Arctic lamprey	<u>Lampetra japonica</u>	S ²	-
Pacific lamprey	<u>L. tidentata</u>	S	-
Alaska whitefish	<u>Coregonus nelsoni</u>	-	N ³
Least cisco	<u>C. sardinella</u>	-	N
Pink salmon	<u>Oncorhynchus gorbuscha</u>	S	-
Chum salmon	<u>O. keta</u>	S	N
Coho salmon	<u>O. kisutch</u>	S	N
Sockeye salmon	<u>O. nerka</u>	S	-
Chinook salmon	<u>O. tshawytscha</u>	S	N
Round whitefish	<u>Prosopium cylindraceum</u>	S	N
Inconnu	<u>Stenodus leucichthys</u>	-	N
Rainbow trout	<u>Salmo gairdneri</u>	S	-
Dolly Varden	<u>Salvelinus malma</u>	S	N
Lake trout	<u>S. namaycush</u>	S	N
Arctic grayling	<u>Thymallus arcticus</u>	S	N
Pond smelt	<u>Hypomesus olidus</u>	S	-
Surf smelt	<u>H. pretiosus</u>	S	-
Ealachon	<u>Thaleichthys pacificus</u>	S	-
Northern pike	<u>Esox lucius</u>	S	N
Lake chub	<u>Couesius plumbeus</u>	-	N
Longnose sucker	<u>Catostomus catostomus</u>	S	N
Burbot	<u>Lota lota</u>	S	N
Threespine stickleback	<u>Gasterosteus aculeatus</u>	S	-
Coastrange sculpin	<u>Cottus aleuticus</u>	S	-
Prickly sculpin	<u>C. asper</u>	S	N

¹Source: Morrow, J. E. 1980. The freshwater fishes of Alaska. Alaska Northwest Publishing Company, Anchorage, Alaska.
McPhail, J. D. and C. C. Lindsey. 1970. Freshwater fishes of northwestern Canada and Alaska. Fisheries Research Board of Canada, Bulletin 173.

²S - denotes occurrence in the Susitna River Basin

³N - denotes occurrence in the Nenana River Basin

Late in the year as the ambient temperatures drop, the glaciers melt at a increasingly slower rate until they finally freeze up. As a result the turbidity from glacial silt begins to improve. As the smaller streams begin to freeze, fish will move down into the Susitna River and more suitable habitat for the winter. Early spring again finds these watercourses used as migration routes as the salmon smolt and subadults undertake their seaward migration and early spring spawners such as the rainbow trout, Dolly Varden and Arctic grayling undertake their upstream migrations.

By far the most abundant type of habitat found in the project area is the smaller rivers and streams. These streams are characterized by swift currents, gravel bottoms, and high water quality (high dissolved oxygen and low silt loads). These conditions were found at sites 2, 3, 11, 12, 13, 15 and 16. In addition many more were observed from the air throughout the project area. These watercourses are utilized throughout much of the year by both the anadromous and resident species. Anadromous fish use these areas for spawning and/or early life maturation, whereas the resident species spend their entire life within this habitat type. Resident species found in these streams include: Arctic grayling, rainbow trout, Dolly Varden, whitefish, longnose sucker, sculpin and burbot.

Table 9 lists the streams of the Susitna River Basin known within the study area to be used by the five species of Pacific salmon (genus: Oncorhynchus), and their value as spawning habitat (ADFG, 1978). This table is not a definitive listing of important watercourses in or near the project area for the Pacific salmon. They represent the watercourses that have been documented as to their value. The ADFG feels that virtually all streams in this area contribute to the anadromous fishery (Watsyold, ADFG 1981, personal communication). Many of these streams are protected by statute under the Anadromous Fish Act (Alaska Statute 16.05.870), also known as Title 16. Appendix F lists the watercourses crossed by the various alignments for the Intertie project and are indexed by route.

TABLE 9
KNOWN FISH HABITAT (SPAWNING AND OTHER) FOR THE GENUS ONCORHYNCHUS
IN THE INTERTIE PROJECT AREA¹

	Chinook	Sockeye	Coho	Pink	Chum
Susitna River	*	*	*	*	*S
Willow Creek	*S	*	*	*S	*
Little Willow Creek	*S	*	*S	-	-
Kashwitna River	*	-	*	-	*S
North Fork Kashwitna River	*S	*S	-	-	-
Caswell Creek	*	-	-	-	-
Sheep Creek	*S	-	-	*	*
Goose Creek	*S	-	-	*	-
Montana Creek	*	-	-	*S	*S
Sunshine Creek	-	-	*S	-	-
Question Creek	-	-	*S	-	-
Birch Creek	*	*S	*S	*S	*S
Trapper Creek	*	-	*S	-	-
Rabideux Creek	-	-	*S	-	-
Talkeetna River	*	*	*	*	*S
Chulitna River	-	*	*	-	*
Chunilna Creek	*	-	*	*	*S
Wiskers Creek	*S	-	*S	-	-
Troublesome Creek	*S	-	*S	-	*S
Tokositna River	*	*	-	-	-
McKenzie Creek	-	*S	-	-	-
Spinks Creek	*	*	-	-	-
Byers Creek	*S	*	*S	-	*S
Byers Lake	-	*S	-	-	-
Gold Creek	-	-	-	*	-
Indian River	*S	-	*S	*	*
Salmon Creek	*	-	*	*	*

¹Source: Alaska Department of Fish and Game. 1978. Alaska's fisheries atlas, volume I. State of Alaska. Juneau, Alaska, USA.

* - denotes an occurrence of fish species in a watercourse
S - denotes use as spawning habitat

These watercourses are located by the township, range and section of their mouths and are designated if they are afforded protection under Title 16. The ADFG at the time of this writing is in the process of updating this list which is a continuous process based, in part, on field investigations.

There are many small deeply incised streams that cascade down out of the Talkeetna Mountains in the east and along both sides of Curry Ridge. These streams are generally intermittent with their flow closely associated with the snow melt at higher elevations and therefore do not support a significant fish population.

Lacustrine habitat is abundant in the Susitna River Basin in the form of lakes and ponds. They range in size from a couple of acres to several hundred acres. Generally, the lakes support a somewhat diverse fish population consisting of Dolly Varden, whitefish, rainbow trout, suckers, burbot and occasionally northern pike. Lakes, such as Byers Lake, that are part of a river system will serve as nursery grounds for Pacific salmon, the sockeye salmon, in particular. For example, Larson Lake and its tributaries support an isolated population of sockeye salmon (kokanee salmon). The ADFG has an ongoing program of stocking lakes with game fish. Within the project area both Christiansen Lake and Benka Lake are stocked with coho salmon.

The project area has countless small ponds, both natural and beaver constructed. A high density of these ponds are found in the southern half of the project area and along the major rivers. They are characterized by shallow depth aquatic vegetation, and warm water temperatures during the summer months. This type of habitat was typical of that found at sites 5, 8, 9, 11, 13 and 14. These ponds are conducive to a large standing crop of benthic organisms and as a result are used as nursery areas for young fish which feed on these invertebrates and use the vegetation for cover. During the winter when the ponds freeze, the fish are forced to areas of flowing water such as inlets, outlets, the stream thread (especially in beaver ponds) or they retreat to deeper waters.

Nenana River Basin

The Nenana River in the northern portion of the project area flows north into the Tanana River. Remoteness from the ocean limits this portion of the basin as anadromous fish habitat. Morrow (1980) indicates that three species of Pacific salmon are found in the Nenana River Basin (Table 8), but the ADFG (1978) lists no watercourses in the project area as important to these species or providing significant spawning habitat. However, the river does have seasonal migration of Coregonids and possibly the inconnu (Alt, 1969). The smaller rivers and streams such as the Jack River, Yanert Fork, Cantwell Creek, Riley Creek and Healy Creek (site 27) all provide access to spawning habitat. Appendix F lists the waters that may be crossed by the Intertie and their status under Title 16 as waters important for the spawning and migration of anadromous fish. Although there are very few streams (Title 16 streams) designated in the Nenana River Basin, most of the streams that are accessible and have appropriate spawning habitat, support spawning runs of resident species such as the Dolly Varden, round whitefish and Arctic whitefish. A number of small streams cascade down out of the mountains along both sides of the project area. These streams have seasonal flow much of which is derived from snowmelt at higher elevations. As stated above, these streams are too intermittent and steep to support a significant fish population.

The lacustrine habitat in the Nenana River Basin is restricted to a series of small lakes and ponds. The majority of which lie in the Nenana River valley. These lakes appear to receive their inflow from runoff and ground water, and for the most part remain isolated from each other and the riverine systems. An exception to this is the lakes in Broad Pass. These lakes (Summit, Edes, Mirror and several others) are all interconnected by small streams which in turn flow into Cantwell Creek. Fish found in this series of lakes include Arctic grayling, whitefish, lake trout and burbot.

There are also many beaver ponds at the lower elevations along the Nenana River valley and in Broad Pass. These ponds such as those found at site 18 provide the same basic functions as discussed in the previous section.

The small lake at site 19 and small ponds at site 25 are all above the tree line. The lake at site 19 exhibited some aquatic vegetation around the shore and appeared deep from the air. Although no fish were observed, the habitat could support an isolated fishery. The small ponds at site 16, however, are very shallow. Success of a fishery in these ponds are extremely limited as they will completely freeze during the winter months.

LAND USE

Contacts were made with federal, state, regional and borough agencies to obtain land use and land ownership information pertinent to the project area and to become aware of those constraints that would be encountered in the routing process.

The disparate functions of the various agencies suggested some would be sources of information only, while others would be involved in the actual routing process. Contacting agencies was an ongoing process up to the time of final route selection.

Comments were also received from the private sector as the result of newspaper announcements, APA publications, maps distributed throughout the project area, public meetings and word of mouth, and have been incorporated into the routing process wherever appropriate.

Updating land use was also required and was primarily concerned with obtaining the precise location of all additional residences, roads and airstrips not displayed on project area USGS maps. This was accomplished by using 1977 aerial

photography in conjunction with 1981 field trips. The field trips were designed to locate any development either not present or not seen on the aerial photography. Field inspection was accomplished through the use of helicopter, automobile, railroad and river rafts.

Land use between Montana and Willow is sparse with a Matanuska Electric Association right-of-way located several miles east of the Parks Highway. Some vacant and low density residential lands along Fishhook Willow Road (Hatcher Pass Road) are also present.

Land use east of Talkeetna and Chase is dominated by the land disposals of Chase II, Unit IV Subdivision, Talkeetna Agricultural lands, Talkeetna Bluffs, East and West Talkeetna Bluffs Additions (1983) and small residential tracts at Emil Lake, Papa Bear Lake and along the Talkeetna River as shown in Figure 15. Both Chase II, Unit IV and the West Talkeetna Bluffs Addition are platted with the latter's master plan being approved and ready for disposal once the Intertie project has been accepted (Alaska Department of Natural Resources [ADNR], Division of Forest, Land, and Water Management, 1981). The East Talkeetna Bluffs Addition (1983) also has an approved master plan with final land disposal pending the new capital relocation. If the capital is relocated at Willow, this addition will become a remote parcel and not a disposal (ADNR, Division of Forest, Land and Water Management, 1981). Parcels within the Talkeetna Agricultural Disposal are available for agricultural use. There are presently a few homesteads around Larson Lake. However, there is the possibility that the Larson Lake residents could develop the lake for residential recreation (Matanuska-Susitna Borough, 1981). Homesteading is also occurring along Montana Creek. There are five landing strips in the Talkeetna area. The two within the village of Talkeetna are registered in Supplement Alaska (National Oceanic and Atmospheric Administration, March 1982).

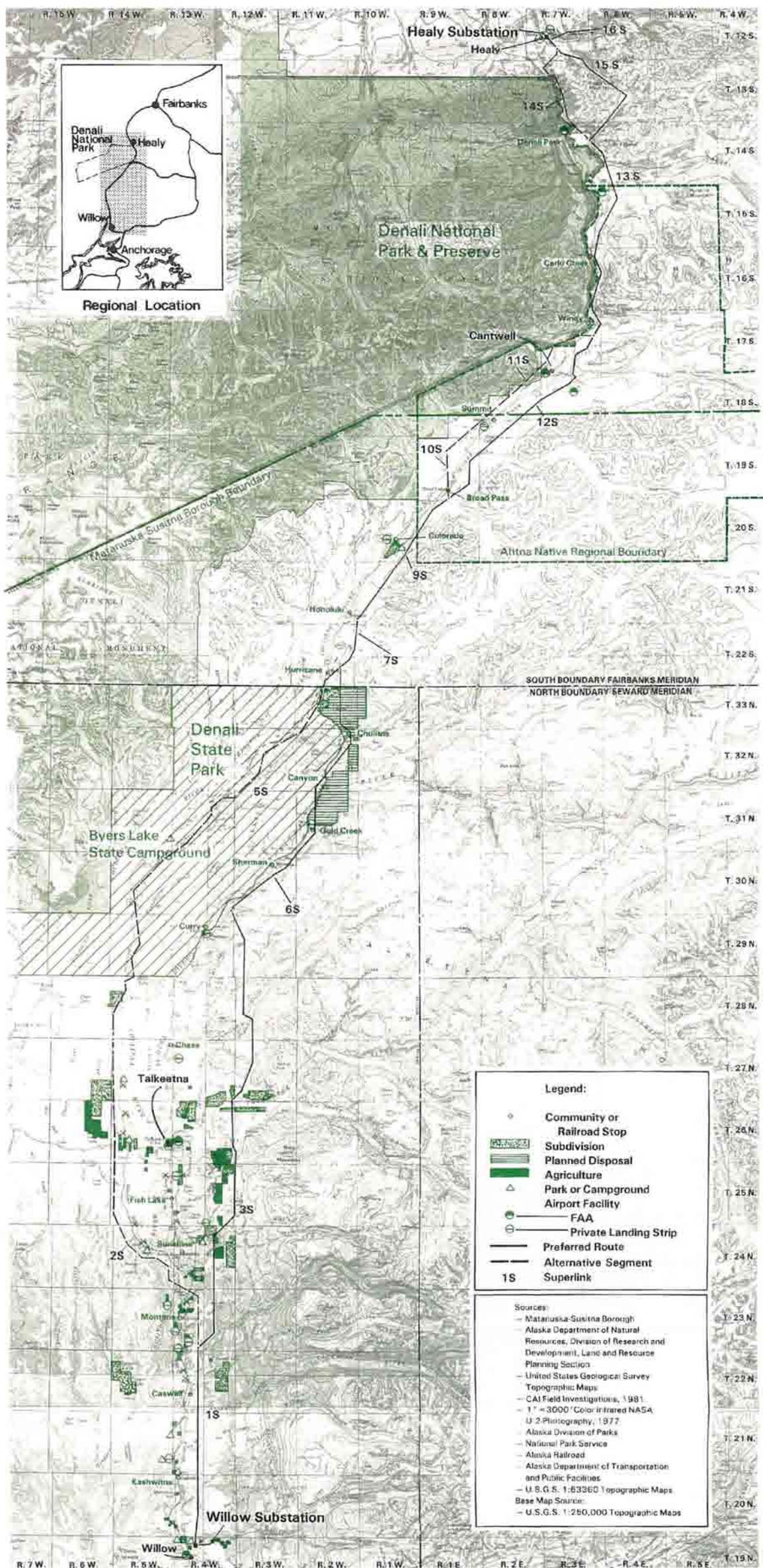
Residential and commercial land uses west of Curry Ridge occur quite frequently in the area and along Petersville Road in the Trapper Creek area. Four

private landing strips and a Supplement Alaska registered airport are located in the Montana area. There is some scattered residential land use along the Parks Highway and Chulitna River within Denali State Park. The areas of principle concentration are the Mountain Haus area, Indian River Disposal, the Division Creek area and the Tokosha Roadless Area, where residents desire to keep the land in a natural, pristine condition. This area also has Byers Lake State Campground and hiking trails leading from Byers Lake State Campground to Curry Ridge and from Troublesome Creek to Byers Lake.

Land use east of Curry Ridge along the Alaska Railroad includes the Indian River Land Disposal and the Indian River Remote Parcel. Both are recreation oriented. The Disposal is surveyed into 5 acre lots having utility easements. Only a limited amount of residents remain the year round. The Disposal is within the Talkeetna Mountains Special Use District, which requires the residents to get a permit before constructing a residential or recreational dwelling. The Remote Parcel will have only a specific number of residents able to obtain lots ranging between 5 and 40 acres (ADNR, Division of Forest, Land and Water Management, 1981). Homesteading is occurring along the Alaska Railroad i.e., Chulitna and Gold Creek, the Susitna and Indian Rivers. There are two landing strips at Gold Creek, one at Curry and at Chulitna. All are private.

Land use between the Middle Fork and East Fork of the Chulitna River and along the Chulitna River is limited to a few residences on the Parks Highway.

Broad Pass land use east of the Parks Highway is primarily residential and commercial development confined to Cantwell along the Denali and Parks Highway east of the community. Development is expected to continue along the



Denali Highway i.e., Cantwell Community Center. The Golden North Airport, situated east of Cantwell along the Denali Highway, is registered in Supplement Alaska, March 1982.

Land uses west of the highway in Broad Pass are residential and landing strips. Residential land uses are concentrated solely around Cantwell, Summit and Broad Pass. There are two landing strips in the Summit area and the Cantwell Airport. Also present are the Parks Highway, Alaska Railroad and a small portion of the eastern boundary of the Denali National Park and Preserve.

The major land use north of Windy up to the Yanert Fork is residential, along areas of the Parks Highway i.e., Nenana River, Slime Creek, Carlo Creek, Deneki Lake and McKinley Village. The Mt. McKinley National Park Airport is located in McKinley Village and the landing strip at the National Park are registered with the Supplement Alaska, March 1982.

Residential and commercial land uses exist along the Nenana River and the Parks Highway near the Denali National Park and Preserve just prior to entering the Nenana Gorge. The Alaska Railroad and the Parks Highway wind through the gorge. There is residential and commercial land use around the Healy Generating Station. The primary developed land use in the Intertie project area is low density residential with some travel oriented commercial uses being located along the Parks Highway. Two private landing strips are located in the Village of Healy.

LAND STATUS

Land ownership within the project area is currently under resolution among federal, state and private interests. Competition is very strong for lands having high scenic values or development potential. The Alaska Statehood Act and the Alaskan Native Claims Settlement Act provide the means for land disposition. The Statehood Act makes federal lands available to the state; the Settlement Act permits conveyance of acreage to Alaskan natives. Additionally, the Alaska Municipal Code permits the borough to select for municipal purposes, ten percent of the vacant unreserved state lands located within its boundaries (Division of Parks, 1980).

According to the Division of Forest, Land and Water Management, land ownership within the project area consists of large federal and state holdings and smaller regional, borough and private land holdings (reference Figure 16).

Federally owned lands occur north of Talkeetna being more intensified north of Cantwell. The National Park Service administers Denali National Park and Preserve. Remaining federal holdings are administered by the Bureau of Land Management and the Alaska Railroad. The Bureau of Land Management manages land in the Broad Pass vicinity. Railroad holdings exist along the Railbelt corridor east of Denali State Park. Railroad withdrawals exist in the vicinities of Talkeetna and Honolulu.

The majority of state lands are in various stages of the state selection process, either classified as selected, tentatively approved or patented (definitions provided at the conclusion of this section). Lands south of Denali State Park are predominantly State-patented mixed with private, borough and a few regional holdings. Nearly all of Denali State Park has been tentatively approved by the

federal government for patent to the state. State tentatively approved lands also exist east of the State Park and northeast of the Denali National Park and Preserve. State selected lands are located to the north of Denali State Park in the Honolulu and Cantwell areas.

Cook Inlet Region Inc., has applied for selection of state owned lands in the Talkeetna area. Matanuska-Susitna Borough lands generally follow the Parks Highway and Petersville Road and are currently under transfer categories similar to state lands, either borough selected, tentatively approved or patented. Only a small amount of borough land has been patented, the majority of borough selected lands have received tentative approval.

Private and leased lands occur primarily south of Curry. These lands were opened to acquisition under the Open-to-Entry program (ADNR, Division of Forest, Land and Water Management, 1981). The heaviest concentrations being in the Montana area, Trappers Creek and east of Chase and Talkeetna. Lands east of Chase and Talkeetna have been open to private development and are being intensely developed according to Alaska standards. The Chase II, Unit IV Subdivision, West Talkeetna Bluffs, Talkeetna Bluffs Additions and Barlett Hills are all being actively developed.

Additional residential development is located between the Chulitna and the Susitna Rivers; in the Tokosha Roadless Area; along the Alaska Railroad, east of Denali State Park; in the Indian River Disposal and Indian River Remote Parcel; in Talkeetna and along the remainder of the Parks Highway.

The Talkeetna Agricultural lands are the only agricultural lands within the project area. They are part of the Barlett Hills Subdivisions. The Rabideux area along the Susitna River, south of Petersville Road has been nominated for potential disposal as agriculture lands by the state.

X All village selections are contained within the Ahtna Native Regional boundary. Eleven applications for native allotments exist within the state patented lands near the southern boundary of Denali State Park. There are heavy concentrations of native allotment applications in the Cantwell and Honolulu-Colorado areas. A single application exists in the vicinity of Byers Lake. The community of Cantwell is a native village.

Placer mining occurs primarily on federal and state selected and patented lands north of Talkeetna.

The majority of Alaska Administrative Code (AAC) lands within the project area are either resource management or public recreation lands. The majority of resource management lands are located on state holdings west of the Susitna River. Denali State Park contains most of the public recreation lands, smaller amounts exist along the Susitna River south of Talkeetna. The remote parcel (southern portion) of the Indian River State Land Disposal is under private recreation status (ADNR, Division of Forest, Land and Water Management, 1981). Additional private recreation lands are mixed with agricultural lands along the Chulitna River and Talkeetna River and along the Susitna River south of Talkeetna. All other AAC lands appear on a lesser scale within the project area.

The following definitions pertain to those land ownership classifications present in the project area.

Federal: those lands under jurisdiction of the Department of the Interior, the National Park Service, Bureau of Land Management or the Alaska Railroad.

Federal State Selected: the state receives land from the federal government in a three-step process. The state first applies for land which is classified as State Selections Applications or Federal State Selected.

State Selections Tentatively Approved or State T.A.: those state selected lands are then approved by the federal government for transference to the state.

State Selections Patented: Federal lands are finally conveyed to the state.

State Planned Disposals: those state lands plotted for subdivision development. There are two located within the project area: Colorado Station and Indian River.

Borough Approved or Patented: if state patented land is not reserved for a particular use a borough can select the land through a process similar to that use by the state in selecting federal lands.

Regional Corporation Selections: those lands selected by the Regional Corporations under provisions of the Alaska Native Claims Settlement Act. Each region is composed of, as far as practical, natives having a common heritage and sharing common interests. The project area lies within the Cook Inlet (CIRI) and the Ahtna Regional Corporations.

Village Selections: those lands selected by Alaskan natives, under provisions of the Alaska Native Claims Settlement Act, which have been traditionally used by them, for their commercial resource value, subsistence hunting and fishing. These lands are located near villages or along rivers. The village receives the surface rights, the regional corporation receives the subsurface rights.

Native Allotments: natives, at the start of the century (1906), were allowed to file for allotments of up to 160 acres on unoccupied federal lands. These are private holdings.

Private: those lands selected for ownership under the Alaska Native Claims Settlement Act. Does not include native lands.

Agricultural Land: those lands classified by the state as having agricultural potential. The state either owns these lands or has sold them to private ownership.

Unpatented Mining Claims: mining claims carried on by an individual(s) on federal lands. The federal government has the claim patent. Patent mining claims are privately owned.

State Department of Natural Resources AAC Lands

In addition to the basic land ownership classifications, within the project area the state has classified various aliquot parts of townships as follows:

Agricultural Land (11 AAC 55.050): Lands classified agricultural because of their location, physical features and climate or may be suitable for agricultural use.

Private Recreation Lands (11 AAC 55.150): Land classified private recreation because of its rural location, physical features or adjacent development are suitable for private, low-density recreational development. No land may be classified private recreation until present and potential public recreation needs in the area have been considered first.

Public Recreation Land (11 AAC 55.160): Land classified public recreation because of its location, physical features or adjacent development are most appropriately used by the public as natural or developed recreation areas, scenic overlooks, waysides, parks, campsites, historic sites or hunting, fishing or boating access sites.

Residential Land (11 AAC 55.180): Land classified residential because its physical features lie adjacent to development; is near an existing road, proposed road or navigable waterway; is suitable for single or multiple family dwellings at medium to high density; provides adequate on-site or off-site services and facilities can be developed for solid waste disposal, wastewater disposal and potable water delivery.

Resource Management Land (11 AAC 55.200): Land classified resource management is an area identified in a land use plan as containing an association of surface or subsurface resources, i.e., minerals, timber, that are especially suited to multiple-use management.

Utility Land (11 AAC 55.210): Land classified utility does not lend itself to classification under other categories because of small or irregular tract size or because its proposed use is not covered under other categories.

Wildlife Habitat Land (11 AAC 55.230): Land classified wildlife habitat because its primary resource value is habitat for wild mammals, birds, fish or other animals.

SOCIOECONOMICS

Regional Settlement Patterns

The southern four-fifths of the project area falls within the Matanuska-Susitna Borough, a regional government whose jurisdiction covers 20,544 square miles. Although the Matanuska-Susitna Borough was Alaska's fastest growing census division over the last decade, its population is still small in numbers. The borough has a population density of less than one person per square mile. According to the U.S. Bureau of Census, the borough's population grew by 176 percent between the 1970 and 1980 censuses, from 6,509 to 17,938 residents (see Table 10). However, the bulk of this growth was concentrated in the Wasilla area

and the population of the project area has grown at a much slower rate than that of the borough as a whole.

The northern fifth of the project area falls in the unorganized borough and outside the jurisdiction of any incorporated local government. There are a number of small rural settlements in this part of the project area.

TABLE 10
MATANUSKA-SUSITNA BOROUGH
POPULATION TRENDS, 1970-1980

	<u>1970</u>	<u>1980</u>
Incorporated places		
Houston	69	393
Palmer	1,140	2,143
Wasilla	-	1,548
Subtotal	1,209	4,084
Unincorporated areas	5,300	13,854
Total	6,509	17,938

Source: 1980 Census of Population and Housing, Preliminary Report

The population of the project area is small and scattered. There are only a few small rural settlements spotted along the main transportation corridors and, as yet, no incorporated cities. The estimated current total resident population within the project area is about 2,378 persons, with population clusters at the settlements of Talkeetna (268), Willow (139), Cantwell (89) and Healy (334). The remaining population is scattered within a narrow band of accessible land mainly between Willow and Trapper Creek along the Parks Highway or along the Alaska Railroad (see Table 11).

TABLE 11

ESTIMATED POPULATION, INTERTIE PROJECT AREA, 1981

	Population
In Matanuska-Susitna Borough	
Willow	139*
Highway/rail corridor north of Willow to Trapper Creek (Montana)	1,023 (40)*
Talkeetna-three township area (Talkeetna town)	640 (264)*
Highway/rail corridor north of Talkeetna to boundary	68
Subtotal	1,870
Outside Matanuska-Susitna Borough	
Cantwell	89*
Healy	334*
McKinley Park	32*
Usibelli Mine	53*
Subtotal	508
Total	2,378

Sources: Asterisked figures are 1980 U.S. Census counts for those designated places. Other population figures were supplied by the Matanuska-Susitna Borough Planning Department and are derived from a summer 1981 housing vacancy survey. Since none of these settlements are incorporated, there are no "official" population figures for them.

Historically, the project area was not intensively settled or used by Alaskan Natives. Even today, this area of the state has only a small share of Alaskan Natives in its total population. According to the 1970 census, less than 5 percent of the population of the Matanuska-Susitna Borough was Alaskan Native, the least of any census division in the state at that time. This share has since likely fallen even lower due to in-migration of non-Natives during the 1970s. Within the project area, three settlements have been recognized as traditional native village sites under the Alaska Native Claims Settlement Act: Cantwell, Montana Creek and Caswell.

Economy and Employment

While the Intertie project area is endowed with a range of natural economic resources, its economy stands at a very undeveloped stage. There have been no significant additions to the project area's economic base during the past decade with two exceptions: expansion of highway-oriented commerce following completion of the Parks Highway and expansion of coal mining activities at Usibelli Mine in the Healy vicinity. The resident labor force is small and the variety of industrial and commercial services provided by the local economy is limited. While there is no detailed employment or economic information published specifically for the project area, some inferences about local economic conditions and trends can be drawn from data about the Matanuska-Susitna Borough.

The resident labor force in the larger Matanuska-Susitna Borough, like its total population, grew very rapidly between 1970 and 1980 (see Table 12). According to Alaska Department of Labor data, the resident labor force of the entire borough rose from 1,968 to 9,197, an increase of 367 percent over the decade. At the beginning of the decade, 1,550 jobs were held by borough residents. By 1980, this figure had grown to 7,790 jobs. As discussed further below, the resident labor force in the borough is very mobile. Many residents are employed outside the borough, especially in the Anchorage labor market. Thus, employment

by place of residence must be distinguished from employment by place of employment.

The Matanuska-Susitna Borough workforce experiences high chronic unemployment rates. As shown in Table 12, its average annual unemployment rate in 1980 was 15.3 percent, well above the statewide average of 9.6 percent and one of the highest regional unemployment rates in the state. Employment in the borough is also subject to wide seasonal swings, reaching a summertime peak when construction labor and recreation-oriented trade and services are in demand, and declining during the off-season. For example, according to Department of Labor 1980 data, midsummer employment levels were about 20 percent higher than wintertime levels.

TABLE 12
MATANUSKA-SUSITNA BOROUGH
LABOR FORCE AND EMPLOYMENT TRENDS
1970-1980

	<u>1970</u>	<u>1980</u>	<u>Percent Change</u> <u>1970-1980</u>
Civilian Resident Labor Force	1,968	9,197	+367%
Total Employment	1,550	7,790	+403%
Total Unemployment	418	1,407	+237%
Unemployment Rate	21.2%	15.3%	

Source: Alaska Department of Labor

The economic structure of the borough is reflected in Table 13 which displays non-agricultural wage and salary employment in the borough in 1970 and 1980. During that period, employment in the borough grew from 1,145 in 1970 to

TABLE 13
MATANUSKA-SUSITNA BOROUGH
NONAGRICULTURAL WAGE AND SALARY EMPLOYMENT
1970 - 1980

	1970		1980*		Percent Change 1970-1980
	#	%	#	%	
Mining	**	**	36	1.1	**
Contract Construction	120	10.5	178	5.5	+ 48%
Manufacturing	**	**	**	**	**
Transportation, Communications, and Public Utilities	114	10.0	314	9.7	+175%
Trade	174	15.2	725	22.5	+317%
Finance, Insurance, and Real Estate	22	1.9	117	3.6	+432%
Services	179	15.6	466	14.5	*160%
Government	481	42.0	1,325	41.1	+175%
Miscellaneous	**	**	**	**	**
TOTAL	1,145	100.0	3,224	100.0	+182%

*Data available for first three quarters of 1980 only.

**Data withheld to comply with disclosure regulations.

Source: Alaska Department of Labor, Statistical Quarterly Series.

3,224 by 1980, an overall increase of 182 percent. The most rapid growth rates occurred in the employment sectors of finance, insurance and real estate (+432 percent) and trade (+317 percent), followed by government (+175 percent) and transportation, communications and public utilities (+175 percent). In absolute terms, the combined sectors of government, trade, and services accounted for almost 80 percent of all employment within the borough by 1980. On the other hand, the sectors of manufacturing, contract construction and mining account for less than 10 percent of all employment in the borough. From these data, it is apparent that the economy of the borough is heavily skewed toward public service and the service sector, including public service, with very little basic employment.

The above data do not cover the communities in the area north of the Matanuska-Susitna Borough. In that sector, it is estimated that about 100 jobs are provided by the operation of Usibelli Coal Mine, Inc., near Healy, plus perhaps another 50 to 75 jobs accountable mainly to highway and recreation-oriented trade and service employment.

A comparison of the employment figures presented in Tables 12 and 13 give some rough measure of the borough's role as a satellite community to the Anchorage regional economy. Table 12, which counts jobs by place of residence, counted 7,790 employees living in the borough. Table 13, which tallies nonagricultural wage and salary employment in the borough, counted only 3,224 jobs.

The greatest part of this discrepancy between employees (7,790) and local jobs (3,224) can be accounted for by the mobility of the borough's work force. A substantial share of the borough's residents, especially in the Palmer and Wasilla areas, commute to jobs in Anchorage or elsewhere outside the borough. Some sample data collected as part of a May 1980 housing and economic development study indicate that a relatively high proportion of residents of the Willow area (33 percent) and of the northern area between Willow and Talkeetna (16 percent) work outside the borough (Ender, 1980).

Comprehensive data about the labor skills and occupational characteristics of the Intertie area's work force or the borough's work force is not available. However, the Department of Labor Employment Center at Wasilla reported in 1979 that it lacked qualified applicants for openings for cable splicers, engineers of all types and helicopter pilots, but a surplus of applicants for heavy equipment operators and laborers.

This evaluation is confirmed by available data about the types and locations of business licenses held within the borough (see Table 14). The categories of trade and services account for by far the largest number of business licenses. These two categories also account for more than 60 percent of the business licenses in Willow and Talkeetna, the two major settlements in the Intertie area.

In summary, these data indicate that the economic base of the borough and, even more so, of the project area remains very narrow and shallow and that employment opportunities are slender compared to the population base.

Future Economic Development

There are many potential development projects within or near the Intertie area that might significantly affect its economic and population growth over the next decade. All of these projects are tentative or speculative at this time. All have the official support of the Matanuska-Susitna Borough government. The most important of these projects that might contribute to growth in the Intertie area are briefly described below.

- o Susitna Hydropower Project. The Alaska Power Authority is now completing a study to assess the feasibility of a proposed hydropower complex on the Susitna River about 50 miles northeast of Talkeetna. The project would entail construction of a pair of dams at the Devils Canyon (estimated

TABLE 14
NUMBER OF BUSINESS LICENSES, BY LOCATION AND TYPE
MATANUSKA-SUSITNA BOROUGH, MARCH 1980

<u>SIC Category</u>	<u>Big Lake</u>	<u>Houston</u>	<u>Palmer</u>	<u>Talkeetna</u>	<u>Wasilla</u>	<u>Willow</u>
Agriculture, Forestry, and Fisheries	3	-	22	-	-	-
Mining	-	-	2	-	-	-
Construction	19	3	50	3	91	4
Manufacturing	3	-	21	2	4	3
Transportation and Public Utilities	2	-	20	8	-	6
Wholesale Trade	-	-	11	-	-	-
Retail Trade	24	3	80	19	-	18
Finance, Insurance and Real Estate	-	1	22	2	37	3
Services	17	1	115	13	129	4
Public Administration	-	1	12	3	5	-
Nonclassifiable	2	-	3	-	1	-
Unknown	4	-	16	1	97	-
TOTAL	74	9	374	51	364	38

Source: Ender, 1980.

Note: There is an arithmetic discrepancy in the source table which has been rectified for the above table.

completion date 1993; 800 MW rated capacity) and Watana (estimated completion date 2000; 400 MW rated capacity) dam sites. When finished, the dam complex would be capable of generating up to 1,200 MW of power for delivery to Railbelt consumers by means of the proposed Anchorage-Fairbanks Transmission Intertie. The most recent estimated cost of the project is about \$5 billion.

- o State Capital Relocation. In a series of referenda, the voters of Alaska have voted to relocate the state capital to a vicinity east of Willow. Current projections are that the new capital city would receive its first residents by 1986. By its completion in 1994, the new capital would support a total of about 10,500 new jobs in the region, about 1,400 residents in the new capital city and perhaps another 10,000 residents in the surrounding region. Actual implementation of capital relocation pends final voter approval of the costs of undertaking the relocation program.
- o Healy Coal. Coal production from Usibelli Coal Mine, Inc., operations near Healy was about 800,000 tons in 1981. The mine currently has about 100 employees with an annual payroll of about \$3 million. The mining company projects that shipments will double to about 1,600,000 tons annually by 1985 under terms of a recently concluded contract with a Korean purchaser.
- o Mining. Rising gold prices stimulated a revival of mining operations, primarily placer mining, at various remote locations in the Railbelt. Favorable price trends could promote a continued rise in mining activities and perhaps some hard-rock mining enterprises.
- o Recreation. The Intertie area's nearness to the populous Anchorage area makes it a favored recreational destination and second-home area for Anchorage residents. There is a plentiful supply of private and public lands

available for this purpose. Continued growth in Anchorage and the Palmer and Wasilla area would foster the expansion of recreation- and highway-oriented commercial development in the project area.

- o Agricultural Development. The State of Alaska is initiating an development project in the Point MacKenzie area that may, if development proves feasible, lead to development of up to 15,000 acres, mainly for dairy farming. Both the state and the borough have additional lands with agricultural potential near the Intertie area that might be opened for agricultural development if conditions prove favorable.
- o Beluga Coal Reserves. The Beluga region about 75 miles southwest of the southern end of the project area, contains massive deposits of sub-bituminous coal near tidewater. Though numerous feasibility studies have been made, it is not yet clear whether, when or in what manner the area's stores of hydrocarbon energy might be economically extracted and transported. Many options exist, but none as yet has proven feasible.
- o Tokositna Recreational Complex. The State of Alaska recently completed a preliminary study to assess the feasibility of a major recreational development in the Tokositna area in Denali State Park south of Denali National Park and Preserve and west of the project area. There is no definite plan or development schedule set for the project at present.

Community Facilities and Services

In general, the rural residents and settlements along the corridor enjoy minimal level of governmental services and facilities. Existing conditions are described briefly in the section that follows.

Housing

Available housing data for the Intertie area are selective and sketchy, in part because there are no uniform definitions for the geographic subareas of the project area. From available information, it can be concluded that the overwhelming majority of housing in the area is single-family in type. A 1980 housing survey estimated that 362 dwellings or 99 percent of the 367 residences in the community areas of Talkeetna, Montana, Caswell and Willow were single-family in construction. There were no multi-family units counted in that survey. Furthermore, the great majority of households surveyed in those communities either owned or were buying their homes. About half of the housing stock consisted of recreational homes. There was a total of 12 units of commercial lodgings tallied (see Tables 15 and 16).

There is no reason to suppose that the above findings about housing conditions are not roughly representative of the rest of the project area. These data support the observation that there is no reservoir of rental housing units or other commercial lodgings available to absorb the housing needs of a sudden influx of a sizable number of temporary workers or their families.

TABLE 15
HOUSING STOCK, SELECT COMMUNITY AREAS
1980

Community Area	Total Residential			<u>Recreational</u>	<u>Commercial</u>
	<u>Single Family</u>	<u>Multi- Family</u>	<u>Mobile Homes</u>		
Caswell	39	-	-	31	1
Montana	69	-	1	44	3
Talkeetna	92	-	2	22	4
Willow	162	-	2	274	4

Source: Ender, 1980

TABLE 16
SOCIAL CHARACTERISTICS OF SELECT COMMUNITIES
MATANUSKA-SUSITNA BOROUGH

	<u>North of Willow</u> (Talkeetna, Montana, Caswell)	<u>Willow Area</u>
Housing:		
<u>Type</u>		
Single Family	200	162
Multi-Family	-	-
Mobile Home	3	2
Total Residential	203	164
Recreational	97	274
Commercial	8	4
<u>Ownership Status</u>		
Renting	44%	15%
Buying	13%	24%
Own	31%	55%
Other	12%	6%
Average Household Size	3.3	3.0
Place of Employment:		
Local	83%	46%
Borough	0%	22%
Anchorage	8%	14%
Elsewhere	8%	19%
Average Annual Income:		
Household	\$27,500	\$24,107
Per Capita	8,348	8,036
Average Adult Schooling:	13.0 years	13.4 years

Source: Ender, 1980.

Utilities

As there are no public community water or sewer systems in the Intertie area, residents must rely upon private arrangements for these basic utilities. On-site water supply and sanitary waste disposal systems are the most common arrangement. Some developed subdivisions have privately-owned community systems. Well contamination problems have been reported at Talkeetna, purportedly a result of that community's small lot sizes and high water table.

Electric power is provided to consumers along the highway system from Willow north to Talkeetna and Chulitna by the Matanuska Electric Association and at Healy by Fairbanks-based Golden Valley Electric Association. Consumers at Cantwell and McKinley Village are served by a combination of small generation and distribution systems or by individual generators.

The Matanuska Telephone Association's telephone service area includes the entire Intertie project area between Willow and Healy and that utility offers telephone service to customers along the highway corridor.

Public Safety

Police protection within the Intertie area is the responsibility of the Alaska State Troopers, which maintains trooper stations at Trapper Creek, Talkeetna, Cantwell and Healy.

As for fire protection, there are Fire Service Areas at Talkeetna and Houston-Willow and local volunteer fire departments at Cantwell and Healy. However, it should be noted that local firefighting capabilities are necessarily limited by the absence of water distribution systems.

Education

Within the Matanuska-Susitna Borough, elementary and secondary education is the responsibility of the borough government, which operates elementary schools at Trapper Creek, Talkeetna, Montana Creek and Willow and Susitna Valley High School at Montana Creek. The high school at Wasilla also serves schoolchildren living in the southern part of the Intertie area. The borough provides schoolbus service within its service area.

The Intertie area north of the Matanuska-Susitna Borough, including schoolchildren from Cantwell and Healy, falls within the Upper Railbelt School District. The district operates elementary and secondary education programs for local schoolchildren at Cantwell and, under contract the Matanuska-Susitna Borough, for some schoolchildren living in the northern part of the borough. Schoolchildren living in remote areas have the option of enrolling in correspondence school programs for elementary and secondary education.

Health Care

There are no hospital or medical clinic facilities within the Intertie area. The nearest hospital facilities are Valley Hospital at Palmer and Fairbanks Memorial Hospital. Ambulances suitably equipped and staffed by volunteers trained to provide emergency medical services are stationed at Talkeetna, Trapper Creek and Willow.

Local Government

There are as yet no incorporated local governments, that is, city governments, within the project area. Within the last year, as a result of local petitions, there have been local incorporation elections at Willow and Talkeetna. In each case, the outcome was decisively against incorporation. The southern four-fifths of the Intertie area falls within the boundaries of the Matanuska-Susitna Borough. The northern fifth is in the unorganized borough with no regional or local form of government.

The Matanuska-Susitna Borough, with headquarters at Palmer, is a second-class municipality and, under Alaska Statutes, has mandatory borough-wide powers of education, tax assessment and planning, along with a wide variety of optional powers. At present, because of the low population densities and rural life-style preference of Intertie area residents, the level of local governmental public services provided by the borough is basic, consisting mainly of education. In 1980, the borough real property tax rate for the area-wide services of administration and education was 8.4 mills. The borough also provided certain other services to some service areas within the Intertie area which were financed by mill levies: land fill and library (0.55 mills), fire (0.60 mills) and flood control (1.40 mills). The borough does not levy a sales tax.

In the unincorporated area north of the Matanuska-Susitna Borough, there are no local governments providing services or levying taxes.

AESTHETICS

Landscape Description

The project area is comprised of six distinct landscape types. The types are the Susitna River lowlands, Curry Ridge, the Chulitna River, Broad Pass, the Alaska Range and the Nenana Gorge. Much of the description of the landscape types was taken from the Department of Natural Resources, Division of Research and Development's study "Scenic Resources Along the Parks Highway" (ADNR, 1981).

The southern boundary of the project area starts within the Susitna River lowlands at Willow. The northern boundary of the lowlands is the southern entrance to Denali State Park. The lower portion, from Willow to the Susitna River crossing by the Parks Highway, is a nearly level, broad river basin. The upper portion contains rolling topography. The Talkeetna Mountains form the eastern boundary. The Alaska Range forms the northern and more distant western

horizon, while the Chugach Mountains are visible to the extreme south. Prominent views within the lowlands are of Mt. McKinley, Mt. Foraker, Mt. Susitna and Peters Hills. The Parks Highway parallels the Susitna River the entire length of this landscape type. It is often less than one-quarter mile away from the river but seldom has views to the river because of the vegetation.

Landcover is predominantly coniferous along the river and mixed stands of white spruce and deciduous on the uplands. This landscape type also contains extensive nearly level, open treeless bogs or muskegs and poorly drained areas dominated by black spruce. Floodplains and low, well drained river terraces generally have large deciduous vegetation thickets. Upland vegetation plays a minor role visually because of its distance from the highway.

Rivers, creeks and lakes are common throughout the lowlands with the Susitna and Chulitna Rivers being the most visually prominent. Residential growth is primarily located in the mountain areas, Willow, Talkeetna and Trapper Creek.

The Curry Ridge landscape lies between the Susitna River lowlands and the Chulitna River landscape type and is dominated by Curry Ridge, the Chulitna River and Susitna Rivers. The Chulitna River varies in width from one and a half miles in the middle of the park to approximately 100 yards near the park's southern boundary. The eastern portion of the landscape is dominated by the Susitna River and its tributary, the Indian River. Byers, Lucy and Spinks Lakes are the most visible.

Landcover is upland spruce-hardwood and alpine tundra. Isolated areas of lowland spruce-hardwood and low brush, muskeg-bog are present. The moist slopes are covered with brush. Willow and alder are typical spruce-hardwood understory plants.

The plant system above timberline is alpine tundra. Here, barren rocks are interspersed with herbaceous and shrubby low-growing plant mats.

South Curry Ridge commands an excellent view of Mt. McKinley rising above the flat Chulitna River valley as well as Ruth Glacier. The Parks Highway and the Byer's Lake area have excellent views of Curry Ridge. Residential growth is primarily along the Parks Highway and the railroad.

Curry Ridge forms the southern boundary of the Chulitna River landscape type. Sixteen miles north, the boundary is formed where the Parks Highway bridge crosses the East Fork of the Chulitna River. The Parks Highway crosses the entire length of this landscape type from south to north. Landforms vary from level valleys to steep ridges in the Alaska Range to steeply incised valleys as exemplified by the Hurricane Gulch railroad bridge which is 260 feet above the creek bottom. There are prominent views of the Alaska Range to the west and the steep river gulches and mountainous terrain along the Parks Highway as it climbs to Broad Pass.

Land cover includes mixed spruce-poplar in the bottomlands, and spruce-hardwood in the uplands which merge into alpine tundra and rocky barren ground at the treeline. Large deciduous vegetation occupy the floodplains and valley slopes. Treeless bogs with low-growing vegetation are also common. Visually, the thin, conical spruce stand out above the shrub vegetation, especially in the uplands.

Water is abundant due to the presence of the Chulitna River system which divides into its East, Middle and West Forks within this landscape type. Waterfalls are present along Hurricane, Honolulu and Antimony Creeks and visible from the Parks Highway. The lakes are small and elongated.

The Denali Highway junction with the Parks Highway is the northern boundary and the Parks Highway crossing of the East Fork Chulitna River marks the southern boundary of the Broad Pass landscape type, a wide drainage trough dividing the Alaska Range. The highest elevation along the Parks Highway, approximately 2,300 feet above sea level, occurs in Broad Pass. The landscape is characterized by contrasting topographies: very broad, gently rolling, glacial carved valley floor with little apparent relief and the steep mountainous sides. Valley floor moraines and drumlines parallel the long axis of this trough. Notable views from Broad Pass include Mt. McKinley, Mt. Deborah, Mt. Pendleton, Panorama Mountain and the Reindeer Hills.

White and black spruce are visually, the most important vegetation in Broad Pass since their spire-like shape and deep green color provide a contrast with the surrounding treeless lands.

Lakes are the most visible water features in Broad Pass. Summit and Mirror Lakes are examples of the long, narrow lakes found in the Pass. The Jack and East Fork Chulitna Rivers are highly visible only at the northern and southern portions respectively of Broad Pass. The railroad stops of Colorado, Summit and Broad Pass are located in the Pass.

The Alaska Range landscape type lies between the Denali Highway junction with the Parks Highway and the first Nenana River crossing by the Parks Highway at the southern boundary of Denali National Park and Preserve. The Parks Highway travels almost due north through this steep crescent shaped mountain range. Elevations range from approximately 2,000 in the valley to over 20,000 feet at Mt. McKinley.

The Nenana River valley is relatively narrow in the range and provides a contrast to the open Broad Pass landscape type to the south. The U-shaped

valley is nearly flat, almost a mile wide in places with broadly flaring walls rising 2,000 to 3,500 feet above the river. This topography provides direct views up the valley. The Nenana River varies from a meandering course with gentle gradients in its upper reaches to a more direct flow through a narrow terraced gorge with 100 to 250 feet drops. Visually prominent land forms include Pyramid Mountain, Panorama Mountain, Reindeer Hills, Mt. Healy and Mt. Fellows.

Land cover is primarily white spruce dominated forests at the lower elevations up to 3,000 feet elevations and bare rock surfaces at higher elevations. Snow is the most extensive land cover between mid-September and early May, during which time the dark green spruce are visually distinctive.

The most important water feature is the Nenana River. It is usually gentle with a few rapids. The Yanert Fork, Jack River and Carlos Creek are other significant features. Glacial lakes are also present, with the Deneki lakes being the most visible. Although present, glaciers are of minor visual significance in this part of the Alaska Range. The Alaska Railroad, Parks Highway, Cantwell, McKinley Village and few private residences are the primary evidence of human settlements.

The Nenana Gorge landscape type extends from McKinley Park Station to the mining community of Healy. Steep mountainous topography and water dominate the landscape as the Nenana River flows through a very narrow, steep walled two story canyon. The outer canyon is U-shaped, and one-half to three-quarters mile wide with walls rising to a height of 2,500 feet above the floor. In the downstream half of the canyon and also for a short distance, at its upstream end, the river flows in an inner gorge about 500 feet wide with vertical walls of nearly 200 to 300 feet. The inner gorge broadens to nearly the full width of the outer gorge in the other parts of the two story canyon. Numerous small creeks enter the river from steep, natural slide areas on both sides. Bison and Ice Worm Gulches are the most visually notable of these tributaries.

Land cover is open coniferous vegetation with an abundance of shrubs or shrublands. The Nenana Valley, Yanert Fork and upper Nenana Valley near the National Park entrance, provide dramatic views at each end of this landscape type. The Alaska Railroad provides an important feature along the west side of the gorge. Residential growth is occurring just north of the National Park entrance along the Parks Highway.

View Identification and Description

Views which were considered visually sensitive by the Division of Parks, Division of Forest, Land, and Water Management and Resource Planning (all with the ADNR), National Park Service, the Alaska Railroad, private individuals and Commonwealth were identified within the individual landscape types (Figure 17 and Table 17). Only views having visual access to the Intertie have been inventoried. Photographs have been used to graphically depict the individual landscapes previously described and are inventoried as Figures 21 to 32, in Appendix G.

Photographs 1 to 3 are within the Susitna River lowlands. The lowlands are characterized by very high scenic resource values according to the study Scenic Resources along the Parks Highway (ADNR, 1981). The first photograph typifies the landscape along the Parks Highway below Montana and is oriented toward the Talkeetna Mountains. The second photograph is from the Parks Highway Bridge across the Susitna River at mile post 104.3. Photograph 3 is along Petersville Road and is representative of the landscape in the vicinity. This is an area of generally low scenic quality and high visual absorption capability.

The next photographs are from the Curry Ridge landscape type. The ADNR has also described the landscape in the Curry Ridge area as having very high scenic resource values. Photograph 4 is looking east from the Parks Highway

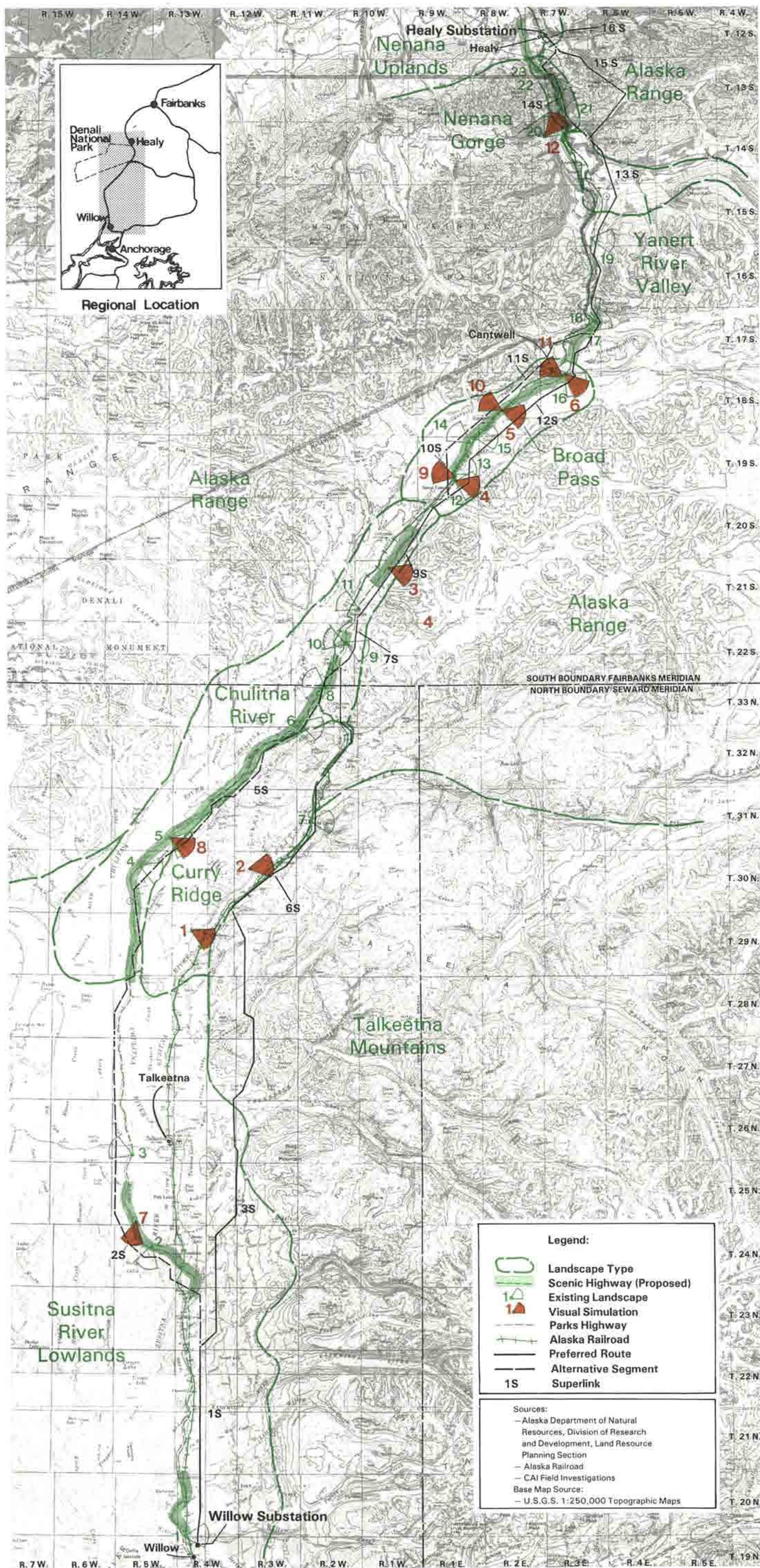


FIGURE 17

Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Visual Resources

0 10 20 Miles
0 10 20 Kilometers



Gilbert/Commonwealth

Table 17

EXISTING LANDSCAPE DESCRIPTIONS

<u>View No.¹</u>	<u>Direction</u>	<u>Orientation</u>	<u>Landscape Unit</u>
1	East	Talkeetna Mountains	Susitna River Lowlands
2	Southwest	Susitna River	Susitna River Lowlands
3	Northwest	Petersville Road	Susitna River Lowlands
4	East	Byers Creek/Ridge	Curry Ridge
5	East	Curry Ridge	Curry Ridge
6	East	Northface Curry Ridge	Curry Ridge
7	East	Talkeetna Mountains	Curry Ridge
8	West	Chulitna River/Alaska Range	Chulitna River
9	East	Hurricane Gulch/Alaska Range	Chulitna River
10	West	Hurricane Gulch/Alaska Range	Chulitna River
11	West	E. F. Chulitna River/ Alaska Range	Chulitna River
12	East	Broad Pass/E. F. Chulitna River Mountains	Broad Pass
13	Northeast	Broad Pass/Alaska Range	Broad Pass
14	Southwest	Mt. McKinley	Broad Pass
15	East	Summit Lake/Alaska Range	Broad Pass-Alaska Range
16	East	Denali Highway	Broad Pass-Alaska Range
17	East	Nenana River	Broad Pass-Alaska Range
18	North	Windy Pass	Broad Pass-Alaska Range
19	East	Carlo Creek	Alaska Range
20	Northeast	Alaska Range	Alaska Range
21	North	Nenana Gorge	Nenana Gorge
22	South	Nenana Gorge	Nenana Gorge
23	Northeast	Nenana Gorge	Nenana Gorge

(1) Refers to Figures 21-32.

crossing of Byer's Creek at mile post 144. The view is oriented toward Curry Ridge. Photograph 5 shows the landscape shore of Byers Lake. Photograph 6 is from the highway crossing of Pass Creek at mile post 168. The view is oriented toward the north end of Curry Ridge. Photograph 7 depicts the landscape as viewed along the Alaska Railroad.

Exceptionally high scenic values characterize the Chulitna River landscape. Photograph 8 at mile post 170 looks toward the Chulitna River, the Alaska Range and Mt. McKinley. Photographs 9 and 10 depict the landscape east up Hurricane Gulch and west down the Gulch from the bridge. The western view is across the Chulitna River to the Alaska Range. Photograph 11 is from mile post 179.3, and includes the Alaska Range, Mt. McKinley and the nearby picturesque cliffs of the East Fork of the Chulitna River.

Photographs 12 and 13 are taken from mile post 194.3 and introduces the Broad Pass landscape type. The views are oriented east and northeast towards the Alaska Range. Photograph 14 at mile post 198 is oriented west to the Broad Pass trough, the Alaska Range and Mt. McKinley, while Photograph 15 is oriented east across Summit Lake to the mountains. This and the remaining views in the pass include some of the most scenic portions of the Broad Pass and Alaska Range landscape types. Photograph 16 represents the view east of Cantwell along the Denali Highway. Photograph 17 is taken east from mile post 215.6 prior to entering Windy Pass. This is the site of a proposed interpretive center by the Division of Parks. The site will focus on the Alaska Range and Nenana River landscape types. The Reindeer Hills are also part of the view. Photograph 18 is looking north up Windy Pass from mile post 216.1. Photograph 19 is taken at mile post 224 near the Jere-a-Tad Lodge. It shows the views residents of the Carlo Creek area will have. Mile post 237 (Photograph 20) shows the view looking northeast just south of the entrance to Denali National Park and Preserve. Mile post 241 (Photograph 21) looks north into the gorge and introduces these views

associated with the Nenana Gorge landscape type. Photograph 22 is taken from the mile post 242 turnout near Dragonfly Creek, looking south down the gorge. Photograph 23 is looking northeast from the Bison Gulch area within the gorge.

The Alaska Railroad was contacted for a response indicating the scenic views they consider most important along their right-of-way. Generally, they preferred locating the line east of the railroad and highway between Willow and Cantwell and west of the railroad between Cantwell and Healy. By priority, the views they wanted to preserve were: 1) views to the west from the Hurricane area; 2) views to the west from the Montana-Lane area; 3) views to the west from the Summit area and 4) views to the east from Cantwell to Healy.

In May, 1981, Commonwealth met with participating agencies to review the project network. The agencies received network maps prior to the meetings. Additional visual concerns about the Curry Ridge area were expressed at the meetings. The concerns were: views west to Mt. McKinley from the top of Curry Ridge; views to the east from the top of Curry Ridge; views to Curry Ridge from the Parks Highway and views from Byers Lake to Curry Ridge and Mt. McKinley.

Visual Analysis Methodology

Any impact which negatively changes the visual character and harmony of the landscape is considered a visual impact. The impact of this project will be a result of introducing a transmission facility into the landscape. Transmission facilities consist of transmission towers, conductors and a cleared right-of-way.

The factors of vegetation, topography, distance and frequency were used to determine what impacts the Intertie will have on the landscape within the project area.

The first factor to be considered is the amount of vegetation available for screening views to the transmission facility or to act as a backdrop. This depends on the vegetation density, its height, color, form and type. The option potential for screening occurs in the dense, tall birch-spruce or spruce vegetation between Willow and Little Coal Creek and in the McKinley Village area. Background vegetation is available for use as a backdrop in Broad Pass. Here the towers will resemble the thin, vertical form and dark color of the spruce at a distance. In addition, a right-of-way will be less evident in Broad Pass because the spruce are arranged in long, narrow north to south stands. This pattern allows the treeless spaces between the stands to be used as a natural cleared right-of-way. Views to the cleared right-of-way will be screened in the dense vegetative birch-spruce or spruce areas. i.e., the Willow area.

The second factor incorporated in the assessment of visual impact is topography. Visual impact is reduced by concealing alignments behind vertical topography, below the crest line. Consideration of changes in elevation, various landforms and the relative scale of the proposed transmission facilities to changes in topography will be considered. In the Alaska Range-Broad Pass areas, the sheer massiveness of the mountains will cause the facilities to be less prominent because of the extreme scale differences.

Distance, the third factor, is defined as the distance between the transmission facility and viewer and is essential. The greater the spatial separation between viewer and facility, the less visual impact will occur. As stated previously, the limited screening potential of the landscape in Broad Pass makes distance the vital consideration in determining visual impact in the pass. Field observation indicated that similar transmission lines in areas south of the project area were definitely noticeable at up to a half mile, could generally be observed up to one and a half miles and became insignificant thereafter.

The approximate number of viewers available to see the line is termed frequency and is the fourth factor. Both stationary viewers (local residents) and mobile viewers, traveling by car, train, river or foot were considered. Most views will be from visitors travelling the Parks Highway.

Determining Visual Impacts

Views were studied during field investigations using the factors of vegetation, topography, distance, and frequency. These four factors were broken down into categories depicting the varying conditions of that factor within the project area:

<u>Factor</u>	<u>Category</u>
Vegetation	Barren
	Open
	Dense
Topography	Nearly Level
	Rolling Morainial
	Near Vertical to Vertical
Distance	0 to 1/2 mile
	1/2 to 1-1/2 miles
	1-1/2 miles plus
Frequency	Roads
	Residences
	Rafters
	Railroad

Strong public and agency concerns over the potential visual impact of the proposed project also resulted in the use of a visual simulation process.

Visual simulation techniques were utilized to better visualize the Intertie's proposed facilities prior to actual development, prepared with the assistance of Robert F. Scheele, Consulting Landscape Planner. The technique attempted to create realistic images of the development in its proposed setting through creative modification and superimposition of photographic images. This ability to 'see' the project prior to its construction creates both an objective decision base and the opportunity to test mitigating measures for developments which seem to create high levels of visual impact.

CULTURAL RESOURCES

In order to assess accurately the cultural resources of the project area, a literature search, records check at the Alaska Heritage Resources Survey (Division of Parks) and a field survey of portions of the preferred route were undertaken by Commonwealth and its subcontractor, Alaskarctic of Fairbanks, Alaska. Results of these investigations are to be reported in a final report which will be prepared subsequent to completion of construction clearance investigations of the final right-of-way in 1982.

Cultural Context

One interpretative scheme characterizes the archeology of central Alaska in terms of five major periods: (1) an early Tundra Period, ending circa 8,000 years before present (BP); (2) an Early Taiga Period, circa 8,000 to 4,500 BP; (3) a Late Taiga Period, circa 4,500 years ago to approximately AD 500; (4) an Athapaskan Period, from approximately AD 500 to about AD 1900, and (5) a Recent Period from about AD 1900 to the present.

The Tundra Period in Alaska is still poorly understood, but it likely represents a time of early postglacial adaptations and a changeover from steppe (grassland) to shrub tundra. Few archeological sites are known from this early period in Alaska.

Direct evidence of the people of the Tundra Period comes from four locales in interior Alaska. These areas are the Tangie Lake region (West, 1967,1974,1975), Healy Lake (Cook, 1968; Cook and McKennan, 1970), Dry Creek (Holmes, 1974a) and the Donnelly Dome and Ridge Region (West, 1967; Bacon and Holmes, 1980). West has argued that the locations of many of these sites suggest a primary dependence upon caribou hunting.

Forests began postglacial invasion of eastern interior Alaska perhaps as early as 10,000 years ago; by 6,000 years ago spruce forest was present in western interior Alaska (Anderson, 1971). During this period a series of boreal adaptations were evident across northern North America, many of which were expressed in technologies characterized, in part, by wide-notched projectile points (Anderson, 1968b).

Forests replaced the earlier shrub-tundra in central Alaska by about 8,000 years ago. Scanty archeological data from this period suggest that for the next 4,000 years a series of forest adapted Archaic cultures inhabited central Alaska (Anderson, 1968a; MacNeish, 1964).

The Late Taiga Period saw the development of Arctic Small Tool Tradition on the western coasts of Alaska. Data are limited for central Alaska, but the Healy Lake, Lake Minchumina (Holmes, 1974b), and other sites indicate that the late Denali Tradition technology were also widespread during this period (Bacon, 1977).

The Late Taiga Period terminated with a surge of influence upon central Alaska from the Bering Sea region. Western Thule appears as suddenly on the Alaska mainland (about AD 500) as did Arctic Small Tool earlier. The appearance of Western Thule marks the end of the Denali Tradition which is replaced by technology similar to that of the early Alaskan Athapaskan.

The relationship between these early Athapaskans and the people known to have occupied central Alaska at an even earlier time is still poorly understood (Cook, 1975). Whatever the case, by AD 500 Athapaskan people occupied interior Alaska and utilized a subsistence strategy similar to that hypothesized for the earlier Taiga periods.

Although there are still larger gaps in our understanding, the best understood part of the prehistory of the project area is the protohistoric period. This period has been studied through ethnohistorical research, linguistics and a limited amount of archeology.

X Linguistic evidence (Kari, n.d.; Krauss, 1980) indicates that the project area was most recently occupied by Athapaskan speaking groups. In general the lower portion of the project area was occupied by Tanaina, and the upper portion of the project area was occupied by the Ahtna Indians. The origins for both groups is unclear, but it appears that the Ahtna may have been in their area for a considerable time (Workman, 1977), while the Tanaina may be fairly recent arrivals to the upper Cook Inlet area (Osgood, 1966; Reger, 1977).

V The first record of European contact is from the voyage of Captain James Cook, who sailed into the inlet bearing his name. Captain Cook noted in 1778 that the Chugach and the Cook Inlet natives were already in possession of blue glass beads and iron (DeLaguna, 1972: Part I:108-207). By 1783, a Russian trader with the Potap Zaikov expedition had established trade links with the Ahtna Indians by trading through the coastal Chugach Eskimos (DeLaguna, 1972).

Trading stations established along the coast later became bases from which military and geological survey exploration parties penetrated interior Alaska during the late nineteenth century (e.g., Eldridge, 1900; Learnard, 1900). These exploration parties, who had been preceded by Malakoff in 1834, continued to map

the Susitna River drainage (State of Alaska, 1975). By the end of the nineteenth century gold prospectors were searching over much of the upper Susitna region.

In 1903 gold was discovered on Galina Creek. This creek, renamed Valdez Creek, became the center of Susitna basin gold activity for the next decade (Moffit, 1912). The dangerous nature of the upper Susitna River precluded supply of the gold fields by riverboat. Overland supply routes developed. Most popular of these utilized the Richardson Trail from Valdez. Consequently movement of men and goods to and from the Alaskan interior tended to be confined to areas east of the Talkeetna Mountains. It was not until some years later that there was renewed interest in the middle and lower reaches of the Susitna valley.

In 1914 Congress authorized construction of the Alaska Railroad. A route was selected which paralleled the Susitna River, and the railroad was completed in 1923 (Fitch, 1967). Nearly fifty years later a roadway was also completed and named the George Parks Highway.

Previously Recorded Cultural Resources

As a result of researching the known cultural resources included in the Alaska Heritage Resources Survey file, the Alaska Native Language Center place name list, personal communications and the Cook Inlet Region Inventory of Native Historic Sites and Cemeteries (CINA, 1975). General locations of the privately recorded sites in the project area are indicated on Figure 18. A total of 103 sites are recorded for the project area with 74 being historic and 29 prehistoric or proto-historic. Also present in the project area is the route of the 1898 USGS exploration trail.

Cultural Resource Reconnaissance

Archeological survey along proposed alignments was conducted during June and July 1981 with field aspects of the research in conformance with Federal

Antiquities Act Permit No. 79-AK-088. All required temporary and special land use permits were arranged for through Land Field Services, Inc., Anchorage, Alaska. Areas surveyed during the 1981 season are indicated on Figure 18.

This study was organized to reflect a two-part field effort. The first part of that effort (referred to as Phase I) consisted of an archeological survey of selected portions of the preferred route. A second part of the study will focus on test excavation at sites discovered during Phase I of the program. Phase I activities consisted of both aerial and on-the-ground archeological survey. Objectives of the Phase I survey included site identification, location and inventory. Phase II investigations will focus on obtaining data which will assist in determining the eligibility of sites for nomination to the National Register of Historic Places. Appropriate plans to mitigate the adverse effects of proposed construction activities to significant cultural resources will be prepared as part of the Phase II investigations.

An area 200 feet either side of centerline was examined during the pedestrian or aerial survey of each proposed link surveyed during the 1981 field season. Approximately 60 percent of the total length of the proposed line was surveyed with the remaining areas to be surveyed in 1982.

Surface inspection for artifacts or other cultural features was inhibited in most places by a heavy vegetation cover which obscured the soil. Particular attention was thus devoted to observing natural exposures such as stream cut banks, animal burrows, frost boils, uprooted tree falls, and other erosional surfaces. In cases where no natural erosion exposure was present at locations judged to be likely site locations (on the basis of regional ethnology and/or archeology), sub-surface tests were made with a small shovel and trowel. These exploratory tests were excavated usually to a depth where bedrock or gravel occurred. In areas where surface soils were too thick to penetrate using a shovel and trowel testing

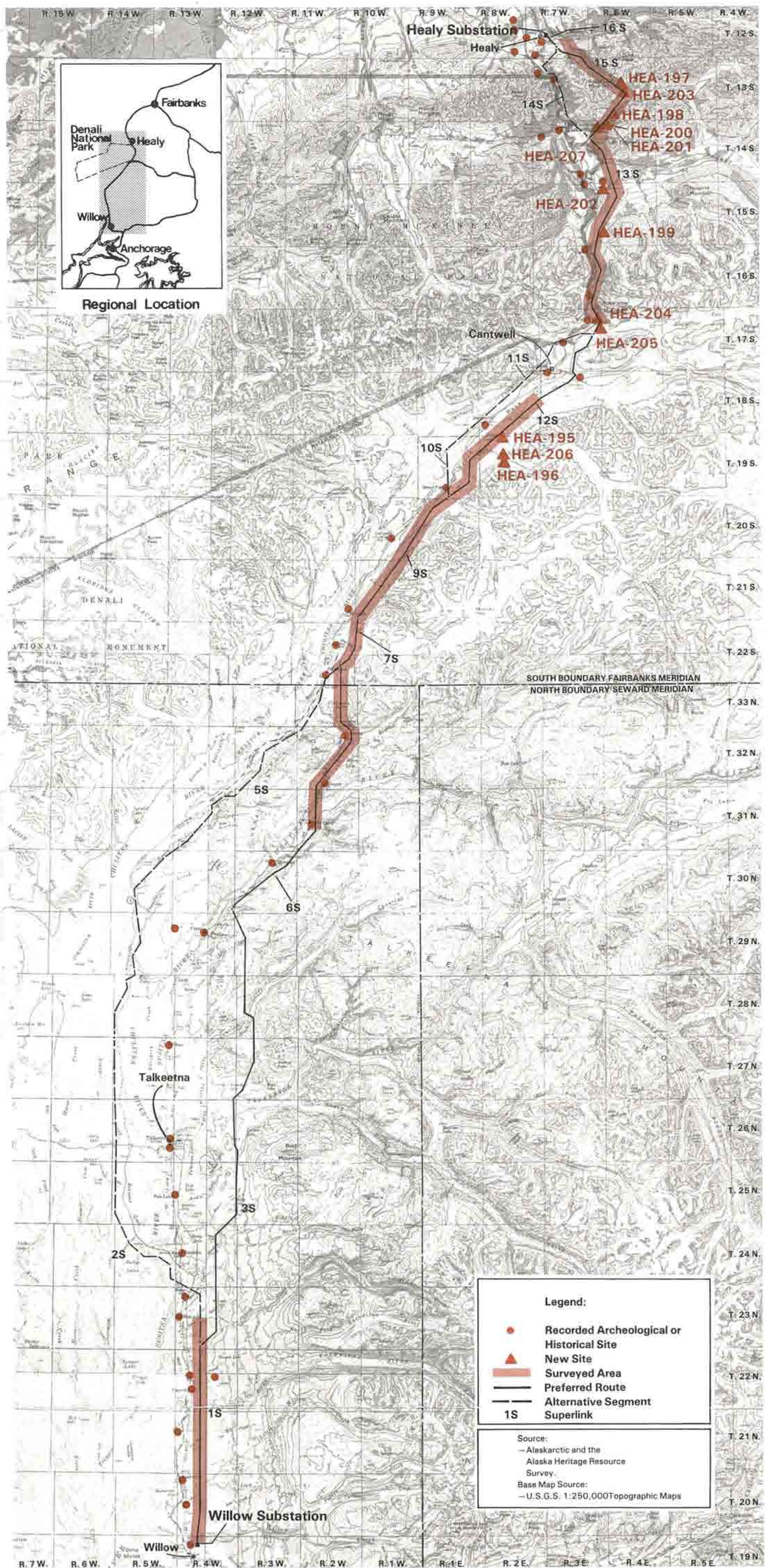
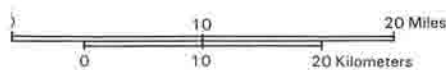


FIGURE 18

Alaska Power Authority | ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

1981 Surveyed Areas and Known Cultural Resources



procedure, tests were arbitrarily terminated when they reached a depth of one meter below the surface. Tested locations were designated by the similarity to landforms known either archeologically and/or ethnographically to have been exploited by aboriginal peoples.

Small collections of both surface and subsurface artifacts were made at selected sites. Photographs were taken to document field conditions, survey methods, and site environmental settings. Curation of photographs, field notes, and artifacts follows accepted professional standards. All collections will be cleaned, cataloged, and accessioned to the University of Alaska Museum in Fairbanks. Site survey cards for each discovered site will be filed in the Alaska Heritage Resource Survey file maintained by the Alaska Division of Parks in Anchorage.

Aerial reconnaissance was used to survey portions of the survey area characterized by steep sidehill slopes. These areas suffer from massive surface soil disturbance due to cryoturbation, therefore opportunities for finding preserved archeological sites are reduced. In addition, such areas are not known archeologically and/or ethnographically to be likely site locations. However, despite the low archeological potential, portions of these areas were surveyed on foot.

Results

As a result of the 1981 fieldwork, a total of 13 sites was discovered in or near the proposed right-of-way during the 1981 field season. Eleven of these sites are prehistoric and two are historic. Each of the discovered sites appears to be small in spatial extent, but site areas are not known for certain since no Phase II site testing was conducted during the 1981 field season.

Four of the discovered sites appear to be within 1000 feet of the centerline. However, only two sites appear to be directly endangered by the

proposed routing along link 13s (HEA-204 and HEA-205). Pending permitting of the final route, these sites may require further investigation. Testing and evaluation at each site should be conducted with the objective of making a determination as to whether either site is eligible for inclusion in the National Register of Historic Places.

V. ENVIRONMENTAL CONSEQUENCES

IMPACT ON TOPOGRAPHY

No impact will be incurred by topographic features as a result of the Intertie project. Areas of steep slopes will affect construction, access and potential soil erosion and are discussed in more detail in the Impact on Soils section.

IMPACT ON GEOLOGY

The Anchorage-Fairbanks Transmission Intertie is expected to have no impact on geologic conditions in the project area. However, certain geologic and seismic features of the project area may affect the Intertie after it is constructed. These include the potential for snow and rock avalanches or fault movements. The transmission line towers and foundations are being designed to accommodate these extreme field conditions.

IMPACT ON SOILS

Preferred Route

Construction and maintenance of the Intertie will affect the soils in the right-of-way by increasing the hazard of water and wind erosion, risking disturbance to areas of permafrost and causing localized soil compaction. The severity of the impact will vary, depending on the characteristics of the soil. However, if mitigation measures are followed, the long-term effect of these impacts should be minimal. Soil characteristics related to potential adverse soil impacts are summarized in Table 18 for the preferred route and alternative route segments;

TABLE 18
SOIL IMPACTS
(Miles Crossed)

Soil Parameter	Preferred Route	With Parks Highway Alternative (links 2s and 5s)	With Broad Pass Alternative (links 10s and 11s)	With Nenana Gorge Alternative (link 14s)
Slope				
0-10%	83.0	101.0	82.5	82.6
10-25%	41.9	38.1	45.7	42.2
Greater than 25%	45.2	37.4	42.3	42.4
Hazards to Soil from Off-Road Traffic ⁽¹⁾				
Slight	20.4	29.0	20.4	20.4
Moderate	1.1	1.5	1.1	1.1
Severe	119.7	111.8	120.1	113.9
Very Severe	28.9	34.2	28.9	31.8
Discontinuous Permafrost	66.7	54.2	66.5	63.7
Silty or Clayey Soils	108.6	115.0	108.6	108.6

NOTE: (1) Assumes activities will cross the average soils in each soil map unit shown in Figure 12.

Source: Interpolation from U.S. Soil Conservation Service (1974) except that slope is from U.S. Geological Survey Topographic Maps.

comparisons have been made for their full length so as to present a more complete overview. Since both the preferred and alternate routes extensively share common links, the differences are attributed solely to the alternative links shown.

Both water and wind erosion of soil have the effect of removing topsoil and nutrients, thereby lowering the productivity or natural fertility of the land. Erosion may also cause secondary problems, such as stream siltation and loss of land through gully formation. Naturally occurring water erosion has produced numerous large valleys and draws in the project area.

The hazard of water erosion depends on climatic patterns, vegetation cover and several soil characteristics, particularly slope and texture. Generally, under local climatic patterns, sloping coarse textured soils must be kept adequately covered by vegetation to prevent washing. Most of the coarse textured steeper soils in the project area can be regarded as highly susceptible to water erosion, especially if the natural vegetation is disturbed. As shown in Table 18 the preferred route crosses 41.9 miles of soils with an average slope over ten percent and 45.2 miles of very steep soils having an average slope over twenty-five percent.

In the steep and very steep areas such as the northern portion of link 3s, and the southern portion of links 6s and 15s, soil disruption and land clearing will be kept to a minimum. The very steep soils will likely be cleared by hand. On slopes where machine clearing is possible, disruption of soils will be minimized by avoiding, where possible, soils susceptible to severe erosion or creep. In all areas the low growing shrubs and herbaceous vegetation will not be cleared unless necessary for line construction or safety reasons.

Access to the transmission line right-of-way will utilize existing roads to the maximum extent possible. However, new access roads or trails will be required from the marshalling yards to the right-of-way. Erosion from road

construction and use is, in part, related to initial construction activities, type of road or trail surface, culvert design, amount of use the road or trail receives, local climate and any mass wasting activity associated with the road or trail. Land clearing, especially on steep slopes, may increase the frequency of mass wasting activity. At the present time the amount of new roads or trails necessary for access to the transmission line right-of-way cannot be estimated precisely.

Access trails along the transmission line right-of-way will be concentrated along the centerline of the right-of-way. As discussed by the SCS (1979), soil features important to off road trafficability of the soils are duration of wet conditions, soil texture and erodibility. The hazards to the soil along the right-of-way centerline from vehicle traffic has been estimated in Table 18 based on ratings applied to each soil map unit in Figure 12 by the SCS. The preferred route traverses 21.5 miles of soils with slight or moderate hazards of damage from off road vehicles and 148.6 miles of soils having severe or very severe hazards.

Access roads or trails will be constructed to present minimal soil erosion hazards. In steep areas access roads or trails will be constructed with erosion control devices, such as water bars, contoured drainage ditches or other appropriate means of curtailing erosion. The roads will be located to cross streams and watercourses at right angles whenever possible. Culverts and bridges will be installed where necessary. In addition, road construction may include dust-control measures in sensitive areas. All existing roads will be left in a condition at least equal to or as good as their condition prior to the construction of the Intertie.

Soils which have been disturbed in the transmission line right-of-way, by access roads, in the material lay-down areas and in other areas will be restored following standard reclamation practices for southern Alaska. Recommendations for revegetation are discussed at the conclusion of the Impact on Vegetation section. Consultation will be made with the SCS, ADNR, other agencies with reclamation experience or the landowner concerning reclamation practices. The

disturbed areas will be monitored until permanent vegetation becomes reestablished. Where access roads must be constructed, grades, embankments, and drainage systems will also be designed and managed with the advice of the local SCS office or the landowner to avoid soil erosion. Use of the roads by the public will be discouraged to the maximum extent possible, consistent with policies or legal considerations of controlling agencies or the landowner.

Discontinuous permafrost is present from the junction of links 3s and 6s near Curry, to Healy at the northern terminus of the proposed line. The preferred route crosses 66.7 miles of discontinuous permafrost as shown in Figure 12. Permafrost is maintained by a very delicate thermal equilibrium and small changes in vegetation cover can cause the ground to thaw. Depressions left by wheels or tracks result in increased depth of thaw. Frozen soil materials with high silt content and high ice content tend to have slope stability problems, even on 1 to 2 percent slopes, if they are thawed.

The impact to permafrost soils will be minimized to the maximum extent possible. Portions of the preferred route crossing permafrost will be built during cold periods when the soil cannot thaw out. Existing ground cover such as vegetation or peat will be disturbed as little as possible where permafrost is present.

Soil compaction will result from the movement of heavy vehicles and equipment along the right-of-way during construction and from the occasional passage of maintenance vehicles during operation of the transmission line. Soil compaction causes decreased soil productivity for vegetative growth, since the compacted soil cannot readily exchange gases with the air or absorb water and plant nutrients. Because the water absorption rate is reduced, water from precipitation runs off compacted soils more readily and increases the hazard of soil erosion.

Compaction will be most severe on the finer textured soils such as the silty or clayey soils (Table 18), especially when they are moist or wet from precipitation or stream overflow. The preferred route crosses approximately 108.6 miles of land which has significant amounts of silty or clayey soils. The impact of soil compaction will be greatly reduced through the natural freezing and thawing action of the soil during the winter. Winter construction scheduling should minimize the compaction hazard.

Minor amounts of topsoil will become mixed with subsoil where borings are made for the structure bases.

Alternative Segments

The Parks Highway alternative, links 2s and 5s, crosses less steep topography than that crossed by links 3s and 6s, and therefore represents less potential soil erosion hazard. As shown in Table 18, links 2s and 5s cross 11.6 fewer miles of steep soils (sloping over 10 percent). This alternative will result in about the same hazards to soil from off road vehicles as the preferred route. Although the alternative segment would cross 7.9 fewer miles of soils rated as having severe hazards, it will cross 5.3 more miles of soils having very severe hazards.

Links 2s and 5s do not cross any permanently frozen soils, while links 3s and 6s cross 12.5 miles of soils with discontinuous permafrost. Links 3s and 6s will result in less compaction on non-frozen silty or clayey soils since they cross slightly less (6.4 miles) than the 2s and 5s alternative. Overall the Parks Highway alternative segment will present less of a hazard to local soils.

The Broad Pass alternative, links 10s and 11s, has very similar soil characteristics, compared to link 12s of the preferred route. As shown in Table 18, the 10s and 11s alternative crosses slightly more (0.4 miles) steep soils. This alternative crosses 0.4 more miles of soils having severe or very severe hazards

from off road travel. The preferred link 12s crosses slightly more (0.2 miles) soils with discontinuous permafrost. Neither links 10s and 11s or 12s cross soils with a high compaction hazard due to the dominance of silty or clayey textures. Because link 12s is 0.4 miles shorter than links 10s and 11s, it will result in less soils crossed and therefore would most likely result in less overall impact to soils.

Alternative link 14s through the Nenana Gorge crosses 2.5 fewer miles of steep soils than link 15s and will therefore result in less soil erosion hazard. Link 14s will also cross 2.9 fewer miles of soils rated as to having severe or very severe as to off road vehicle hazards. Likewise link 14s will present less impact to permafrost by crossing 3.0 fewer miles of soil with discontinuous permanently frozen layers. Neither link will cross significant amounts of soils dominated by silty or clayey surface horizons which will be particularly susceptible to compaction from vehicles.

In the Nenana Gorge unstable subsurface conditions prevail and landslides are especially common. Since it was built in 1923, the Alaska Railroad line has had numerous track stability problems in this area. Major slides occurred in this area during the central Alaska earthquake of 1947 (Wahrhaftig, 1958). If tower foundations of the alternative link 14s are situated on bedrock, these slope stability hazards can largely be avoided.

IMPACT ON MINERAL RESOURCES

Little impact on mineral resources will result from construction or operation of the Intertie. Some small quantities of sand and gravel deposits will be required for structure foundations. However, the amounts used will be negligible and constitute only minor losses to the resource.

IMPACT ON CLIMATE

The Intertie will not have any impact on climate. Climatic conditions within the project area have been incorporated in the design of the transmission

facilities, however, to accommodate extremes of wind and ice loading and temperature.

IMPACT ON WATER RESOURCES

Preferred Route

Construction of the Intertie between Willow and Healy will require the transmission line to cross unavoidably several large rivers and numerous creeks. Construction activities may result in temporary stream siltation, bank erosion and accidental spillage of lubricating oils and other chemicals into the watercourses. However, specialized mitigative measures will be implimented to ensure that impacts to the project area water resources are kept to an absolute minimum.

Appendix F lists the watercourses crossed by the preferred route; the number of crossings and the names of the significant watercourses are included for each route. Table 19 summarizes the watercourses crossed and paralleled by the preferred route and alternative segments. The preferred route crosses 87 watercourses shown on the USGS topographic quadrangles (1:63,360 scale). All are classified as continously flowing streams by the USGS. The largest streams are the Susitna River, Chulitna River, Talkeetna River and Nenana River. The preferred route parallels (within 300 feet) a total of 28,600 linear feet of streams. This route also crosses or approaches within 300 feet of 9 lakes or ponds which are 10 acres or larger in size.

The major impact hazard to water resources will occur during construction of the Intertie. Construction equipment which fords smaller streams or works along streambanks could cause direct siltation of the watercourse or cause indirect stream bank erosion and siltation by removing vegetation, disturbing permafrost, making ill advised stream channel changes or installing facilities such as culverts or rip rap. The effects of siltation could be to alter stream channels,

TABLE 19
IMPACT TO WATER RESOURCES

	Preferred Route	With Parks Highway Alternative (links 2s and 5s)	With Broad Pass Alternative (links 10s and 11s)	With Nenana Gorge Alternative (link 14s)
Watercourses Crossed				
Rivers and Forks	9	7	9	11
Creeks and Gulches	76	93	78	83
Sloughs	2	1	3	2
Watercourses Paralleled (linear feet) ¹	28,600	45,600	24,100	26,700
Ponds Crossed (Number) ²	9	18	10	10
Significant Watercourses Crossed (Number of times Crossed)				
Willow Creek	1	1	1	1
Kashwitna River	1	1	1	1
Sheep Creek	1	1	1	1
Montana Creek ³	1	-	1	1
Talkeetna River	1	-	1	1
Susitna River	1	1	1	1
Chunilna Creek	1	-	1	1
Indian River	2	-	2	2
Chulitna River	-	1	-	-
Byers Creek	-	4	-	-
Honolulu Creek	1	1	1	1
East Fork Chulitna River	1	1	1	1
Middle Fork Chulitna River	1	1	-	1
Jack River	1	1	1	1
Cantwell Creek	-	-	1	-
Windy Creek	-	-	1	-
Nenana River	1	1	1	3
Yanert Fork	1	1	1	1
Healy Creek	1	1	1	1

NOTES: 1) Paralleled within 300 feet of the right-of-way centerline
2) Ponds over 10 acres in size within 300 feet of right-of-way centerline
3) Between Willow and Talkeetna
Source: U.S. Geological Survey Topographic Maps

fill ponds or damage aquatic flora or fauna. Careless alteration of pond banks could lower pond water levels. During maintenance activities, similar impacts could occur on a smaller scale.

However, the transmission line will have no significant effect on watercourses as long as construction activities are kept out of channels or away from stream banks. Accordingly, general guidelines have been established to set back structure bases from watercourses at least 200 feet and guy anchors no closer than 100 feet to the watercourse, where possible. During warm periods when the streams are not frozen over, a buffer strip will be established along major watercourses to minimize disturbance of the vegetation and soils. During stringing of the conductors and shieldwires across the watercourses, all equipment will be kept out of the buffer strip. The conceptual access plan specifies the special precautions undertaken to avoid crossing natural barriers. Most of these barriers are watercourses.

Where watercourses must be crossed by equipment trails, such crossings will be conducted in a manner to limit pollution or siltation of the watercourse or accomplished during cold periods when the stream is frozen. This will serve to minimize the effect of construction on the stream as well as on the stream banks. Construction equipment will be properly maintained to ensure fuel or lubricating oil spillage is kept to an absolute minimum. Repairing and fueling stations will not be located in or near watercourses, lakes or ponds.

Ground water is not expected to be significantly affected by the transmission line. In many areas the ground water lies below the depth of the average structure footing depth of 30 feet. Where ground water is encountered at depths shallower than 30 feet, the disturbance is anticipated to be localized and temporary. No significant effect to local aquifers is expected.

After construction is completed maintenance operations will be carefully controlled to avoid adverse impacts. Mitigative measures described for construction activities will be followed to avoid impacts resulting from maintenance operations.

Alternative Segments

The Parks Highway alternative (links 2s and 5s) crosses 52 watercourses, 14 more than preferred links 3s and 6s. It also parallels significantly more stream channels and crosses 9 more lakes or ponds. Although this alternative avoids crossing the Talkeetna River, it is less desirable due to crossing a larger number of watercourses and lakes or ponds than links 3s and 6s.

The Broad Pass alternative (links 10s and 11s) makes 14 crossings of watercourses as compared to 11 crossings for link 12s of the preferred route. This alternative parallels about 4500 feet less stream channel than the preferred segment but affects one more lake or pond. Links 10s and 11s appear to have about an equal hazard to hydrology as the preferred link 12s.

The Nenana Gorge alternative (link 14s) crosses 17 streams, 9 more than the preferred link 15s. The alternative link crosses the Nenana River twice, while the preferred link avoids this river. The preferred link affects one less lake or pond. Both parallel about the same amount of stream channel. Because the alternative would cross the Nenana River twice, this link is less desirable than the preferred link.

IMPACT ON WILDLIFE

There are certain inherent impacts associated with the clearing of a right-of-way and construction of a transmission line in any location. These include primary impacts such as the alteration of existing habitats and the subsequent

disruption of the wildlife species utilizing those habitats and the effects the line itself has on the indigenous fauna. The latter impact generally affects bird populations more than other species. It should be noted that most impacts associated with construction and operation of the transmission line will be directed toward individuals of the population rather than toward entire populations of species. Secondary impacts of transmission line construction and operation are only indirectly related to the transmission line. These impacts are more closely associated with the increased human accessibility a right-of-way provides into an area which is otherwise relatively inaccessible.

Primary Impact

The initial alteration of habitats will result from removal of trees and shrubs within the right-of-way which will interfere with tower erection or line reliability, or reduce human safety during conductor and shield wire stringing. Big game species in the vicinity of the right-of-way will be temporarily disrupted by the noise and human activity associated with right-of-way clearing. The disruptions will affect big game species only as long as the activity lasts, except where clearing and construction occurs near calving grounds during the appropriate season. There is a possibility that this increased stress on parturient cows or ewes may cause premature delivery or post-partum abandonment (Thompson, 1977).

The moose, which utilizes many different habitat types, will probably be the species which encounters construction activity the most. However, because it is a generalist herbivore (Belovsky, 1981), the moose will be the least adversely impacted by habitat alterations (Spencer and Chatelain, 1953). Where the proposed route crosses heavily forested areas (cover types 5, 6 and 7) the moose will benefit from clearing the right-of-way and establishing a subclimax community (Leopold and Darling, 1953).

Big Game

The distribution of caribou along the proposed route is somewhat limited. Those that do occur in the vicinity of the right-of-way may be displaced by construction activities. (Based on observations made during field studies, the inherent curiosity of the caribou may overcome their initial fear of the increased human presence). Little alteration of caribou habitat will result from construction of the transmission line. The animal utilizes cover types which require little if any clearing. However, Leopold and Darling (1953) indicate caribou avoid disturbed areas; some ground cover will be destroyed during tower erection and line stringing. Recovery of this small amount of vegetation to a condition suitable for caribou utilization will take considerable time. Recovery will occur providing human activity on the ground along the line is restricted.

Both grizzly and black bears will relocate to avoid the human activity along the right-of-way, except where construction occurs near a den site during winter dormancy. Reynolds and Hechtel (1980) reported that seismic activity caused some agitation to denning bears but did not result in relocation of den sites. However, they cautioned against disturbing denning females with newborn cubs as this may cause abandonment and subsequent loss of the cubs. Because grizzly bears do not necessarily use the same den year after year (Craighead, 1979) locations of den sites, except those recorded immediately prior to construction, would be of little use. However, winter construction activity should avoid known denning areas from October 1 through April 30. Alteration of habitats may temporarily affect bear use of the right-of-way, but this impact will be relatively short-term.

Wolves which occupy the general vicinity of the right-of-way will also be displaced during construction of the transmission line. These disruptions will be very temporary and last only as long as human activity remains at high levels. Additionally, when their principal prey species (i.e., caribou, sheep and moose) are adversely affected, the wolf will also be negatively impacted. Other secondary

impacts associated with the project may affect the wolf as they would other species. These secondary impacts will be discussed further in later sections.

Dall sheep, which occur at the northern end of the proposed route, will be impacted only minimally by clearing, tower erection and stringing. The proposed line does not intrude into known sheep range, and where it is close, no habitat alterations will be necessary. However, the use of helicopters to construct the line in the Moody and Montana Creek drainages could severely impact those sheep utilizing Sugarloaf Mountain during the construction period, if appropriate restraints are not placed on helicopter movement. Horseji (1976) described the reaction of bighorn sheep to helicopters in flight, even up to one mile away. Personal observations during field studies did not corroborate Horseji's noted "explosive reaction", but the sheep near site 24 did appear agitated during helicopter flights in their presence. The increased stress resulting from such excitement could increase mortality rates (Horseji, 1976) in the Sugarloaf Mountain sheep herd.

Small Game

Small game species will be somewhat affected by construction and maintenance of the proposed transmission line. Generally, these species will relocate during human activities, and re-invade the right-of-way when construction activity levels subside. Right-of-way clearing in heavily forested areas may provide habitat improvement for most of the small game species which utilize sub-climax communities. Population levels of most of the small game species fluctuate cyclically. Therefore, as direct loss of individuals will depend on density, no prediction can be made as to the loss of individuals. However, there will be no measurable impact to the regional populations of any of the small game species.

Migratory Game Species

Construction of the Intertie may have some affects on waterfowl populations in the immediate vicinity of the proposed right-of-way. The important

species (as detailed in previous sections) arrive in the project area from mid-April to mid-May to begin nesting (Bellrose, 1976). From this time until about the end of September, when most of these ducks leave, they are susceptible to disturbance from construction activities. Because the area is not as productive as most of the rest of the state, any disruption to nesting ducks will have minimal affect on waterfowl production statewide.

Trumpeter swans arrive in the project area and establish territories soon after ice breakup and begin nesting in May (Hansen et al., 1972). Some birds remain flightless through August (Bellrose 1976). During nesting and brood rearing, these swans are very susceptible to human disturbance. In fact, Hansen et al. (1972) reported that disruption "...induced by human intrusion, appeared to be the greatest factor leading to higher mortality rates..." of young swans. For this reason, construction activity should be restricted during May through August in areas with active trumpeter swan nesting territories. Aerial surveys of the links containing known swan nests (Figure 13) should be undertaken immediately prior to construction to determine water bodies with nesting swans.

Sandhill cranes should not be greatly affected by habitat alteration in the project area. These birds prefer the muskeg-bog and other open type habitats. Because little clearing will be required in these cover types, the sandhills will not lose many habitat requirements. The common snipe, which utilizes both open and forested cover types, will also not be adversely impacted by habitat alterations.

One important impact which will affect many migratory and resident bird species regardless of habitat requirements is the mortality associated with collisions. Such collisions with conductors, guywires, shield wires and towers are generally considered only somewhat mitigable (Avery (ed.), 1978). While birds other than migrants are also subject to collisions, the potential is probably greater with migrants than with local species (Avery (ed.), 1978). James and Haak (1979) reported the majority of birds collided with shield wires, perhaps while trying to

avoid the larger, more visible conductors. With current technology, the potential for bird collisions with high voltage transmission line structures cannot be eliminated. However, the horizontal configuration of the conductors may lower the collision potential (Thompson, 1978) especially where the line lies perpendicular to communication flyways.

Furbearers

The mammals classed as furbearers will not be greatly affected by construction and operation of the transmission line except during the initial right-of-way clearing. The removal of trees and shrubs will result in a loss of some habitat and food species for beaver. Maintenance of a shrub community in the right-of-way will substantially reduce this loss. The marten will lose some habitat as a result of right-of-way clearing. Although the marten requires large expanses of mature spruce forest, it will utilize clearcuts to some degree (Soutiere, 1979) and will probably adapt to the presence of the cleared right-of-way. Other furbearers will undergo some short-term impacts during clearing and construction, however, their populations are not expected to be affected.

Nongame Mammals and Birds

Some small mammals will be lost during right-of-way clearing, tower erection and line stringing. The loss of some individuals of these species is unavoidable. The reproductive rates of most of the small mammals involved are such that populations will recover within one to two reproductive seasons. Habitat alterations may affect some small mammals and result in population shifts.

Nongame birds will also undergo population shifts during clearing and construction activities. Once the line is in place, the right-of-way will become a part of a territory of most of the species which were present prior to construction. Anderson et al. (1977) reported that only one species in Tennessee obviously avoided a 30.5 meter (m) wide transmission line right-of-way. However, they pointed out that a very wide right-of-way (91.5 m) shifted population structures so

that summer residents tended to displace permanent residents. They further indicated that narrower corridors provided the least change in forest community composition, while wide corridors attracted and supported grassland species. Anderson (1979) reported that migrant populations lost numbers when a 45 m right-of-way was cleared through a forest. It is expected that similar shifts would occur in the heavily forested regions of the project area, with birds which utilize muskeg-bog and wet or moist tundra (see Kessel, 1979) increasing their utilization of the corridor. This shift can be minimized by allowing clumps of understory vegetation to remain in the right-of-way (Hooper et al., 1973).

Certain raptors may lose some nesting habitat as a result of clearing. All of the routes avoid known bald and golden eagle nests. Once the right-of-way is cleared, some raptors will find it provides hunting habitat or hunting perches not previously available. There is a possibility that raptors may collide with the line. The spacing of conductors and shield wires is such that there is little possibility of electrocution.

Endangered and Threatened Species

Of the two species listed by the USFWS, neither are known to utilize the project area except possibly as migrants. Neither species should be adversely affected by habitat alterations associated with the project. Neither the peregrine falcon nor the eskimo curlew are particularly susceptible to collisions with the transmission line, although collisions may occur.

The possibility of providing nesting habitat for peregrine falcons through the use of nesting platforms attached to the transmission towers in appropriate cover types is currently being investigated (M. Nelson, 1981, personal communication). The value of such platforms has been demonstrated for several raptor species, however it is not yet clear that endangered peregrines will utilize the platforms.

Secondary Impact

The major ecosystems in the project area are relatively undisturbed. Only two features provide some disruption to, what is for the most part, pristine wildlife habitat. These are the Parks Highway and the Alaska Railroad. Construction of both of these corridors has resulted in several important primary and secondary impacts on wildlife. The clearing and construction of both have resulted in the alteration of habitat and disruption of wildlife activity. The use of both has resulted in the direct loss of wildlife. Up to 300 moose have been killed by trains on the railroad in a single winter, (Didrickson, ADFG 1981, personal communication). Based on availability of habitat and population levels in the region, these impacts are relatively minor. However, the increased human activity associated with these corridors has resulted in even greater habitat alterations along with increased hunting pressure.

The potential impacts of a third corridor in this area will be similar. Additionally, the presence of another corridor may increase the distance which large mammals must go to find escape cover or a refuge from increased human presence. This will increase stress levels on such animals which may affect reproductive rates and survivability.

Preferred Route

Much of the proposed route avoids areas of human activity, however, that increases the probability of secondary impacts in areas not previously disturbed by human activity. Link 1s comes within one mile of a known trumpeter swan nesting area and between a second nest site and the Susitna River (a migratory corridor). Additionally it crosses large areas of muskeg-bog which provide nesting habitat for sandhill cranes and a large number of shorebirds. All these species are particularly susceptible to collisions with transmission lines (see Avery, 1978: 108-109; Walkinshaw, 1956; Krapu, 1974; and others). Because the link follows an existing narrow right-of-way and traverses areas with some previous

disturbance, the major impact to wildlife along this link will probably be bird collisions. These impacts are, with current technology, unavoidable. Much of the right-of-way along link 1s has been proposed for revegetating with browse species (i.e., willow, alder, etc.) to provide habitat for moose (Didrickson, 1981 ADFG, personal communication). Evaluation of such revegetation should be undertaken in this area prior to mitigative efforts.

Although some human disturbance, including cabins and tractor trails occur along the southern and northern portions of link 3s, the rest of the link traverses relatively untouched habitat. A bald eagle nest has been identified along the North Fork of Montana Creek approximately 1 mile east of the link (Figure 13). The major impacts to wildlife associated with this link will be habitat alterations from clearing through the various forest cover types. These will be relatively minor because of the remaining available habitat. Secondary impacts resulting from increased human accessibility will be major along this link.

Link 6s more or less follows the Alaska Railroad for most of its length. It passes approximately one mile from two bald eagle nests (Figure 13) and crosses the Susitna River, a minor migratory corridor. It also crosses twice and parallels the Indian River. The major impacts to wildlife along this link will be habitat alterations in the bottomland forests and bird collisions. The disturbed nature of most of the corridor precludes secondary impacts.

Only minor impacts to wildlife are expected along link 7s. Most of the link is in shrubland cover type and no major rivers are crossed.

The Parks Highway is more or less paralleled by link 9s. The link crosses the East Fork of the Chulitna River. Most of the route is in upland forest and habitat alterations will be the major impact to wildlife.

Link 12s crosses the Middle Fork Chulitna River and crosses and parallels the Jack River at the north end of Broad Pass. Although most of the habitats are open along the link (wet tundra and shrubland), some areas of upland forest are also crossed. Some impact will be expected from habitat alterations along this link.

Link 13s crosses and then parallels the Nenana River. Most of the habitats involved along link 13s would be shrubland and upland forest with some wet tundra present. The major impact to wildlife associated with this link will be from habitat alterations, although some bird collisions may also occur.

Link 15s parallels Montana, Moody or Healy Creek for most of its length and crosses Montana and Healy Creek once. This link comes closer to the area the dall sheep utilize than any other link. Evidence presented in the impact section indicated the use of helicopters along this link may be more injurious to dall sheep than other methods of construction, if precautions are not taken during construction. Measures to minimize this impact should include seasonal restrictions (stay within one-half mile of the right-of-way from spring breakup to mid-June) and operative restrictions (maintain at least 1,000 feet of ground clearance when operating above ground elevations of 3,000 feet and avoid flights across Sugarloaf Mountain). Major wildlife impacts associated with this link will be disturbance of the sheep and possibly caribou, habitat alterations in the Montana Creek drainage and bird collisions.

Link 16s is very short and will probably involve very little impact to wildlife.

Alternative Segments

In the southern portion of the project area, the Parks Highway alternative follows the Parks Highway fairly closely. This alternative traverses areas which contain a great deal of human activity. The wildlife species which are

sensitive to human disturbance at least sometime during their life cycle (i.e., certain raptors, calving moose, etc.) will avoid areas where human activity levels are high, particularly during those periods when their tolerance is low. These species avoid the settled areas along the Parks Highway.

Link 2s more or less follows the Parks Highway. A trumpeter swan nesting location exists at the south end of the link. The major impact along this link will be habitat alterations, although the previous disturbance in this area precludes major impacts. However, bird collisions, particularly at the Susitna River Crossing, could occur.

Link 5s also generally follows the Parks Highway and passes approximately one mile from three trumpeter swan nesting locations which were identified in 1968 (Figure 13). Additionally, the link crosses the Chulitna River, which is a minor migratory corridor. The major impacts associated with link 5s will be habitat alterations. Additionally some bird collisions could occur, however little impacts from increased accessibility will be expected.

In Broad Pass, there is an alternative to the proposed route: link 10s, a relatively short link which crosses Broad Pass transversely. The major impact associated with link 10s will be bird collisions and habitat alterations. The Broad Pass area is a migratory corridor and is subject to low ceilings. The combination of these two conditions give link 10s a very high potential for bird collisions. Additionally, the crossing of the Middle Fork of the Chulitna River will have to be realigned.

Link 11s generally parallels the Parks Highway and Alaska Railroad for most of its length. It also parallels and crosses Cantwell Creek, crosses the Jack River and the proposed State Selected Cantwell/Broad Pass Caribou Winter Range Ecological Preserve (Underwood and Juday, 1979). Most of the link traverses shrubland and only minor impacts will be expected from habitat alterations.

The alternative to going through the Moody-Montana area is to route through the Nenana Gorge. For most of its length, link 14s parallels the Nenana River and the Parks Highway. It crosses the Nenana River twice and Moody Creek. The link also comes close to the dall sheep area on Sugarloaf Mountain. Some disturbance to the dall sheep could be expected during construction but because the link so closely follows the road, disruption to the sheep will be minimal. Some bird collisions could occur, particularly at the Nenana River crossings. Habitat alterations will cause some impact in the forested areas.

IMPACT ON VEGETATION

The primary impacts to vegetation will come as a consequence of clearing operations for right-of-way development. Clearing is necessary for safety standards when stringing the line and for reliability after the line is operational. Surface disturbance associated with foundation placement and access will also modify the vegetation. The following discussion will address both general and specific (by cover type) impacts while appropriate methods of mitigation are outlined.

Primary Impact

In forested areas removal of the overstory will create the major impact because of the direct loss of vegetation. The microclimate will also change due to the increased amounts of light and changes in other parameters. For instance, Brown (1972) reported that the surface wind velocity, in clearcut strips within a black spruce forest, was higher and of longer duration. This allows increased evapotranspiration rates from the surface vegetation. As a result of these modifications, species will inhabit the right-of-way which are capable of surviving under these changed conditions. In many cases they will be light tolerant and the community will initially resemble a roadside or field. In time shrubs and trees will invade or sprout from stumps and will periodically require maintenance. Selective

clearing will modify the tunneling effect mentioned above, while also minimizing visual problems.

Secondary Impact

Mechanical damage may also occur to edge trees with the possibility of insects or fungi using these wounds to enter the trees. A decline in vigor may result from these damages or from changes brought about by clearing (Carvell and Johnston, 1978). Careful equipment operation will, for the most part, alleviate this problem.

Other problems center around the disposal of slash. Proper disposal methods will be required because of the disease and insect potential of certain species (i.e., spruce). If slash is to be burned, proper placement of the piles is necessary as Peace (1962) indicates bark of living trees may become scorched. In certain areas chipping may suffice which will also aid in soil stabilization and revegetation. Carvell and Johnston (1978) report sunscald is common on certain right-of-way edge trees. It is caused by repeated and rapid freezing and thawing in the winter on the side of the tree exposed to the sun. While no known studies have been completed in Alaska, this problem has been observed on poplars, and is more common on the north and northeast margins of openings (Carvell and Johnston 1978). Sun scald may not be serious enough to affect routing options but should be considered in right-of-way maintenance programs.

Another impact will be the selected removal or topping of danger trees. Severe topping, where required, must be done with extreme care following standard industry guidelines. Carvell and Johnston (1978) indicate cuts made in early spring heal most rapidly except for species such as birch. These should be trimmed in summer when sap runs less freely. Although many species tolerate heavy topping, old birch trees and conifers may recover slowly (Carvell and Johnston 1978). This may be especially true in Alaska.

Cover Types

Ebner (1976) indicated that surface disturbance for transmission line construction is relatively low compared to that from most projects of similar scope. He also indicated that most clearing is done on soils that can tolerate the disturbance.

Bottomland Spruce-Poplar

Zasada et al. (1981) found that revegetation (after timber harvest) in balsam poplar areas was rapid with grasses, horsetails, willows and alders invading. Their study would correlate with vegetation type 5 located along the first six links. Precautions will be necessary on steep slopes but if ground cover and stumps are left, little problem can be expected with erosion and revegetation should proceed naturally.

Lowland Spruce-Hardwoods

The lowlands, as pointed out in an earlier section, are often located adjacent to the bottomlands. Cover type 7, lowland spruce-hardwood forest, is also associated with the southern links (1s-5s) but clearing should not be as great as in the floodplains because of the differences in growth conditions. This is evidenced by Viereck and Little (1972) who indicated a tree only two inches in diameter could be 100 years old. Furthermore, these areas are usually classed as noncommercial forest land which is in sharp contrast to the very productive bottomlands. Due to the waterlogged soils, winter construction is scheduled to facilitate construction activities and reduce damage to the vegetation.

Upland Spruce-Hardwoods

The upland spruce-hardwood areas (cover type 6) are associated with links 3s through 15s but are dominant in the central portion of the project area. As altitude increases, soil depth (and moisture) decreases but becomes increasingly important for vegetation establishment and survival. In fact Shelton (1962)

indicated these parameters influence treeline more than climate. Shelton found more forest cover present on the south slope but growth rates between north and south were similar. Consequently more clearing may be necessary on south slopes in these forested areas. Also, if the surface vegetation is left intact with only trees cut about 6 inches above ground and shrubs trimmed, little problem with erosion can be expected. Summer construction is anticipated for much of this type except for permafrost areas which are highly sensitive to warm weather construction.

Shrublands

Near treeline and watercourses shrub thickets (cover type 8) can be found. This cover type dominates links 11s through 16s. Since shrubs will not interfere with the line reliability only initial trimming will be necessary in certain areas for stringing operations. If the ground cover and shrub root mass are not disturbed, regrowth will occur in the spring season following trimming. The impact will also be lessened by avoidance of steep slopes by vehicles. A positive aspect of the new growth will be additional wildlife browse.

Tundra

Moist, wet and alpine tundra, cover types 1, 2 and 3 respectively, are scattered throughout the project area but seem to be concentrated north of Hurricane Gulch on links 9s through 13s. It is a well known fact that these are sensitive or fragile ecosystems and that off road vehicular traffic will create an adverse effect. The 1976 Surface Protection Seminar sponsored by the Bureau of Land Management is a case in point in which the adverse impacts and suggested mitigation were discussed. Of primary importance is the degree of terrain degradation to which Brown (1976) indicated it was proportional to the number of passes. He also said a single pass on the tundra can cause serious permafrost degradation and erosion. Consequently, construction will be completed when the ground is frozen.

Low Brush, Muskeg-Bog

This cover type (9) dominates the initial link but is also found on links 2s, 3s and 5s. Due to the waterlogged soils involved with this type (sphagnum borofibrists; Appendix D, Table B) access and construction during summer months would create extensive damage to the vegetation. Consequently, construction will be completed when the ground is frozen so fewer or less extensive mitigative measures will need to be employed.

Aquatic Plants, Streamsides

Impacts to aquatic plants should be very minimal due to the use of winter construction on most of the aquatic environments. A buffer strip adjacent to major watercourses will also be handcleared further relieving impact to these sensitive areas. Consequently little direct or indirect impact to those species and their habitats should result from operations connected with the transmission line.

Impact to Threatened and Endangered Plants

While no endangered or threatened plant species are known to occur for the project area, the plants identified previously could be present. If any are located, mitigative measures will be recommended; most likely a slight tower shift or re-routing access would be all that is necessary to protect the individuals and their habitat.

Preferred Route

The following discussion is a result of utilizing vegetation and soils information in Table 20 (revegetation guidelines), Table 21 (Soil information and revegetation groupings), Table 22 (cover types crossed), field observations and information provided in the previous sections which were drawn from the literature and personal contacts.

TABLE 20
REVEGETATION GUIDELINES¹

<u>Mixtures</u>	<u>Revegetation Classes</u>	<u>Variety Name</u>	<u>Broadcast Seeding Rates Lbs/Acre</u>	<u>Fertilizer/Lbs</u>	
				<u>1st Year</u>	<u>2nd Year</u>
I. SOUTHERN PORTION (COOK INLET-SUSITNA AREA)					
Red Fescue	1,2	Arctared	10	100-100-50	0
Hard Fescue*	3	Durar	10	100-100-50	30-60-30
Creeping Foxtail	4	Garrison	10	100-100-50	30-60-30
Sodding or adjacent living material	5	-	-	-	-
Sodding or adjacent living material	6	-	-	-	-
II. HIGHER ELEVATIONS (TUNDRA)					
Replace with native tundra sod vegetation or native grasses.					
III. NORTHERN (INTERIOR AREAS)					
Smooth Brome	1	Polar or Manchar	20 16	100-60-60	0
Smooth Brome	2	Polar or Manchar	10 8	100-60-60	60-60-60
Smooth Brome	3	Polar or Manchar	10 8	60-60-60	60-60-60
Creeping Foxtail	4	Garrison	8	60-60-60	60-60-60
Creeping Foxtail	5	Garrison	8	60-60-60	60-60-60
Cottongrass Soil	6	-	-	-	-

¹Alaska Rural Development Council, 1977

Red Fescue and Smooth Brome mentioned by
Dr. Mitchell, personal communication, 1981.

TABLE 21

APPROXIMATE CORRELATION OF REVEGETATION CLASSES¹ WITH SOILS

<u>Map Symbol</u>	<u>Soil</u>	<u>Revegetation Classes</u>
SO1	Typic Cryorthods	1
	Sphagnic Borofibrists	6
SO4	Typic Cryorthods	2
	Sphagnic Borofibrists	6
SO10	Humic Cryorthods	3
SO15	Pergelic Cryorthods	2/3
	Histic Pergelic Cryaquepts	5/6
SO17	Pergelic Cryorthods	3
	Rough Mountainous Land	3
Q25	Pergelic Cryaquepts	3
	Pergelic Cryochrepts	3
RM1	Rough Mountainous Land	3
R10	Typic Cryochrepts	1/2
	Aeric Cryaquepts	1/2
	Histic Pergelic Cryaquepts	5/6

¹ Alaska Rural Development Council, 1977

TABLE 22

COVER TYPES CROSSED¹
(ACRES DISTURBED)

Cover Types	Preferred Route	With Parks Highway Alternative (links 2s and 5s)	With Broad Pass Alternative (links 10s and 11s)	With Nenana Gorge Alternative (link 14s)
1. Moist Tundra	21.4	-	21.4	21.4
2. Wet Tundra	42.6	44.6	24.2	42.6
3. Alpine Tundra	9.5	-	9.5	9.5
5. Bottomland Spruce- Poplar Forest	120.0	119.9	120.0	120.0
205 6. Upland Spruce- Hardwood Forest	652.0	602.7	713.4	652.0
7. Lowland Spruce- Hardwood Forest	338.7	510.7	338.7	338.7
8. Shrublands	162.5	149.2	166.5	162.5
9. Low Brush, Muskeg-Bog	49.3	78.5	49.3	49.3
TOTAL	1396.0	1505.6	1443.0	1396.0

¹Assumptions in clearing have been made only for the comparative evaluation of routes:

- 110 feet cleared or disturbed in forested areas (cover types 5, 6, and 7)
- 0.5 acre cleared or disturbed at tower locations in cover types 1, 2, 3, 8, and 9
- 10 foot access road cleared or disturbed in cover types 1, 2, 3, 8, and 9

Link 1s will be impacted minimally as a result of anticipated winter construction and the reduced amount of necessary clearing involved with the low brush, muskeg-bog and lowland spruce-hardwood areas. Natural revegetation should also occur rapidly in the bottomland areas.

Links 3s and 6s will traverse eight vegetation types in its 73.1 miles. Most of the route crosses upland and lowland spruce-hardwood forests but about 13 percent is located in the tundra. In addition, when considering soils information, over three-fourths of these links cross steep slopes and rough terrain which may pose a severe problem for construction access. As a result, it may be difficult to revegetate the right-of-way either by natural or artificial means.

All of link 7s and two-thirds of link 9s are located on soils with steep slopes and rough terrain. A portion of link 9s is located on peaty soils so winter construction would alleviate many problems. Link 9s also crosses some tundra but the majority of the link crosses upland spruce-hardwood forests and shrublands.

Link 12s is 22.2 miles long with almost one-third (6.5 miles) being located in tundra.

Almost one-quarter of link 13s is in tundra areas, while most is located in shrublands. Upland spruce-hardwood forests are also present.

Link 15s is also located in an undeveloped area of upland spruce-hardwood and shrublands. Consequently, a new right-of-way will change the vegetative character.

The final link is less than a mile long and is located entirely in the shrubland cover type. Minor changes in the vegetation community should result from construction and maintenance of this link.

Alternative Segments

The Parks Highway option consists of links 2s and 5s and is 79.5 miles in length. From a vegetation perspective, the further development of this existing corridor presents a better option than establishing a new corridor. For instance, these links traverse one-third less steep lands than the preferred links and therefore cause fewer erosion problems. Consequently, vegetation which is left after construction will have a better rate of survival. Approximately 29 acres less tundra will be disturbed on these links, although an additional 172 acres of lowland spruce-hardwood will be crossed.

Links 10s and 11s comprise the Broad Pass alternative and are located on the same soils as is the preferred route. Therefore erosion will be similar. Also, only 1.1 miles are located in tundra as compared to 6.5 for the preferred link.

Link 14s, the Nenana Gorge alternative, is only 10.9 miles in length and traverses 0.4 acres less vegetated lands than the preferred route. Almost half of this link is on the Rough Mountains Land which is mostly barren. It is also located mainly adjacent to an existing developed corridor and crosses lands which will pose less of a soil erosion problem.

Mitigative Measures

Only that vegetation which will interfere with safety and reliability standards will be removed within the buffer strip or greenbelt established at major stream and river crossings. Clearing necessary in this area will be by hand, with no machine clearing permitted.

In areas where the vegetation is removed and construction activities alter the soil surface, original contour will be achieved when weather and ground

conditions permit. Access will be chosen to alleviate erosion problems and when necessary erosion control devices will be constructed. Slash and timber will be disposed of according to regulations.

Artificial revegetation of the entire right-of-way is not economically feasible or environmentally necessary. For instance Neiland (1978) stated, "Cost accounting may show that if native and naturalized vegetation will invade bare areas, although perhaps somewhat more slowly than with immediate reseeding but with longer lasting vegetation of more value to wildlife and with a tolerable level of erosion, tax money might better be spent on other aspects...".

Consequently, the entire right-of-way should not require revegetation. Instead, a vegetation management plan can be produced cost effectively to mitigate impacts in those areas specifically requiring prompt action following construction. Only problem areas (tundra, steep slopes) will become candidates for revegetation. Since methods and mixtures are site specific (Brown, Johnson and VanCleve, 1978) the plan should be developed after final route alignment has been designed and the construction plans have been completed.

The plan should incorporate data from studies of natural revegetation (succession), soils, maintenance objectives, regulatory requirements, artificial establishment and economics. Generally revegetation should follow accepted published guidelines (Alaska Rural Development Commission, 1977). Table 20 identifies some common herbaceous plants and is associated with Table 21, which outlines soil descriptions. Woody plants could also be utilized where local conditions permit. General suggestions are provided in Alaska Rural Development Commission (1977).

IMPACT ON FISHERIES

Construction and maintenance of the Anchorage-Fairbanks Transmission Intertie will create conditions that potentially could affect the aquatic environment. Generally impacts associated with transmission lines are short termed, lasting not more than one or two growing seasons and localized in the vicinity of the right-of-way. However, if proper mitigative measures are not employed, the possibility exists that construction of the proposed line could have far reaching effects on the aquatic environment not only in the construction zone but in seemingly remote areas.

The concept of constructing the Intertie by restricting construction to area units bounded by natural barriers (generally watercourses) will reduce the expected impacts to the aquatic environment. Figure 7 depicts a conceptual access plan and how the proposed alignment could be generally divided into several area units. Construction will be completed within each area unit so that natural barriers will be crossed along existing corridors, either the Parks Highway, the Alaska Railroad or other roadways. The final access plan to be employed for the Intertie project will be jointly implemented by APA, their contractors and appropriate state and federal agencies. The resultant plan will be designed to aid in meeting requirements set forth under Title 16 and the State Water Quality Standards (18 AAC 70.010-110).

Preferred Route

The preferred route makes 87 crossings of rivers and streams (as shown in Appendix F) and comes within one mile of 44 lakes larger than 40 acres and countless smaller lakes and ponds. As previously mentioned, virtually all these water bodies are important habitat for the endemic and anadromous fisheries. The clearing of the right-of-way, establishment of a construction road and movement of equipment through watercourses may increase runoff and sedimentation to the

receiving waters. Adult fish generally will migrate through waters that are heavily silt laden as evident by their passage up rivers and streams with heavy loads of glacial silt. However, they migrate to areas where there is high water quality (high levels of dissolved oxygen and low silt) and where lack of sedimentation becomes important in increasing spawning success and fish production. Hall and Lantz (1969) report that silt forms a layer on spawning gravel that may reduce the intergravel dissolved oxygen levels around developing salmonid eggs. They further report that a layer of silt as little as one-quarter of an inch may delay hatching, reduce hatching success, prevent swimup and produce weaker fry. Siltation not only affects the eggs and fry but also reduces the benthic food organism by filling in available intergravel habitat (Smith, 1940). Increase in runoff may lead to the reduction of fish production as higher peak flows will be reached quicker, shifting stream gravel and scouring eggs, fry and food organisms downstream (Hall and Lantz, 1969). However, Hall and Lantz (1969) also report these impacts generally will not be permanent if adequate attention is given to stream protection.

Many of the adverse impacts can be reduced, if not eliminated, by timing construction to periods of low potential erosion or the use of passive erosion controls. Winter construction periods as proposed for the southern portion of the line (Construction Zone 1 and parts of Construction Zone 2 in Figure 7) and in areas where there is permafrost (Figure 12), will enable construction activities to take place while snow protects the low vegetative cover that stabilizes soils. In addition, ice bridges will be used by construction equipment for crossing spawning areas while salmonid eggs and fry are in the gravel. Use of ice bridges will also enable construction equipment to cross treacherous waters such as the Kashwitna and Talkeetna Rivers which otherwise would require temporary bridges, extension of access roads or environmentally unacceptable fords.

In areas where there will be no winter construction, crossings should be made by use of temporary bridges, culverts, or low water crossings. Bridges should be constructed to preserve bank integrity which will reduce the potential for bank

erosion and creation of gullies. In the use of culverts on small streams, the placement of the tubes and fill should not impede the movement of fish in either direction. The tubes should be large enough to pass water levels that would reasonably be expected to occur during the construction period. Tubes should not create any water velocities greater than four feet per second under normal flow and flow lines should be placed six to eight inches below the stream bottom to prevent damming. At the completion of the construction activities all temporary bridges, culvert tubes and gravel will be removed and the stream banks reshaped to preconstruction conditions.

At stream crossings where equipment will move directly through the water without the aid of bridging structures, the crossings must be made during the periods when there are no eggs or fry in the gravel. Generally this will be a period in June and July after the rainbow trout and Dolly Varden fry have developed through swim-up and before the Pacific salmon start to spawn. Equipment should have low psi surface loading to reduce gravel compaction and prevent the gravel from being dug up. During these periods, these activities should be closely coordinated with the ADFG. In areas where spawning gravel has been destroyed by compaction and siltation from excessive equipment crossings, all reasonable methods should be employed to restore the stream bottom.

Erosion can be reduced by the implementation of passive restraints such as contour furrowing, water spreaders, diversion ditches, soil binders, and rock or gravel blankets. The method or combination of methods used to control erosion will be site specific based on existing conditions and further defined during the permitting process. Any exposed ground should be seeded, mulched or otherwise stabilized as soon as the construction activities have ceased. In addition, the establishment of a buffer strip on each bank of major streams crossed will act to retard water flow and filter out silt. Burns (1972) found that streams in the Pacific Northwest show reduced and short-term effects from logging, if protected by a buffer strip. The increase in sediment loads to the aquatic system through a buffer

strip is expected to be small and localized. Silt that settles in the aquatic system should be flushed out during successive periods of high water and after one breeding season fish production should return to predisturbance levels (Burns, 1972; Hall and Lantz, 1969).

In forested areas where the preferred route crosses watercourses a reduction in the tree canopy will be required along the cleared right-of-way. The smaller watercourses such as those found in the forested area in the south like Goose Creek, Answer Creek, Gold Creek and the numerous smaller streams that have no names (Figure 13), may experience an elevation in ambient water temperatures from the increase in solar radiation. Burns (1972) states that streams may increase their temperature as much as 1.0°C per 100 feet of cleared stream and cool at the rate of 0.5°C per 100 feet of stream. An increase in water temperatures can increase metabolic rates and the activity of pathogenic organisms, decrease the saturation levels for dissolved oxygen and in general create chronic or lethal situations to all levels of the aquatic biota. Sylvester (1974) has found that young heat-stressed sockeye salmon are more vulnerable as prey at night, as well as during the day.

The narrow right-of-way clearing, approximately 110 feet or less, over forested watercourses will lessen the impacts due to solar radiation. Migrating salmon smolt (sub-adults) migrate from the nursery areas toward the ocean with aid from the river currents and darkness. During the day they hide under low streamside vegetation that overhangs the streams (Sylvester 1974). Removal of this vegetation will remove cover for these migrating smolt. However, there will be little permanent reduction in cover habitat. Vegetation that is removed should return within several growing seasons.

During the right-of-way clearing and construction phases of the proposed project, no debris should be allowed to enter the aquatic systems. Slash and other waste vegetation should be, when required, chipped and spread as mulch to

aid in stabilizing the soil. However, the mulch, which will reduce dissolved oxygen levels during decomposition, should be prevented from entering watercourses. Vegetative materials not used for mulch should be disposed of in an upland area. Where reseeding takes place, reseeded stream banks should be fertilized only to the extent to ensure rapid stabilization, but not to increase nutrient loading in the adjacent waters. Standing timber in the right-of-way that will be removed and salvaged should not be skidded across streams or otherwise be allowed to destroy bank vegetation or disturb bottom gravel. In areas of winter construction, all debris should be removed to prevent it from entering the aquatic system the following spring.

As the proposed route will not cross directly over large lakes, impacts to lacustrine habitat will not be as potentially extensive as it is to the riverine systems. However, construction activities should be restricted from inlets or outlets of lakes during periods of open water as these areas are preferred spawning and nursery habitat for some species of salmonids. This will be especially true around Baldy and Larson Lakes along link 3s, Summit Lake along link 6s, and several other unnamed lakes along the preferred route.

The preferred route will cross directly over many small lakes and countless beaver ponds, many small enough to allow construction equipment passage; however, all activities should avoid these areas. Small lakes, ponds, beaver impoundments and streams are all very important habitat as nursery grounds for the local and anadromous fish communities (Watsyold, 1981). If activities should be necessary immediately upstream of these small, water bodies, appropriate precautions will be taken to avoid creating an erosional situation that will increase the silt loads or further accelerate their degradation.

Due to remoteness of portions of the proposed route (link 3s and some of link 6s), handling and storage of gasoline, fuel and lubrication oils, hydraulic fluids and other petrochemicals must be accomplished in a manner to keep these

chemicals out of the aquatic system. The dynamics of the aquatic system quickly distribute spilled chemicals in a manner that makes clean-up extremely difficult. Toxic chemicals will generally move downstream as a slug creating adverse effects as it moves. Therefore, the bulk storage of all fuels and lubricating oils should be in the marshalling yards where approved handling techniques are observed, and the fuel transfer personnel are trained in emergency containment and clean-up procedures. Stream crossings by refueling vehicles will be coordinated with the ADFG. Refueling of vehicles and short-term storage of fuels and oils will be in upland areas or removed from the immediate area of watercourses. Petrochemicals remaining from routine servicing of equipment will be collected and transported back to the marshalling yard for proper disposal. In the event of an introduction of a petrochemical into a lake, river or stream, emergency containment measures will be employed and the appropriate state agencies will be notified to ensure rapid containment and clean-up of the "spill."

Alternative Segments

The Parks Highway alternative (links 2s and 5s) favors a corridor that generally follows the Parks Highway between links 1s and 7s. Impacts to the aquatic environment will be similar to those outlined above with a few exceptions. Routing it along the highway will reduce the occurrence of remote transportation of petrochemicals. Although this alternative crosses 52 watercourses as compared to 38 for links 3s and 6s, these crossings are generally at points very close to the confluences with major rivers (Susitna and Chulitna). Any resultant siltation would be mitigated by the magnitude of the silt loads in these rivers. Exception to this would be Byers Creek where the line crosses the creek four times, all above Byers Lake.

The Broad Pass alternative (links 10s and 11s) is situated generally west of the Parks Highway through Broad Pass. This alternative makes 14 crossings as compared to 11 crossings for the preferred route. However, the alternative route

segment parallels the floodplain of Cantwell Creek, increasing the chance for adverse impacts to this watercourse. The preferred route is to the south of the highway well away from the majority of the lakes in Broad Pass, while the alternative has the advantage of crossing a highly disturbed area surrounding Cantwell.

The Nenana Gorge alternative (link 14s) follows the Nenana River north to Healy remaining mostly on the east side of the river. This alternative makes 17 crossings of watercourses, as compared to eight along the proposed route. However, the majority of the streams crossed along the alternative are small streams with seasonal flow and deeply incised channels. With proper tower placement along this link these deep channels could be spanned, and the line could be constructed with little or no adverse impact to the aquatic environment. Again any silt load caused by the construction will quickly be diluted by the waters of the Nenana River immediately below the crossings. The proposed route parallels a tributary to Montana Creek and most of Moody Creek, increasing the chance of adverse impacts along this link. The alternative corridor generally parallels the Parks Highway through the gorge area. The use of the highway for transport of materials and equipment lessens the chance of impact from erosion or petrochemical spills.

IMPACT ON LAND USE

Preferred Route

Link 1s parallels an existing Matanuska Electric Association right-of-way its entire length. This option will avoid creating an entire new corridor because of the parallel rights-of-way. The alignment bisects low-density residential development along Fishhook Willow Road, which could potentially prevent future residential growth in this area as well as bisecting existing growth. The link will not infringe on the air spaces of the Willow Airport, the landing strip at Kashwitna nor the three private landing strips south of Montana.

Link 3s crosses private residential lands in: the Chase II, Unit IV Subdivision, the West Talkeetna Bluffs Addition (1983), the Talkeetna and Goose Creek Agricultural Lands, the Emil Lake area and along the Talkeetna River. A special alignment will be required to avoid the Chase II, Unit IV Subdivision. Impacts within the Addition will be moderate because the Division of Forest, Land and Water Management will incorporate the proposed alignment by not putting land within its right-of-way up for disposal. It could create a more significant impact by making parcels adjacent to the right-of-way less desirable for disposal. The alignment was located to prevent the removal of potential crop and pasture lands in the agricultural lands and reduce the acreage available for small tracts in the Emil Lake and along the Talkeetna River. Only future residential development at Larson Lake might be affected by the alignment. The alignment infringes on float plane air space around Big Lake, however, no impacts are anticipated. No other air spaces are crossed.

Link 6s crosses private lands in the vicinity of Gold Creek and Chulitna River along the Alaska Railroad. The alignment will reduce the amount of land available for homesteading and could eventually bisect residential growth in the two areas. The alignment bisects individual tracts east of Sherman which could cause people to reevaluate settling here. The alignment will not infringe on the air space of the Curry and Chulitna landing strips, but will conflict with two landing strips in Gold Creek as it crosses within 1,500 feet of both runways. Approximately three miles of the Denali State Park are crossed north of Susitna River; little impact on land use will result in this undeveloped portion of the park.

No land use impacts are associated with links 7s and 9s. Link 9s will not interfere with a landing strip at Colorado. Private native allotments and private lands in the Cantwell area will be traversed by link 12s. The alignment could prevent or disrupt residential growth expected to continue east along the Denali Highway and west along the Parks Highway. Link 12 comes within 5,000 feet of the Golden North airport, but will not infringe upon its air space.

Link 13s avoids all land use with the exception of a small native allotment along the Nenana River just east of the Parks Highway. The alignment will reduce developable acreage within the allotment and could bisect it.

Link 15s will come close to private residences east of Healy along Healy Road and could discourage any growth in this area.

Alternative Segments

Link 2s crosses 4.3 miles of private lands. The land is concentrated in two locations: the area around Montana Creek and the Petersville Road area. The alignment bisects residential growth and will deny land for some future growth in both areas. The link will not infringe on the Montana Creek airport nor a private landing strip just northwest of it.

Link 5s crosses approximately 5 miles of private lands and native allotments and lies one and one-half miles within the Indian River Subdivision. Impacts within the subdivision will be moderate where the right-of-way crosses land set aside as a gravel source for road and home construction within the subdivision and critical where it crosses two lots and a common area being used as screening from the Parks Highway and as a source of wood (ADNR, Division of Forest, Land, and Water Management, 1981). The private and allotment lands are primarily located along the Parks Highway between the southern boundary of the Denali State Park and Troublesome Creek. This is the Mountain Haus area where residential growth is occurring. The alignment could create an impact by deferring some future residential growth because, according to sentiments, people generally do not want to build close to the right-of-way.

The most significant land use impact associated with the Parks Highway alternative (links 2s and 5s) will be the crossing of Denali State Park. Impacts to the park will consist of both direct and indirect effects. The alignment will cross four existing back-country hiking trails and several proposed trails which will be contrary to the parks intent of maintaining a wilderness setting within the park. The Denali State Park Master Plan makes reference to new overlook-rest areas being planned along the Parks Highway and an expansion of the Byers Lake Campground (ADNR, 1975). These proposals might be reevaluated in light of construction of a transmission facility. The right-of-way will undoubtedly create a defacto road, leading to more vehicle trespass with concurrent destruction of park values through littering, tree damage, poaching, etc. Two indirect impacts will be: the beginning of a park separation creating greater accessibility which is against the parks concept of retaining an essential wilderness setting within the park and finally; the Division of Parks has been appropriated additional monies by the state legislature to address the feasibility of developing a visitor center facility in the Tokositna area of Denali State Park. One of the tasks of the study is to evaluate alternative potential sites on Curry Ridge. A transmission facility behind Byers Lake could cause a reevaluation of any potential sites on Curry Ridge.

No residential land will be affected by alternative links 10s and 11s in Broad Pass. Link 11s crosses a small portion of the Denali National Park and Preserve and the right-of-way could lead to vehicular trespass and concurrent destruction of existing land uses within the park. In order to avoid the National Park, the link would have to traverse the Cantwell air space. This route would have probably gone along western Broad Pass if it were not for the difficulty of avoiding the Cantwell air space.

Alternative 14s crosses directly behind new residential growth occurring east of the Parks Highway in the vicinity of Kingfisher Creek. The alignment will significantly affect any future residential growth in this area. The alignment will not encroach upon the air space at the National Park or the two airstrips at Healy.

Routes utilizing the alternative segments cross more private and native allotment lands because their alignments generally parallel more of the Parks Highway. The preferred route actually crosses more total private lands but most of that lies near the Talkeetna Agriculture lands.

IMPACT ON LAND STATUS

Preferred Route

There are no apparent land status impacts associated with link 1s. Lands northeast and southeast of Talkeetna will continue to be extensively developed for residentially use. Link 3s crosses a considerable amount of private land in this area as well as state and borough lands which could be selected for private ownership. A transmission line could cause some private concerns to reevaluate their selections, i.e., the proposed Goose and Sheep Creeks Agricultural Disposals which are presently under state ownership. If the disposals are opened for selection, the ensuing transmission line could cause a lessening in the desire to live there. The alignment also crosses considerable State Public Recreation lands. This could affect the recreation and aesthetic values these lands are designed to preserve. There are state lands along the Alaska Railroad being selected for private ownership. Link 6s could cause a reevaluation of selections here.

There are no apparent land status impacts associated with links 7,9 and 15s. Links 12 and 13s cross considerable land set aside for village selection by Alaska natives living in the Ahtna Region. A transmission line could cause the natives to reevaluate these selections along these alignments.

Alternative Segments

Alternative link 2s will have minimal impact upon land status. Link alternative 5s crosses borough lands in the vicinity of the Denali State Park

southern boundary which are being opened up for private selection. A majority of the remaining lands are owned by the state and dedicated to the Denali State Park. An alignment could cause a reevaluation of park development proposals.

Links 10s and 11s cross considerable lands within the Ahtna Regional Corporation set aside for village selections by the Alaska natives. A transmission line could cause the reevaluation of village selection lands by the natives. The links cross the Denali National Park and Preserve which will require appropriate grants of right-of-way. This will cause a problem as permits have to be obtained before access can be given.

SOCIOECONOMIC IMPACT

This section sets out the socioeconomic impacts upon the project area of the proposed Intertie project. The analysis applies to both the preferred and the alternative routes. First, there is a brief summary of those project features with potentially important socioeconomic consequences. This is followed by an analysis of impacts upon the project area, together with a discussion of measures incorporated into the project design to mitigate adverse socioeconomic impacts.

Description of Project

The construction program will span about 20 months beginning in late 1982. However, the great bulk of the construction effort will be heavily concentrated in the second season, peaking in the summer of 1983. The project will be concluded in mid 1984 and is scheduled to come on line during summer of that year.

Installation of the transmission line will require a total field construction work force of about 100-150 workers. However, many of the installation tasks will be performed in phased sequence, so that total employment at any given time

will be well below that total. Furthermore, the duration of most job tasks will typically be four to six months. The work force will be drawn from a variety of occupational categories. Approximately one-third can be classified as skilled labor in supervisory positions or in skilled trades. The remainder can be classified as unskilled labor, e.g., groundmen. In addition to the construction work force will be the helicopter crews providing support.

According to standard industry practice and hiring agreements, it is assumed that all project workers will be drawn from the membership of the International Brotherhood of Electrical Workers. It is expected that the great majority of workers can be supplied from the resident Alaskan work force. Employees will be hired from Anchorage and Fairbanks union hiring halls and a portion of the work force will include qualified union members now living in the project area.

During field construction, the project work force will be divided into several work crews. In view of the lack of housing and community and commercial services throughout the project area, each crew will be supported by a temporary base camp to be established by the contractor(s) to standards specified in union agreements. It is intended that these base camps will be essentially self-sufficient for the routine daily needs of the work force. First aid medical services will be available at the base camps, but, with the availability of helicopter transport, serious cases of injury or illness can be speedily evacuated to superior medical facilities at Palmer or Anchorage.

Possible camp sites are located in the vicinity of Sunshine about 30 miles north of Willow, in the vicinity of Hurricane near mile post 170 on the Parks Highway and in the general vicinity of Cantwell. These locations are accessible by existing highways or the Alaska Railroad and provide feasible points of departure for access to remote work sites.

Daily movement of work force between base camps and work sites will usually be by ground access. In some remote sections of the right-of-way, it may be necessary to rely upon helicopter services, as dictated by economies of time or unavailability of alternative means of transport.

Socioeconomic Impacts

Based on comparison of current socioeconomic conditions in the project area with the relevant features of the Intertie construction project, it is not anticipated that the project will cause any significant disruptions or adverse socioeconomic impacts within the project area. This finding is the outcome of a number of factors in the proposed project plan that work in concert to obviate or diminish unwelcome direct community impacts. By the same token, it is not anticipated that the construction project itself will directly or substantially enhance the local economy, apart from the long-term benefits that may accrue to electric consumers due to cheaper, more reliable power than would prevail were the transmission line not installed.

The scale of the project's employment impacts is modest and short-term, especially in comparison to the labor pool in south-central and interior Alaska from which it will draw and in comparison to other development projects under consideration for the Matanuska-Susitna Borough and the Healy area.

The project concept and route alternatives incorporate a number of features designed to mitigate environmental impacts. These same features also serve to minimize any adverse socioeconomic impacts.

The use of temporary work camps to quarter the field work force will effectively forestall any problems that might stem from the short supply of rental housing and commercial lodgings in the project area. The work camps will also avoid creating any demand for additional public services due to the project.

The work camp arrangements, the 10 hour day/6 day work week schedule, the short term of the project, a labor pool drawing from all of south-central and interior Alaska and the local inavailability of housing will all cooperate to discourage immigration of workers' families to take up temporary or permanent residence in the project area. For these reasons, it is projected that the project will fail to generate any permanent population growth in the project area, nor are any significant additional demands for housing, education or other local public services or facilities expected to result from the project.

The provision of temporary work camp quarters and the substantial share of non-local workers expected to be employed will tend to depress the volume of purchases of local goods and services made by the project work force. Likewise, due to the specialized nature of the project, it is expected that local purchase of materials, equipment and supplies for the project will be negligible. These circumstances will minimize the stimulus to the local secondary economy that might be engendered by the project. The primary economic impacts on the project area will likely be positive but modest, stemming from direct employment of some local residents on the project work force and the purchasing power added to the local economy by their wages. In some small measure, the project will also temporarily lower the area's chronic high unemployment rate.

In conclusion, despite the rural character of the project area, it is not expected that project construction activities will have any significant lasting impact on employment and population levels in the area, nor on the local demand for housing or public services and facilities. Similarly, the logistic requirements for the project can be met without overload of existing transportation facilities.

VISUAL IMPACT

Design considerations for construction materials were chosen in the initial stages of the project that would allow the facilities to better harmonize visually with the landscape. Nonspecular conductors and steel towers utilizing a rusty appearance will reduce the contrast between the facilities and the surrounding landscape colors, while the simple x-shaped towers will complement the forms of the vegetation, particularly the black spruce, and allow a minimum viewing mass.

The most significant visual impacts to landscape types will occur in the Nenana Gorge landscape where the visual absorption capability is very low, since land cover is predominantly bare rock with sparse tree and shrub vegetation along the river and alpine tundra on the slopes. The scenic quality is very high; the area is one of the few places along the entire highway where Dall sheep can be viewed and visitor concentration is high. Impacts are generally lower once out of Windy Pass going toward Willow. Impacts in the remainder of the Alaska Range landscape are low to moderate because the alignments were placed in the dense stands of spruce along the low river terraces. Impacts in Broad Pass are low to moderate despite the low visual absorption capability of the landscape type because alignments are generally located out of the particularly sensitive foreground and middle ground lands and in the background. Impacts became significant when alignments are placed in the foreground. Impacts along the Chulitna River, Curry Ridge and the Susitna River are generally low to moderate because of the visual absorption capability provided for by the dense spruce and spruce-birch vegetation.

Preferred Route

Significant visual impact will be imposed upon residences along Fishhook Willow Road by link 1s due to the lack of vegetation immediately adjacent to

the road. However, much of the Parks Highway along the link is located in areas having the ability to conceal the alignment due to the thick foreground vegetation (ADNR, 1981). Foreground vegetation is defined as areas within one-half to one-quarter mile either side of the highway (U.S. Forest Service, 1974). This capability to conceal the alignment will result in little visual impact to motorists traveling the highway and to persons residing along the highway. Some impact will occur to motorists when the alignment is viewed from certain angles, i.e.; for example, the alignment will be visible for a short time just north of the Willow Creek Bridge, as one looks east over open bogs. But here, distance will lessen the impact as the alignment is one and one-half miles from the highway, causing the towers to resemble the thin vertical black spruce in form and color. There are residences in Caswell with views to the towers but again, the one mile distance allows the towers to be integrated with existing landscape creating moderate visual impact. The "treeless" bog areas between the black spruce stands allow for a natural right-of-way, lessening the impact.

There is little visual impact along the majority of link 3s because thick stands of spruce, birch and balsam poplar were retained as spatial separations between the alignment and residences. Impacts will occur where the alignment crosses over trails and waterways leading to local residences, although maintenance of a vegetation buffer along major watercourses will impair views along the right-of-way. There could be serious impact where the alignment crosses the southeast corner of the Chase II, Unit IV Subdivision. This, however, will be altered to reduce impact during centerline finalization. The alignment also bisects the West Talkeetna Bluffs Addition (1983) which is waiting for final approval of the Intertie project before starting disposals. The thick spruce and birch on-site vegetation should provide significant screening to the addition except to parcels nearest the right-of-way.

The tower tops along link 6s will introduce a moderate degree of impact to residences along the Alaska Railroad and tourists traveling the railroad. This is

due to the vegetation being generally shorter than the towers and the towers being located on the slopes. The impact will increase if the towers are viewed through the scattered openings associated with the area. Visual impacts to the railroad will be high at the two alignment crossings. This is especially true at the crossing nearest the Susitna River. The low poplar and alder vegetation in the floodplain offers little concealment of the towers and right-of-way as they approach the railroad. Visual simulations 1 and 2 which are included in Appendix G show that the cleared right-of-way and tower tops will definitely be visible to hikers on Curry Ridge.

Link 7s traverses a highly scenic and visibly sensitive landscape of Hurricane Gulch. Consequently, the alignment was kept at least one-half mile off the Parks Highway to allow using more of the foreground vegetation for the purpose of screening. However, the tops of the towers will be visible occasionally from the Parks Highway and the cleared right-of-way will be visible as it crosses Hurricane Gulch. The foreground vegetation, the alignment's distance from the highway and the fact that views along this portion of the highway are oriented to the west across the Chulitna River to the Alaska Range will moderate the visual impact to motorists.

Visual simulation photograph 3 shows that the towers along link 9s are likely to be visible only occasionally because they are well screened by vegetation.

Visual impacts will be minimal along most of link 12s, with the exception of the Cantwell area and north. The minimal impact can be attributed to four factors: the distance between the viewer and the alignment allows the towers to diminish in size relative to the viewers; the right-of-way will be less evident because the spruce in Broad Pass are arranged in long, narrow north to south stands allowing the "treeless" spaces between stands to be used as a natural cleared right-of-way; some of the alignment is located behind vertical topography and below the crest line to avoid complete silhouetting; and the sheer massiveness

of the mountains diminishes the presence of the towers because of the large scale differences. Visual simulations photographs 4,5 and 6, show how the actual alignment will be perceived in the Broad Pass landscape. [The alignment will introduce significant visual impacts into the Cantwell area because of its proximity to existing residential lands extending east out of Cantwell along the Denali Highway and Old Airport Road. The towers and cleared right-of-way will be apparent and adequate mitigative measures will be difficult because of the sparse low vegetation. The alignment will be visible where it closely parallels and then crosses the almost treeless Reindeer Hills.]

[Significant visual impact by the towers will occur to nearby residences as link 13s crosses the Nenana River. The line will be highly visible to motorists as it parallels the Parks Highway and Panorama Mountain through Windy Pass. Only a few short, scattered spruce offer any screening on Panorama Mountain. Although there is generally a good distribution of foreground screening available between Slime and Carlo Creeks, the alignment is so close to the highway and residences that it will be visible from certain angles.] There will be moderate impact to both motorists and residents along the Parks Highway for the remainder of the alignment. This is because of the general availability of foreground vegetation immediately adjacent to the highway and an increased distance as the alignment moves away from the highway and residences. There are several residences behind McKinley Village which will have views to the line because of inadequate screening vegetation but the impact will be lessened by the distance factor of one mile. The alignment will introduce a visual impact to rafters on the Nenana River.

Healy residences will be visually imposed upon by link 15s, although Healy is already visually disrupted by the existing generation station and its associated transmission facilities. No other residences will be affected. There are bush pilots using the Moody and Montana Creek Basins as part of their tour as well as a hunting guide service. Both services feel the alignment will disrupt the view of hunters and airplane passengers.

Alternative Segments

The opportunity to view alternative link 2s from the Parks Highway will be minimal because the dense foreground stands of birch and spruce will provide only an occasional glimpse of the alignment through an opening. (See visual simulation, photograph 7.) The best view of the alignment from the Parks Highway is at the Susitna River Bridge. Although the tops of the towers might be visible from the bridge depending on final tower location, the impact will be minimal because of a one mile spatial separation. There is a small park for motor homes, campers and boat launching next to the bridge which will also be visually affected by the alignment. Two residential areas in the Montana Creek area and along Petersville Road will be visually affected by link 2s. The Petersville Road area has five residences within 500 feet of the right-of-way, while the Montana Creek crossing has seven residences within 500 feet. The distance between the right-of-way edge and these residences will probably not allow for complete screening. Location of the alignment, across the Parks Highway at Montana Creek and Petersville Road, could create high visual impacts for motorists in the form of long tunneled views down the cleared right-of-way.

The dense foreground vegetation along the Parks Highway will periodically provide views to link 5s even though it occasionally comes within 600 feet of the Parks Highway. The roadside vegetation often creates a tunnel-like driving experience and views to Mt. McKinley and Curry Ridge will seldom be interrupted by the alignment except further north in Denali State Park where the alignment will become more visible because of the sporadic vegetation. Visual impact to motorists will probably occur at points where the alignment crosses the highway because the dense vegetation will allow tunneled views down the cleared right-of-way. However, the speed of travel and the views oriented to natural attractions like Ruth Glacier will tend to decrease these impacts. The crossing of the Alaska Railroad will be similarly affected. The State of Alaska has appropriated additional monies to address the feasibility of developing a recreational and

cultural facility in the Tokositna area of Denali State Park. One of the sites to be evaluated is Curry Ridge. Link 5s could cause the Division of Parks to reevaluate potential sites on the ridge, as the primary recreational activity will be focused on views west to Mt. McKinley.

The dense vegetation will result in minimal exposure to most residences along link 5s. The one exception being the Indian River Disposal where residences along Big Horn Drive are within a few hundred feet of the right-of-way and will definitely be affected. There is generally sufficient vegetation, topography and color available for minimizing the alignment's presence behind Byers Lake. Visual simulation photograph 8 shows that parts of the towers will occasionally be visible from Byers Lake State Campground because the rock cliff background draws attention to them. The alignment will not interrupt views to Mt. McKinley or the Alaska Range from the highway, nor to views of Mt. McKinley from on top of Curry Ridge. It will be a visual interruption to hikers going to Curry Ridge; a visual disturbance and intrusion into the wilderness setting of Denali State Park and a visual separation of the park.

Visual simulation, photograph 9, shows that Superlink 10s will be visible to motorists when cresting the climb along Parks Highway leading into Broad Pass. However, the landscape clearly dominates one's attention, especially when Mt. McKinley is in view. This will tend to lessen the impact. The alignment will be visible from the town of Broad Pass.

[Visual simulation photographs 10 and 11 show the opportunity to utilize topography and distance for screening exists along link 11s. Also, significant are the points that the dark-colored towers will blend in with the dark vegetative background even though the alignment comes critically close to the highway in places, i.e., Cantwell Creek drainage. The mountainous landscape and McKinley massif, when visible, will probably draw one's attention away from the alignment. There will be moderate visible impact to Cantwell residents who will be able to view the line from certain angles.]

[There will be some attention drawn to the alignment traversing the Parks Highway north of Cantwell. However, the massiveness of the surrounding landscape and the initial revealing of Windy Pass will get most of the attention alleviating the negative exposure.]

[Visual impact will be severe along alternative link 14s. The alignment parallels the Nenana Gorge where the screening capabilities are very limited due to the bare rock and almost nonexistent vegetation. The alignment will be very visible to viewers utilizing the Parks Highway and Alaska Railroad, rafters on the Nenana River and residences along the highway and river. The alignment will be visible to Healy residents as it approaches the generating station. See visual simulation photograph 12.]

[There are impacts common to most alignments which were too numerous to locate and evaluate. Trails supporting activities like access, hiking, hunting, dog sledding or skiing are too numerous to determine impacts. All the rafting, canoeing and access waterways were not evaluated. Aerial sightseeing tours, private aircrafts and railroad users probably feel the alignments create visual impacts. There will be visual impacts to residences where the alignments cross jeep trails and other unimproved roads leading to their land. Finally, the cleared right-of-way will open up some wilderness areas to human trespass or access, primarily vehicular, which could lead to the destruction of natural values and consequential visual disruptions.]

IMPACT ON CULTURAL RESOURCES

Impacts on the cultural resources of the project area could result from ground disturbance associated with construction and vandalism or ground disturbance associated with increased accessibility. All historic or prehistoric sites which fall within the project right-of-way may be subject to direct ground disturbance impacts resulting from road or temporary bridge construction, pole or

tower placement and clearing. All sites located in or near the right-of-way may also be affected by vandalism and in associated public areas, ground disturbance caused by off-road vehicles and subsequent erosion may occur.

There are several methods by which impacts to cultural resources can be reduced. Pre-construction survey and testing will identify specific resources so they can be avoided during siting. Should impact to any specific resources be unavoidable, data recovery is a possible mitigative measure. However, unavoidable impact to a site is unlikely given the confined and variable nature of transmission line construction activities.

Preferred Route

The potential impact of the preferred route is moderate. Link 1s has been surveyed and will impact no cultural resources. Link 3s is located in presently unknown area, but crosses terrain which can be characterized as having low to moderate archeological potential. The results of the 1981 field studies suggest extremely low site density for the project area south of the Alaska Range. Link 6s has been partially surveyed and site potential for this area is also low. This segment does cross the 1898 USGS trail along the Susitna River and there may be unrecorded historic resources in this locale. Link 7s has been surveyed and there are no known cultural resources along this segment. Link 9s passes near two sites which lie outside of the right-of-way. Link 12s again crosses the 1898 USGS trail and passes near one site discovered during the 1981 fieldwork. However, this site lies outside of the right-of-way and will not be subject to any direct impacts. Link 13s passes near four sites which lie outside the right-of-way and two sites which lie within the right-of-way and might, therefore, be subject to direct project impacts. Most of this segment has been surveyed. Link 15s also has been surveyed. This segment passes near six sites, none of them within the right-of-way and therefore not subject to direct project impacts. Link 16s has not been surveyed and has no known cultural resources located near it.

Alternative Segments

Parks Highway alternate using links 2s and 5s, has slightly more potential for impacts to cultural resources. Neither of the two segments have been surveyed. However, because of their proximity to the Parks Highway and Chulitna River there is an increased potential for unrecorded cultural resources to be impacted. In addition to this increase in potential, link 2s crosses the 1898 USGS trail and might impact some resources associated with this trail.

The Broad Pass alternative (links 10s and 11s) also has a higher risk of impacting cultural resources. Both segments have not yet been field inspected. In addition, link 10s passes near two sites which may be subject to indirect impacts of the project. Link 11s passes near one site (outside of the right-of-way) and crosses the 1898 USGS trail. Both segments have somewhat higher potential for sites than the corresponding preferred route.

A route, using the Nenana Gorge (link 14s) is difficult to accurately assess. The Nenana Gorge has seen a considerable amount of archeological investigation. There are a number of sites in this restricted area and six of these are near to the proposed right-of-way. The specific route proposed has not been examined specifically for this project so no definite statement of its impact on known resources can be made. However, considering the concentrations of sites, it seems likely that there may be a considerably higher potential for additional site discovery within the gorge and mitigation by avoidance may be quite difficult given its constricted nature.

Recommendations

As a result of 1981 efforts the following recommendations are made:

1. Phase I archeological clearance survey will be completed for all portions of the construction right-of-way.

2. Phase II testing and evaluation should be initiated for sites HEA-204 and HEA-205, since link 13s has been selected as part of the final right-of-way. This testing and evaluation will be in enough detail to evaluate each site for potential eligibility for inclusion on the National Register of Historic Places.
3. If any surveyed links are realigned, resurvey of affected portions of such links will be completed prior to construction.
4. Such additional sites as may be discovered to lie in the path of the final approved right-of-way will each be tested and evaluated for potential eligibility for inclusion on the National Register of Historic Places.

ELECTRICAL ENVIRONMENTAL EFFECTS

Three studies of the electrical environmental effects, associated with the Anchorage-Fairbanks Transmission Intertie, have been made and documented (Commonwealth, 1982). These studies addressed the ultimate maximum development of the right-of-way and were based on three parallel 345 kV single-circuit lines located on a common 400 foot wide right-of-way. Although initial operation of the Intertie is planned at a lower voltage (138 kV), electrical environmental effect studies were based on the ultimate maximum operating voltage of 362.5 kV. The electrical environmental effects of a single 345 kV transmission line will be slightly less but in the same general order of magnitude as the three circuits studied.

Electrical environmental effects from the Intertie when operated at 138 kV will be much lower than 345 kV electrical effect levels and will be, for practical purposes, negligible.

The Electrical Environmental Effects Report (Commonwealth, 1982) considered: a) transmission line corona generated effects such as ozone production, audible noise, radio frequency interference for AM broadcast band and 27 megahertz citizen band radios, television interference and b) electric and magnetic field effects, induced currents and safety.

The conclusions presented in the electrical effects report (based on operation of the Intertie at 362.5 kV) are:

- No measurable levels of ozone will be generated by the Intertie transmission lines.
- The low levels of audible noise produced by the Intertie will not result in significant noise problems.
- No interference to FM radio reception caused by radio frequency noise from the Intertie is expected.
- No interference to AM radio reception from the Intertie is expected at distances greater than 1000 feet from the centerline of the right-of-way.
- No interference to television reception is expected from the Intertie in locations where present television reception is good.
- Electric and magnetic field strengths produced by the Intertie at ground level will be harmless.
- The minimum phase-to-ground clearance of 30 feet is sufficient to satisfy the 8 kV/meter design criterion for maximum electric field strength on the right-of-way.

- The 30 foot phase-to-ground clearance is sufficient to satisfy the NESC five milliamperere induced current criterion for large vehicles (13.5 feet H, 8.5 feet W, 70 feet L) on highways and major roads crossing perpendicularly beneath the Intertie.
- No shock hazards from induced currents from the Intertie are expected.

Results of preconstruction measurements of radio and television signal strengths and radio frequency noise (Commonwealth, 1982) document the radio and television reception during July 1981, at 11 sites in the project area. Table 23 gives the observed reception quality and number of stations at the measurement sites.

Based on Federal Communication Commission (FCC) criteria, all AM radio stations received at the 11 sites offer intermittent service in the project area. According to the criteria, these radio signals are subject to fading and interference from atmospheric and manmade noise.

TABLE 23

Existing Quality of Reception for AM Radio Stations
 (Based on Field Measurements of Radio Station
 Signal Strengths July 9-15, 1981)

<u>Site Number</u>	<u>Location</u>	<u>Number of Radio Stations Judged to have the Following Quality of Radio Reception</u>				
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
10	Willow	-	-	3	3	-
20	Trapper Creek	-	-	2	2	3
30	Chase	-	-	-	1	4
40	Lane Creek	-	-	1	1	4
50A	Curry	-	-	-	-	1
60	Cantwell	-	-	-	-	1
70	Carlo Creek	-	-	-	-	1
80	Deneki Lake	-	-	-	1	3
90	McKinley Village	-	-	-	-	-
100	McKinley Park	-	-	-	-	-
110A	Healy	-	-	-	1	1

LEGEND:

- A - Entirely Satisfactory
- B - Very Good, Background Unobtrusive
- C - Fairly Satisfactory, Background Plainly Evident
- D - Background Very Evident, Speech Understandable With Concentrating
- E - Speech Unintelligible

To preserve the existing quality of reception of the very weak radio station signals measured between Willow and Curry, it is necessary to recommend a minimum separation between parallel route segments and the Parks Highway and between the line route and residences. The minimum recommended separation is 1000 feet from the centerline of the right-of-way.

Television signals, especially those from the television translators, are much stronger on a relative basis than the measured AM radio signal strengths due to the proximity of the television translator antenna. Because of the strong signal strengths, no interference from the Intertie is anticipated in areas where good reception is presently obtained, provided that the minimum recommended separation from the line route to the residences (between Willow and Curry) is satisfied.

A Communication Tower Survey (Commonwealth, 1982) was made in the project area between Willow and Healy. The purpose of the study was to identify situations where the physical presence of towers may cause degradation of communications and to recommend clearance criteria to avoid degradation.

The following types of communications facilities were identified in the study:

1. FM Translators
2. Television Translators
3. Earth Stations
4. Air NAVAIDS Not Located at Airports
 - a. Nondirectional Radio Beacons
 - b. Remote Center Air Ground Facilities
 - c. Single Frequency Outlets
 - d. Simultaneous Single Frequency Outlets
5. Air NAVAIDS Located at Airports
 - a. VOR stations

- b. Unicom
 - c. Remote Communications Outlets
 - d. Flight Service Stations
 - e. Airport Advisory Services
 - f. Airport Landing Alert Systems
6. Common Carrier and Point-to-Point Microwave

A total of 50 communication towers were identified. Licensees of those facilities for which an impact is considered possible have been contacted and advised of the recommended clearance criteria and requested to comment on the adequacy of the criteria.

The recommended clearances have been considered in line routing and will be considered in locating transmission towers, where possible, to minimize possible interference.

IMPACTS OF MAINTENANCE PROCEDURES

Maintenance of the Intertie is required to assure the high degree of reliability expected of such a facility. The types of activities required are described as follows.

Transmission Line Maintenance

Transmission line maintenance covers those activities that will be directly associated with the structures, their foundation, guys, anchors, and conductors and shield wires.

Routing inspections will be made to detect any damaged components or problems which might lead to an outage or serious damage for failure if not repaired. Inspections will be made on a regular basis with the frequency depending

on the operating entity's particular practices, the importance of the line, the type and quality of line construction and seasonal weather conditions. The inspection may be made by aircraft including light planes and helicopters, or from the ground by walking or by light vehicle.

Routine maintenance includes inspection, repair, or replacement of damaged components such as insulators, clamps, dampers or other hardware components, tightening or replacing bolts and replacing or restoring damaged warning and identification signs.

Routine maintenance can usually be done with the line energized or during brief periods of line outage. In general, the work can be done with relatively light tools and small crews.

Line restoration following major damage usually requires the use of heavy tools and equipment and relatively large crews. Such damage can be expected to occur only infrequently on a well designed and constructed facility, but accidents and natural phenomenon beyond the line design capability can cause the failure of any line. Such loss results in the line being out of service. There will usually be both public and political pressure to restore the services rapidly. Since there is a necessity for restoring the line to service as rapidly as possible, the construction operations must proceed in spite of weather or seasonal restraints. For these reasons it is highly desirable to have preplanned ground access to all parts of the line right-of-way so that construction equipment can be transported for emergency restoration of the line. Where major ground mobilization is required for emergency line repair, impacts sustained will be similar to those described previously in the Environmental Consequences section.

Right-Of-Way Maintenance

Right-of-way maintenance consists principally of vegetation control and erosion control and restoration. Initial vegetation control is by clearing all trees and shrubs, under and adjacent to the line, which are of such height that they might interfere with construction activities or operation of the line. Allowance will be made in determining the height of the trees and shrubs to be cut to allow for several years regrowth before reclearing is required.

Subsequent vegetation regrowth may be controlled by chemical means or by recutting, although no determination on the use of herbicides has been made at this time. A detailed analysis of their use will be conducted by the operating entity for the Intertie and, if used, will be held in strict conformance with state and federal regulations. Application of these chemicals would not be on a broadcast plan but one of selective use in problem areas or on nuisance vegetation. Because of their ability to spread in an aquatic system and the effects on non-target species, no herbicides would be applied within the buffer strip established on either side of major watercourses.

The interval before reclearing will vary with the vegetation type crossed. In areas of tundra, low-brush, muskeg-bog and shrublands, little clearing will be required during the length of the project. Areas principally affected by reclearing will be the bottomland, lowland and upland spruce-hardwood forests which dominate links 3s, 6s and 9s. Impacts will be minimized through selective cutting and clearing techniques.

Erosion control is performed to prevent serious erosion of the right-of-way as well as to prevent sediment depositions in watercourses along the right-of-way. The need for erosion control and restoration will be greatest during and immediately following completion of the construction operations. Careful control of the construction operations will minimize the erosion control and restoration

necessary. Regular inspection and prompt attention to any developing erosion problems will assist in keeping potential impacts of erosion to a minimum.

✓ ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

Adverse effects will occur as a result of construction and operation of the Intertie. The extent and duration of effects considered unavoidable has been reduced through many aspects of planning, design and construction of the Intertie. Considerations in route selection, tower design, helicopter-assisted transport of materials and labor and winter construction will lessen the degree of adverse environmental impacts. However, some effects are unavoidable and will occur during both construction and operation of the Intertie.

Impacts associated with construction and determined to be unavoidable include the temporary disruption of habitat and relocation of species. The effects will be temporary and generally subside once noise and human activity associated with construction is past. Loss of vegetation due to clearing, increased potential for soil erosion and additional sediment loads in local watercourses will occur. A majority of these impacts will be short-term in duration; the effects of which will diminish through time.

Unavoidable impacts associated with operation and maintenance of the Intertie include: increased access, alteration of certain habitats, visual exposure of facilities, land use effects and air navigation. Access into previously undisturbed areas will occur in portions of the preferred route, principally in the northern half of 3s and 6s. Little ground access is readily available in these remote areas. A new right-of-way will provide opportunities for increased human activities effectively denied prior to the proposed project. While efforts will be made to restrict trespassers and to establish only minimum standard access roads or trails, the potential for additional access, nevertheless, for hunting, camping, hiking and other forms of outdoor recreation will increase.

Maintenance of vegetation within the right-of-way will result in modification of habitat through periodic clearing. The net acreage involved is relatively insignificant and will likely effect individual species, rather than populations of species. Where tundra (cover types 1, 2 and 3) are found along the preferred route, impacts will occur in direct proportion to the number of passes of vehicular traffic. Terrain degradation to both the tundra cover type and associated discontinuous permafrost will be direct and long-term in duration.

[Visual effects of the Intertie will be evident wherever the line will be seen by a significant number of viewers. The route selection process resulted in an alignment effectively utilizing landforms, vegetation and distance. Certain landscapes or features of the project area will nonetheless, sustain increased visibility and reduce scenic quality. Broad Pass, Cantwell, Windy Pass, and areas south of Montana Creek will afford views of the proposed facility and subsequent visual impacts.]

Land use impacts will be minimal, since the preferred route avoids most developed lands in the project area. Residential areas will be largely unaffected, while future residential growth, as planned by the state in various subdivisions, will accommodate the proposed right-of-way. Little, if any, effects on commercial forestry will be evident. Agricultural lands near Talkeetna may be slightly affected where the right-of-way may alter agricultural patterns.

Minor effects on air navigation will be unavoidable, where the line traverses near private airstrips or lakes utilized for aerial access. Airports or airfields registered in the Supplement Alaska have been accounted for in planning and design of the Intertie. Applicable regulations of the U.S. Department of Transportation, Federal Aviation Administration have been defined in Part 77, Subchapter E, Airspace, of Title 14 of the Code of Federal Regulations, entitled Objects Affecting Navigable Airspace. Use of the obstruction standards referenced in Subpart B have insured that all minimum airspace requirements have been satisfied by the proposed project for all registered facilities.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction and operation of the Intertie will require the utilization of land, labor and materials. These resources will be committed for varying periods of time and, in some instances, can be restored after the useful life of the facilities.

The Intertie will require the acquisition of a 400 foot wide right-of-way of which approximately 210 feet will be utilized for the proposed project. Land use within the right-of-way should not appreciably change, except in those areas where clearing is required. Approximately 1396 acres of vegetation will be removed from the right-of-way. Upon retirement of the line, the land so dedicated can be returned to its original use. Land required for the substation additions is already owned by the participating utilities.

Materials committed in construction of the Intertie can be generally summarized as follows:

Pilings - 1343 tons of steel

Structures - 6080 tons of steel

Conductor - 3326 tons of aluminum with steel case

Static Wire- 462 tons of steel

Metal used in the towers, conductors and static wire can be salvaged and reused after the useful life of the facilities. Foundation materials can be removed, if necessary, and used as fill or road surfacing material.

Fuel and manpower expended during facility construction and maintenance will be irretrievably committed.

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Construction of the Intertie will result in the long-term benefit of providing reliable and efficient electrical power to the citizens of Anchorage and Fairbanks. The project will afford the advantages of reserve sharing and transfer of economy energy, while improving the overall stability and supply of power in the Railbelt.

Environmental consequences which will occur to achieve these benefits include:

- clearing and control of woodland vegetation to insure safe and efficient line operation;
- localized disruption of permafrost and tundra environments;
- access into previously remote lands;
- visual exposure of the proposed facilities;
- possible avian mortality resulting from collisions with the proposed facilities.

[The significance of the environmental consequences described previously should be placed in the context of future corridor development and the long-term consequences to the environment. While a single right-of-way results in certain

specified impacts, this project has been planned so that future transmission line construction in the Railbelt utilize the Intertie right-of-way. The cumulative environmental effects sustained by numerous separate and disparate rights-of-way can be appreciably diminished through the beneficial and effective use of a common right-of-way. 7

APPENDIX A

ROUTE SELECTION METHODOLOGY

ROUTE SELECTION METHODOLOGY

Formulate Study Process

The initial phase of the route selection process was to define a study approach most suitable to the Intertie project. It was determined that selection of an acceptable route would be made with respect to three important goals:

1. Satisfy regulatory and permit requirements.
2. Respond to concerns expressed through the Public Participation Program.
3. Achieve routing objectives.

In order to satisfactorily initiate the route selection process, a methodology was adapted for the Intertie project based on the network theory. This process involves the identification of corridors, establishes a network of potential line route segments within them and evaluates alternative routes based on specific criteria. Figure 19 graphically depicts the overall route selection process and should be referenced throughout this section.

Several objectives were agreed upon by Commonwealth and the APA to assist in the routing process. They were:

- Minimize Impact on Land Use
- Minimize Conflict with Existing Life Styles
- Minimize Impact on Natural Systems
- Minimize Visual Impact

- Minimize Impact on Cultural Resources
- Maximize Sharing of Existing Rights-of-Way
- Optimize Construction and Operational Costs

The alignments selected for study were evaluated with respect to these objectives so that a route would be selected which balances environmental resources, public concerns, construction and maintenance feasibility and reliability.

Develop Data

Upon selection of a routing methodology, data collection was initiated to obtain available and published data. Existing aerial photography for the project area was acquired to assist in the analysis of existing conditions. In the general absence of the mapped data, this data source became an important tool; photographic sources included false color infrared (NASA U-2 Photography, 1977), true color photography (Alaska Railroad, 1979) and black and white photography (Lower Susitna River Basin, 1980). Later in the evaluation of alignments, project photography was also made available (North Pacific Aerial Surveys, Inc., 1981).

Agency contacts were an essential aspect of data collection. In obtaining existing literature, agency interests and concerns were also discussed to identify significant issues or problem areas. Agencies contacted during the course of the project are listed in Appendix H, Consultation and Coordination With Others.

Identify Corridors

Identification of transmission line corridors was the initial step in the route selection process for the Anchorage-Fairbanks Transmission Intertie. The corridors were delineated to generally outline the project study area, providing the basis from which more detailed studies would be conducted. Corridors were defined in broad terms with variable widths in order to accommodate a number of

Route Selection Process

ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

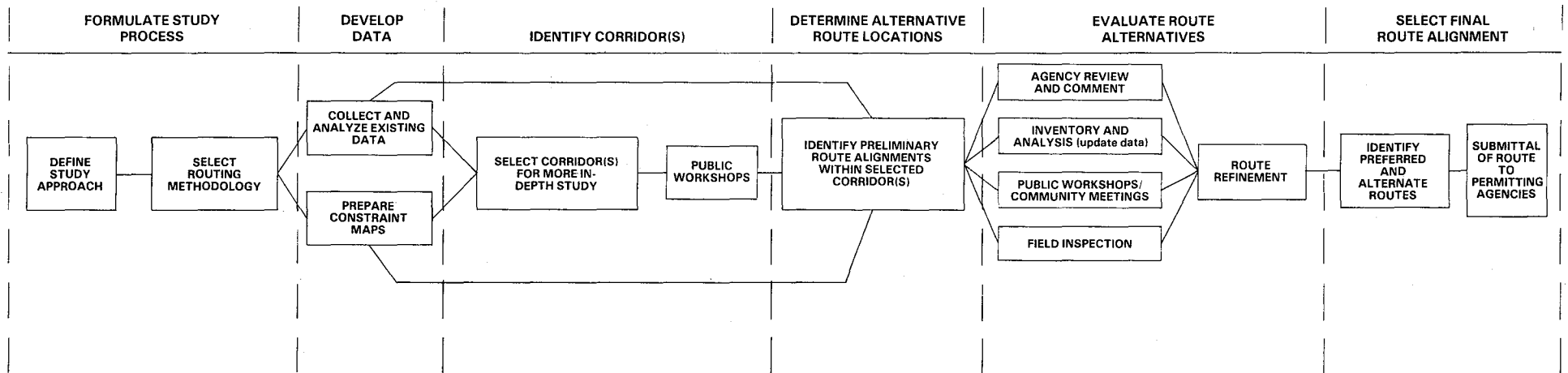


FIGURE 19

alternative route segments within them. For the Anchorage-Fairbanks Transmission Intertie, corridors were thus delineated between the Willow Substation to the south and Healy Substation to the north. Figure 20 depicts the general location of the corridors selected.

Preliminary alignment of corridors was based on the identification of potentially feasible line locations. Corridors were initially selected which satisfied two fundamental objectives:

1. Technically acceptable corridors which posed reasonable engineering constraints and afforded reliable and maintainable service.
2. Environmentally acceptable corridors which combined transportation and utility facilities to avoid establishing dispersed rights-of-way.

A review of corridor locations then commenced, utilizing USGS maps (1:63360), various aerial photographic data and previously assembled information for the project area. Major geological features, severe topography or elevations, principal river courses and other natural features which would preclude use for transmission corridors were avoided to the extent possible. Additional consideration was given to existing land use developments, utility rights-of-way, and transportation systems. Based on this data, corridors were delineated which offered potentially feasible alignments, although varying in width from over four miles in Broad Pass to less than one mile in Nenana Gorge and Windy Pass. Further description of these corridors provides a more detailed rationale for their alignment.

Corridor Description

Alignment of the corridor north of the Willow Substation was facilitated by the presence of an existing Matanuska Electric Association right-of-way. This 100 foot right-of-way will be paralleled in part by the Intertie, enabling joint use of access.

Proceeding north for approximately 19 miles the corridor then splits into two alternative alignments: a) a western corridor essentially parallel to the Parks Highway and b) a more easterly corridor situated east of Talkeetna and later parallel to the Alaska Railroad.

The western corridor at its point of beginning was located west and south of the Parks Highway, avoiding more intensive development near the intersection of the Talkeetna Spur Road and the Parks Highway, while allowing for a reasonably narrow crossing of the Susitna River. At this point, the corridor widened to include both sides of the Parks Highway. Near Petersville Road, the corridor was generally confined by Sawmill and Scotty Lakes and wetland areas to the west and the Chulitna River along the east. After crossing the Chulitna River near mile post 126, the corridor continued to parallel both sides of the Parks Highway bounded by the Chulitna River on its boundary and avoiding steep topography along Curry Ridge to the east. It varied from 1-1/2 to 3 miles in width.

The alternative eastern corridor was situated approximately 3 miles east of the Talkeetna Spur Road at its closest point to avoid numerous lakes and associated small tracts in the vicinity of Sunshine and Answer Creeks and Bartlett Hills. After crossing the Talkeetna River near its confluence with Chulitna Creek, the corridor widened to more than four miles in the vicinity of Chase. North of Chase the corridor became more closely aligned with the Alaska Railroad right-of-way, being bounded by the Susitna River on the west and steep topography associated with the Talkeetna Mountains on the east. The corridor width did not exceed one or two miles in this area as it crossed Gold Creek, the Susitna River and Indian River. The corridor then merged with the Parks Highway corridor near Chulitna Pass, generally being aligned along the Chulitna River.

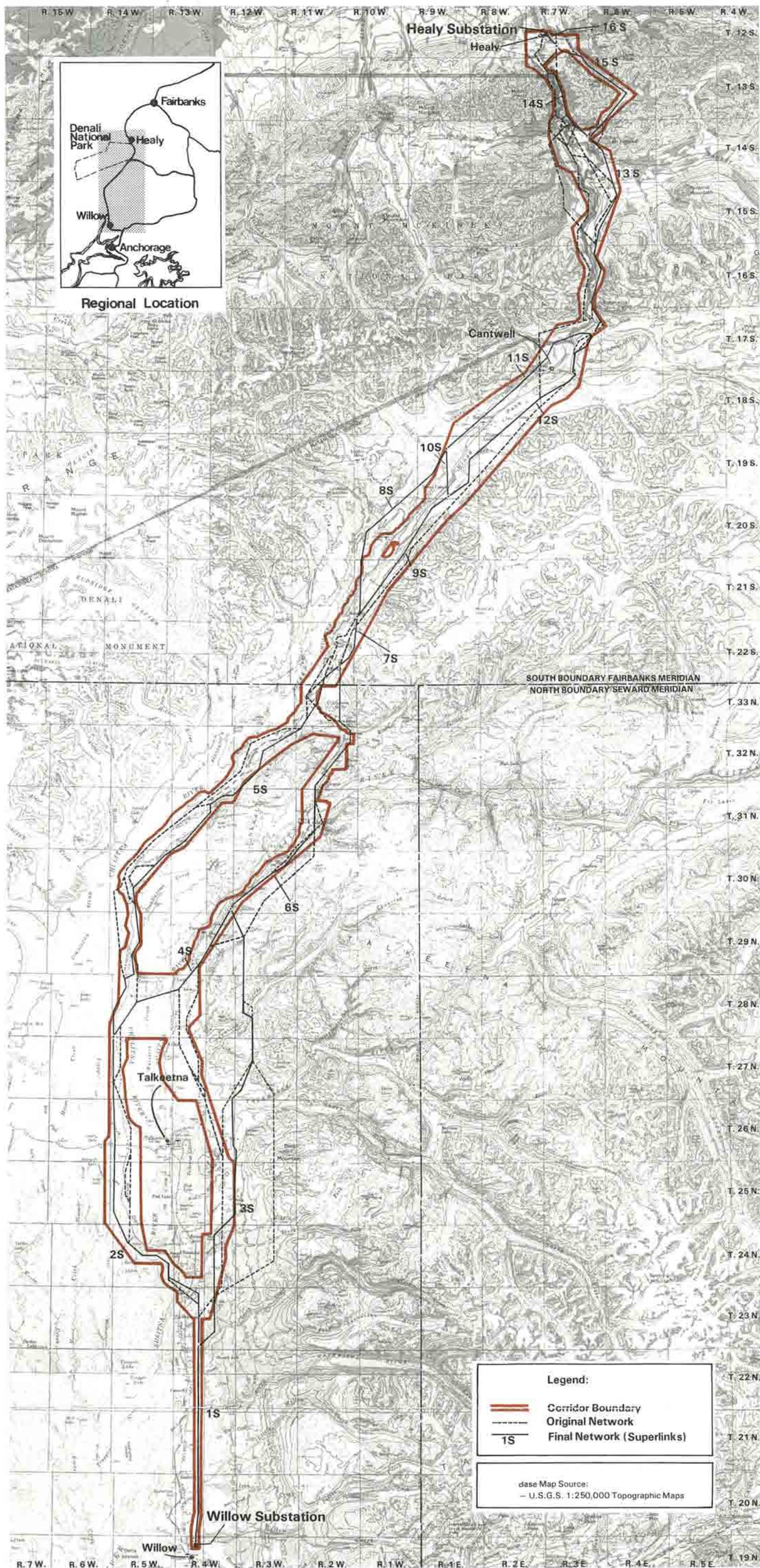


FIGURE 20

Alaska Power Authority **ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE**

Corridor and Final Network

0 10 20 Miles
 0 10 20 Kilometers



APPENDIX B

PUBLIC PARTICIPATION PROGRAM

At this juncture there was a single corridor bounded by the Chulitna River to the west and Indian Hills (near Chulitna Butte) to the east. As the corridor proceeded north crossing Hurricane Gulch, Honolulu Creek and the East Fork Chulitna River, it was narrowly confined by steep topography to the east and lowland areas associated with the Chulitna River to the west. In the vicinity of mile post 194, the corridor widened considerably to accommodate numerous routing alternatives in Broad Pass. North of Cantwell the corridor was narrowly constricted through Windy Pass. Panorama Mountain, Reindeer Hills and mountain ranges in excess of 5,000 feet limited consideration of other corridors in this locale. North of Carlo Creek, the corridor was extended to the west near Riley Creek and to the east, where topography becomes less severe in the vicinity of the Yanert Fork.

Near Montana Creek north of the Yanert Fork, the second corridor major option was delineated. The western alternative proceeded north through Nenana Gorge with the corridor confined to widths approximating one-half mile, while the second alternative was aligned with the Montana and Moody Creek drainages. Both corridor options converged at the Healy Substation north of Healy Creek.

Public workshops were conducted on January 19-21, 1981, at Anchorage, Talkeetna, Cantwell and Fairbanks to receive comments on the project's overall feasibility and preliminary corridor locations.

Determine Alternative Route Locations

Within the corridors a preliminary network of route segments or links was delineated. The links were located using the USGS topographic maps as a base and aligned where most suited to existing project area conditions. Initial selection of alignments was based on use of acceptable terrain and topographic conditions, avoidance of private tracts, as well as excessive stream and river crossings, use of vegetation edges and property and section lines. [Additional consideration was given to effects on scenic quality and existing land use development.] A network

consisting of 89 links and 58 nodes, or points of intersection, was originally prepared on March 27, 1981.

Evaluate Route Alternatives

The first revision to the network occurred during the period April and May 1981 and resulted in numerous additional links and nodes. Impetus was provided by agency meetings and field reconnaissance conducted in late May and early June 1981. Additions to the network were incorporated during this time and included alignments: 1) east of Chulitna Butte, 2) west of the Parks Highway in Broad Pass, 3) in the vicinity of the entrance to Denali National Park and Preserve and 4) west side of Nenana Gorge. The network, as modified, consisted of 115 links and 69 nodes and was issued June 3, 1981.

A second series of public workshops was held to incorporate comments on the network previously described. Meetings were held in Talkeetna, Cantwell and McKinley Village June 9-11, 1981.

Response during these sessions prompted two major changes in the network, both of which were outside the original corridors identified for study by Commonwealth: 1) provision for crossover segment south of Denali State Park to connect the east and west corridors and 2) addition of a "near east" alignment east of the original route near Talkeetna and extending north across the upper elevations of the Talkeetna Mountains to merge with original eastern route near Gold Creek. This second revision of the network resulted in a new total of 123 links and 76 nodes and was issued on June 26, 1981.

Acceptance of these networks additions was markedly different. The former, a crossover segment south of Denali State Park, was not readily accepted by communities situated along the Alaska Railroad. The latter, however, incorporating a more remote alignment not originally identified within the project area, was

considered more acceptable in its avoidance of existing residential areas, subdivisions and agriculture lands.

Informal "brown bag lunch" meetings were conducted on July 7, 1981 in Anchorage and July 10, 1981 in Fairbanks to assure that these principal communities in the vicinity of the project were kept informed of the project's status. An interagency meeting was also conducted on July 9, 1981 to review current status of the network; agencies included the Alaska Department of Natural Resources, Alaska Department of Fish and Game and U.S. Fish and Wildlife Service. Consensus at this meeting resulted in the general endorsement, by the agency representatives present, of a remote alignment east of Denali State Park, located on lower elevations of the Talkeetna Mountains. While certain other areas of disagreement remained, the acceptability of a "near-east" alignment was established.

A third and final revision of the network was made on July 17, 1981 in order to accommodate: 1) interconnection of near east and railroad alignments and 2) addition of route segment west of Parks Highway in the vicinity of the Middle Fork Chulitna River. This revised network yielded 125 links and 78 nodes and is shown in Figure 20.

An examination of the network commenced in order to refine the 125 link segments to a more effectively manageable number, with respect to engineering, environmental and economic concerns. The links remaining were then combined into larger route segments or "superlinks" and formed the basis for detailed engineering and economic analyses described in the Route Selection Report (Commonwealth Associates Inc., 1982). The superlinks and their respective lengths are noted in Table 24.

TABLE 24
ROUTE ALIGNMENT SEGMENTS
(Superlinks)

<u>Superlink</u>	<u>Length Miles</u>
1s	19.0
2s	34.2
3s	44.8
4s	17.5
5s	45.3
6s	28.3
7s	5.2
8s	19.6
9s	14.6
10s	4.2
11s	18.4
12s	22.2
13s	20.8
14s	10.9
15s	13.8
16s	1.4

Reference: Commonwealth Associates Inc., 1982.

PUBLIC PARTICIPATION PROGRAM

APA, during the preliminary routing and design of the Intertie, actively sought and engaged public involvement. Through the Public Participation Office (PPO), three major objectives of the PPO Program were established: (1) inform the public; 2) record their responses and 3) incorporate public preferences into the decisions of a route. A brief summary of each of these objectives is provided.

INFORM THE PUBLIC

Informing the public was accomplished by mailings, meetings, letters and sharing maps.

Mailings

A total of five mailings went out from January 1981 through December 1981. They were received by the following numbers of people.

January	-	450*
March	-	1700*
May	-	1700*
June	-	1700*
August	-	1700*

*Included all boxholders in Willow, Talkeetna, Trapper Creek, Cantwell, McKinley Park and Healy.

Meetings

A total of 15 public meetings were held in the areas of Fairbanks, McKinley Park, Cantwell, Talkeetna/Trapper Creek and Anchorage. Topics which were discussed during these meetings included:

- economic feasibility
- corridors and specific routes
- biological effects
- visual impact of line
- attempt to find "compromise route" in Trapper Creek, Talkeetna and Chase areas
- methods of construction
- discussions on routing objectives
- discussions on preferred routes
- access

Over 650 people attended these meetings which were held January 1981 through November 1981.

Maps

Over 200 maps were distributed throughout the process to interested individuals at meetings and by mail. Some persons stopped by the PPO to get the maps. Maps displayed the corridors selected for study, and as the project progressed, more specific route alignments were displayed for review and comment.

Letters

Forty-six letters were received in the PPO. Eight-five percent were from smaller communities (other than Anchorage and Fairbanks). Forty-eight letters which were received in the Governor's office were referred to APA. These letters may be reviewed at the PPO. Whenever appropriate, responses were sent.

RECORD THEIR RESPONSES

While each community had concerns specific to its area, some concerns were common throughout the Railbelt: 1) the visual impact of the line; 2) potential ATV use of any new access roads; and 3) possible biological effects of the line. Comments received during the meetings were noted and newsletters were provided to summarize their results, as well as to provide new relevant information regarding the project.

A summary of preferences by community is provided.

Anchorage and Fairbanks:

- Concern for visual impact of the line.
- Concern to avoid private property owned by individuals living in Anchorage and Fairbanks.

Trapper Creek:

- Preserve views in the area.
- Avoid Denali State Park.
- Avoid the Parks Highway route.
- Avoid the Trapper Creek area.
- Do not interfere with radio and tv communications.

Talkeetna:

- Avoid going through Talkeetna.
- Route the line so people do not see it.
- Route the line so people do not live near it.

People Living North of Talkeetna Along the Railroad:

- First choice: no Intertie at all. However, if there is a line:
- Do not follow the railroad so closely.
- Go further east.
- Do not have overland access.

Cantwell:

- Not opposed to the transmission line.
- Provide a substation to tap power off the line.
- Route the line so it does not interfere with legal air space around local airports.

McKinley Park:

- First choice: no Intertie at all. However, if there is a line:
- Do not route through Denali National Park and Preserve.
- Do not route near existing homes.
- Preserve views near the park entrance.
- Do not put overhead lines through Nenana Gorge.
- Preferences were expressed for underground through Nenana Gorge or helicopter construction in the Moody and Montana Creek drainages.
- Consider using existing railroad right-of-way along west side of gorge.

INCORPORATE PUBLIC PREFERENCE

The transmission line route that was approved by the Board of Directors reflects approximately 90 percent of the public preferences heard during 1981, with the lack of correlation on access north of the Talkeetna River. Avoidance of visual impacts and most communities along the Railbelt was achieved by the preferred route.

The emphasis of public involvement has now changed from communications with large groups of people (communities) to a one-on-one involvement with specific landowners affected by the project.

APPENDIX C

ECOLOGICAL STUDY SITES

ECOLOGICAL STUDY SITES

Site Number	Name	Location
1	Willow Creek	T19N, R 4W, Sec 5 SM ⁽¹⁾
2	Rogers Creek	T20N, R 4W, Sec 28 SM
3	Little Willow Creek	T20N, R 4W, Sec 16 SM
4	Talkeetna River	T26N, R 4W, Sec 3 SM
5	E. of Papa Bear Lake	T27N, R 3W, Sec 19 SM
6	Chunilna Creek	T28N, R 3W, Sec 23 SM
7	Marsh	T28N, R 5W, Sec 16 SM
8	Lake	T29N, R 3W, Sec 32 SM
9	Pond	T29N, R 4W, Sec 27 SM
10	Small Stream	T31N, R 2W, Sec 33 SM
11	Byers Creek	T31N, R 4W, Sec 1 SM
12	Little Coal Creek	T32N, R 3W, Sec 1 SM
13	Pass Creek	T33N, R 2W, Sec 28 SM
14	Small Stream	T33N, R 2W, Sec 23 SM ⁽²⁾
15	Little Honolulu Creek	T22S, R11W, Sec 1 FM
16	Honolulu Creek	T21S, R10W, Sec 29 FM
17	Middle Fork Chulitna River	T21S, R10W, Sec 6 FM
18	Small Stream	T18S, R 8W, Sec 33 FM
19	Pond-Reindeer Hills	T17S, R 7W, Sec 22 FM
20	Nenana River	T17S, R 7W, Sec 12 FM
21	Nenana River	T16S, R 7W, Sec 13 FM
22	Uplands	T14S, R 7W, Sec 15 FM
23	Hornet Creek	T13S, R 7W, Sec 21 FM
24	Nenana River	T13S, R 7W, Sec 8 FM
25	Alpine Ponds	T13S, R 6W, Sec 33 FM
26	Moody Creek	T13S, R 6W, Sec 8 FM
27	Healy Creek	T12S, R 7W, Sec 21 FM

(1) Seward Meridian

(2) Fairbanks Meridian

Source: Commonwealth Associates Inc., 1981

ECOLOGICAL STUDY SITES(1)
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 1

Location: T. 19 N , R. 4 W , Section 5 , Meridian: SM

Altitude: 200' , Aspect: N/A , Other: Campground

Date(s) Inspected: 5/26/81 - 7/8/81

VEGETATION(2)

Cover Type(s):	Lowland Spruce/hardwood	Streamside vegetation
Trees:	White Birch/spruce	N/A
Shrubs:	Alder/Willows	Alder/willows
Herbaceous:		Grasses

WILDLIFE

Cover:	Good
Mammals:	Beaver, moose
Birds:	Black-capped chickadee, ruby-crowned kinglet, harlequin duck, belted kingfisher, white-crowned sparrow, bald eagle

AQUATIC RESOURCES

Habitat Type:	River
Name:	Willow Creek
Bottom Type:	Gravel and stone
Turbidity:	Very low
Water Quality:	High
Apparent Use:	Migration and spawning

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 2

Location: T. 20 N, R. 4 W, Section 28, Meridian: SM

Altitude: 200', Aspect: N/A, Other: _____

Date(s) Inspected: 5/31/81

VEGETATION⁽²⁾

Cover Type(s):	Shrublands	Lowland Spruce/hardwood
Trees:	N/A	Black spruce
Shrubs:	Birch	Heaths, spirea
Herbaceous:	Horsetail, nagoonberry	Horsetail

WILDLIFE

Cover:	Fair
Mammals:	Moose
Birds:	Blackpoll warbler, white-crowned sparrow, olive-sided flycatcher, sandhill crane

AQUATIC RESOURCES

Habitat Type:	N/A
Name:	
Bottom Type:	
Turbidity:	
Water Quality:	
Apparent Use:	

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 3

Location: T. 20 N , R. 4 W , Section 16 , Meridian: SM

Altitude: 200' , Aspect: N/A , Other:

Date(s) Inspected: 5/29/81

VEGETATION⁽²⁾

Cover Type(s):	Lowland Spruce/hardwoods	Grassy openings
Trees:	White birch	N/A
Shrubs:	Highbush cranberry	Rose, willow
Herbaceous:	Horsetail, grass	spirea Grass

WILDLIFE

Cover:	Fair
Mammals:	--
Birds:	Lincoln's sparrow, dark-eyed junco

AQUATIC RESOURCES

Habitat Type:	N/A
Name:	
Bottom Type:	
Turbidity:	
Water Quality:	
Apparent Use:	

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 4

Location: T. 26 N, R. 4 W, Section 3, Meridian: SM

Altitude: 450', Aspect: N/A, Other:

Date(s) Inspected: 5/29/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar

Trees: Balsam poplar, white spruce, white birch

Shrubs: Alder, willow

Herbaceous: Horsetail, grass, ostrich fern

WILDLIFE

Cover: Good

Mammals: Moose-beaver

Birds: Alder flycatcher, Swainson's Thrush, white-crowned sparrow
black-capped chickadee, tree swallow

AQUATIC RESOURCES

Habitat Type: Large river

Name: Talkeetna River

Bottom Type: Sand, gravel, and stone

Turbidity: High

Water Quality: High

Apparent Use: Migration and spawning

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 5

Location: T. 27 N , R. 3 W , Section 19 , Meridian: SM

Altitude: 700' , Aspect: N/A , Other: _____

Date(s) Inspected: 7/8/81

VEGETATION⁽²⁾

Cover Type(s):	Upland spruce/hardwood Forest	Streamside
Trees:	White Spruce, White Birch	N/A
Shrubs:	Highbush cranberry, rose, Spirea	Blackberry, rose
Herbaceous:	Bunchberry Twin flower	Grass, rich assemblage of flowering plants

WILDLIFE

Cover:	Fair
Mammals:	Moose-beaver
Birds:	Dipper, ruby-crowned kinglet, common snipe

AQUATIC RESOURCES

Habitat Type:	Stream
Name:	Unnamed
Bottom Type:	Sand and gravel
Turbidity:	Low
Water Quality:	High
Apparent Use:	Spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 6

Location: T. 28 N , R. 3 W , Section 20 , Meridian: SM

Altitude: 1000' , Aspect: N/A , Other: _____

Date(s) Inspected: 7/7/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar
Trees: Balsam poplar, white spruce
Shrubs: Willow, alder
Herbaceous: Ostrich fern, grass

WILDLIFE

Cover: Good
Mammals: Moose, beaver
Birds: White-crowned sparrow

AQUATIC RESOURCES

Habitat Type: River
Name: ChuniIna Creek
Bottom Type: Gravel
Turbidity: Medium
Water Quality: High
Apparent Use: Spawning and migration

Note: (1) Refer to Figure 13 for location.
 (2) Vegetation is major species only.
 N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 7

Location: T. 28 N, R. 5 W, Section 16, Meridian: SM

Altitude: 700', Aspect: N/A, Other:

Date(s) Inspected: 7/8/81

VEGETATION⁽²⁾

Cover Type(s): Low brush, muskeg-bog Lowland Spruce/hardwood

Trees: N/A Black spruce

Shrubs: Bearberry Heaths, alder

Herbaceous: Sedges

WILDLIFE

Cover: Various

Mammals: Moose, red squirrel

Birds: White-crowned sparrow, common snipe, dark-eyed junco, common
redpoll, golden-crowned kinglet

AQUATIC RESOURCES

Habitat Type: N/A

Name:

Bottom Type:

Turbidity:

Water Quality:

Apparent Use:

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 8

Location: T. 29 N , R. 3 W , Section 32 , Meridian: SM

Altitude: 2100' , Aspect: Various , Other: _____

Date(s) Inspected: 7/7/81

VEGETATION⁽²⁾

Cover Type(s):	Shrublands	Wetland below pond
Trees:	N/A	N/A
Shrubs:	Birch, spirea Crowberry	Cinquefoil
Herbaceous:	Grass	Rich assemblage of flowering species

WILDLIFE

Cover:	Good
Mammals:	Moose, beaver, arctic ground squirrel
Birds:	Green-winged teal, savannah sparrow, rough-legged hawk

AQUATIC RESOURCES

Habitat Type:	Pond
Name:	Unnamed
Bottom Type:	Sand and organics
Turbidity:	Low
Water Quality:	High
Apparent Use:	Spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 9

Location: T. 29 N, R. 4 W, Section 27, Meridian: SM

Altitude: 1500, Aspect: W, Other: _____

Date(s) Inspected: 5/31/81 - 7/8/81

VEGETATION⁽²⁾

Cover Type(s): Shrublands
Trees:
Shrubs: Alder, heaths
Herbaceous: Grasses, ferns, cow parsnip etc.,

WILDLIFE

Cover: Fair (Good in places)
Mammals: Moose, grizzly bear, beaver
Birds: Blackpoll warbler, gray-crowned rosy finch, black-capped chickadee, common snipe, Lincoln's sparrow, common golden eye, pine siskin, dark-eyed junco

AQUATIC RESOURCES

Habitat Type: Pond
Name: Unnamed
Bottom Type: Organic
Turbidity: Low
Water Quality: High
Apparent Use: Unknown probably spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 10

Location: T. 30 N , R. 2 W , Section 5 , Meridian: SM

Altitude: 3200-3300' , Aspect: NW , Other: _____

Date(s) Inspected: 7/7/81

VEGETATION⁽²⁾

Cover Type(s): Shrublands
Trees: N/A
Shrubs: Willows
Herbaceous: Sedges and rich assemblage of flowering plants with
 none really dominant

WILDLIFE

Cover: Fair (ground cover only)
Mammals: Arctic ground squirrel, black bear, caribou
Birds: --

AQUATIC RESOURCES

Habitat Type: Stream
Name: Unnamed
Bottom Type: Gravel and rock
Turbidity: Low
Water Quality: High
Apparent Use: None

Note: (1) Refer to Figure 13 for location.
 (2) Vegetation is major species only.
 N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 11

Location: T. 31 N, R. 4 W, Section 1, Meridian: SM

Altitude: 1100', Aspect: N/A, Other: _____

Date(s) Inspected: 5/29/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar
Trees: Balsam poplar, white spruce
Shrubs: Willow
Herbaceous: Grass, horsetail

WILDLIFE

Cover: Fair
Mammals: Moose, beaver
Birds: Yellow-rumped warbler, savannah sparrow

AQUATIC RESOURCES

Habitat Type: Stream
Name: Byers Creek
Bottom Type: Gravel and stone
Turbidity: Low
Water Quality: High
Apparent Use: Spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 12

Location: T. 32 N , R. 2 W , Section 1 , Meridian: SM

Altitude: 1300'-1400' , Aspect: Various , Other: Steep slopes

Date(s) Inspected: 5/28/81

VEGETATION⁽²⁾

Cover Type(s): Upland Spruce/hardwoods

Trees: Spruce/birch

Shrubs: N/A

Herbaceous: N/A

WILDLIFE

Cover: Fair

Mammals: Moose

Birds: White-crowned sparrow, common raven, Swainson's thrush

AQUATIC RESOURCES

Habitat Type: Stream

Name: Little Coal Creek

Bottom Type: Gravel and boulders

Turbidity: Low

Water Quality: High

Apparent Use: Migration and spawning

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 13

Location: T. 33 N , R. 2 W , Section 29 , Meridian: SM

Altitude: 1300' , Aspect: N/A , Other: _____

Date(s) Inspected: 5/29/81

VEGETATION⁽²⁾

Cover Type(s):	Low brush, muskeg-bog	Lowland Spruce/hardwood
Trees:	N/A	Black spruce
Shrubs:	Willow, birch, heaths	Birch, heaths, spirea
Herbaceous:	Sedges	Crowberry Grasses

WILDLIFE

Cover: Various

Mammals: Beaver, moose

Birds: Belted kingfisher, blackpoll warbler, Bohemian waxwing, tree swallow
 northern phalarope, Lincoln's sparrow, northern waterthrush, pintail,
 green-winged teal, long-billed dowitcher, lesser yellowlegs, olive-
 sided flycatcher.

AQUATIC RESOURCES

Habitat Type: Stream

Name: Pass Creek

Bottom Type: Sand and fine gravel

Turbidity: Moderate

Water Quality: High

Apparent Use: Spawning and nursery

Note: (1) Refer to Figure 13 for location.
 (2) Vegetation is major species only.
 N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 14

Location: T. 33 N, R. 11 W, Section 14, Meridian: SM

Altitude: 1700', Aspect: SW, Other: _____

Date(s) Inspected: 5/29/81

VEGETATION⁽²⁾

Cover Type(s): Upland Spruce/hardwood

Trees: Spruce

Shrubs: Willow, birch, heaths

Herbaceous: Grass

WILDLIFE

Cover: Good

Mammals: Moose, beaver

Birds: Lincoln's sparrow, lesser yellowlegs, rusty blackbird, gray jay, tree sparrow, orange-crowned warbler

AQUATIC RESOURCES

Habitat Type: Small stream

Name: Unnamed

Bottom Type: Gravel and stone

Turbidity: Low

Water Quality: High

Apparent Use: Spawning and nursery

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 15

Location: T. 22 S , R. 10 W , Section 6 , Meridian: FM

Altitude: 1800-1900' , Aspect: N , Other:

Date(s) Inspected: 5/30/81

VEGETATION⁽²⁾

Cover Type(s):	Upland Spruce/hardwood	Shrublands
Trees:	White spruce, Balsam Poplar	N/A
Shrubs:	Alder	Alder
Herbaceous:	Crowberry	
	Ferns	Horsetail
		Grass

WILDLIFE

Cover:	Fair
Mammals:	Moose, Bear sp.
Birds:	Yellow-rumped warbler, common redpoll, Wilson's warbler mew gull, black-capped chickadee

AQUATIC RESOURCES

Habitat Type:	Stream
Name:	Little Honolulu Creek
Bottom Type:	Gravel and rock
Turbidity:	Low
Water Quality:	High
Apparent Use:	Spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 16

Location: T. 21 S , R. 10 W , Section 29 , Meridian: FM

Altitude: 1600' , Aspect: N/A , Other: _____

Date(s) Inspected: 5/30/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar

Trees: Scattered Balsam Poplar

Shrubs: Willows

Herbaceous: Grass, bluebells

WILDLIFE

Cover: Good

Mammals: Moose

Birds: --

AQUATIC RESOURCES

Habitat Type: Stream

Name: Honolulu Creek

Bottom Type: Gravel and large stone

Turbidity: Low

Water Quality: High

Apparent Use: Spawning

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 17

Location: T. 21 S , R. 10 W , Section 6 , Meridian: FM

Altitude: 1700' , Aspect: N/A , Other: _____

Date(s) Inspected: 10/26/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar

Trees: Spruces/Balsam poplar

Shrubs: Alder and willows, juniper

Herbaceous: Grasses

WILDLIFE

Cover: Fair

Mammals: Snowshoe hare, fox, red squirrel

Birds: Goshawk, ptarmigan

AQUATIC RESOURCES

Habitat Type: Large River

Name: Middle Fork Chulitna River

Bottom Type: Gravel and stone

Turbidity: Very low

Water Quality: High

Apparent Use: Migration and spawning

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 18

Location: T. 18 S , R. 8 W , Section 33 , Meridian: FM

Altitude: 2400' , Aspect: N/A , Other:

Date(s) Inspected: 5/30/81

VEGETATION⁽²⁾

Cover Type(s): Shrublands

Trees: N/A

Shrubs: Birch, willows

Herbaceous: Sedges

WILDLIFE

Cover: Fair

Mammals: Caribou, beaver, grizzly bear

Birds: Ruby-crowned kinglet, American robin, white-crowned sparrow

AQUATIC RESOURCES

Habitat Type: Small stream

Name: Unnamed

Bottom Type: Organic

Turbidity: Medium

Water Quality: High

Apparent Use: Unknown, probably spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 19

Location: T. 17 S, R. 7 W, Section 23, Meridian: FM

Altitude: 2500-2700', Aspect: Various, Other: _____

Date(s) Inspected: 5/30/81

VEGETATION⁽²⁾

Cover Type(s): Shrublands
Trees: N/A
Shrubs: Birch
Heaths
Herbaceous: White mountain avens

WILDLIFE

Cover: Fair (scattered)
Mammals: Bear (sp), caribou, moose
Birds: Horned lark, willow ptarmigan, varied thrush, savannah sparrow,
green-winged teal, lesser scaup

AQUATIC RESOURCES

Habitat Type: Alpine pond
Name: Unnamed
Bottom Type: Rock, sand, and organics
Turbidity: Low
Water Quality: High
Apparent Use: Unknown, probably spawning and nursery

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A - Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 20

Location: T. 17 S , R. 7 W , Section 12 , Meridian: FM

Altitude: 2100' , Aspect: N/A , Other:

Date(s) Inspected: 5/28/81 and 7/9/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar

Trees: Occassional Spruce

Shrubs: Willows

Herbaceous: Bunchberry

WILDLIFE

Cover: Fair (ground cover minimal)

Mammals: Moose , beaver

Birds: Swainson's thrush, common redpoll, white-crowned sparrow,
common raven

AQUATIC RESOURCES

Habitat Type: Large river

Name: Nenana river

Bottom Type: Sand and gravel

Turbidity: High

Water Quality: High

Apparent Use: Migration

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 21

Location: T. 16 S, R. 6 W, Section 19, Meridian: FM

Altitude: 2000', Aspect: N/A, Other:

Date(s) Inspected: 5/28/81 and 7/9/81

VEGETATION⁽²⁾

Cover Type(s): Bottomland Spruce/poplar

Trees: Spruces

Shrubs: Willows

Herbaceous: Bunchberry, horsetail

WILDLIFE

Cover: Fair

Mammals: Moose

Birds: Yellow-rumped warbler, alder flycatcher, white-crowned
sparrow mew gull, dark-eyed junco, chipping sparrow

AQUATIC RESOURCES

Habitat Type: Large river

Name: Nenana River

Bottom Type: Sand and gravel

Turbidity: High

Water Quality: High

Apparent Use: Migration

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES(1)
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 22

Location: T. 14 S , R. 7 W , Section 15 , Meridian: FM

Altitude: 1800'-2000' , Aspect: N/A , Other: Gentle slopes

Date(s) Inspected: 5/28/81 and 7/9/81

VEGETATION(2)

Cover Type(s):	Upland Spruce/hardwood	
Trees:	Spruces/white birch	White spruce/aspen
Shrubs:	Heaths/birch	Birch/cinquefoil
Herbaceous:	Sedges	Crowberry Lupine, anemone

WILDLIFE

Cover:	Fair
Mammals:	Moose
Birds:	Swainson's thrush, dark-eyed junco, tree sparrow, mew gull, white-crowned sparrow, golden eagle

AQUATIC RESOURCES

Habitat Type:	N/A
Name:	
Bottom Type:	
Turbidity:	
Water Quality:	
Apparent Use:	

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 23

Location: T. 13 S, R. 7 W, Section 22, Meridian: FM

Altitude: 1500'-1700', Aspect: W, Other: Steep slope

Date(s) Inspected: 5/28/81 and 7/9/81

VEGETATION⁽²⁾

Cover Type(s): Upland Spruce/hardwood

Trees: White Spruce/balsam poplar/trembling aspen

Shrubs: Alder/willow/rose/shrubby cinquefoil

Herbaceous: Grasses/white camass/ferns

WILDLIFE

Cover:

Mammals: Moose, snowshoe hare

Birds: American robin, black-capped chickadee, Swanison's thrush

AQUATIC RESOURCES

Habitat Type: Mountain stream

Name: Hornet Creek

Bottom Type: Sand, gravel and large rocks

Turbidity: Low

Water Quality: High

Apparent Use: None

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES(1)
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 24

Location: T. 13 S, R. 7 W, Section 9, Meridian: FM

Altitude: 1500-2000', Aspect: SW, Other: Steep slope

Date(s) Inspected: 5/28/81 and 7/9/81

VEGETATION(2)

Cover Type(s): Shrublands

Trees: N/A

Shrubs: Alder

Herbaceous: Grasses

WILDLIFE

Cover: Good

Mammals: Red squirrel, snowshoe hare

Birds: Black-billed magpie, white-crowned sparrow

AQUATIC RESOURCES

Habitat Type: Large river

Name: Nenana River

Bottom Type: Sand, gravel and stone

Turbidity: High

Water Quality: High

Apparent Use: Migration

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 25

Location: T. 13 S, R. 6 W, Section 33, Meridian: FM

Altitude: 3100', Aspect: Various, Other: _____

Date(s) Inspected: 5/30/81

VEGETATION⁽²⁾

Cover Type(s): Shrublands

Trees: Occasional spruce

Shrubs: Birch

Herbaceous: Sedges

WILDLIFE

Cover: Fair to Poor (Scattered)

Mammals: Caribou, dall sheep, moose, beaver

Birds: Varied thrush, white-crowned sparrow, bufflehead

AQUATIC RESOURCES

Habitat Type: Small Alpine ponds

Name: Unnamed

Bottom Type: Organic

Turbidity: Low

Water Quality: High

Apparent Use: None

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 26

Location: T. 13 S, R. 6 W, Section 8, Meridian: FM

Altitude: 2100', Aspect: NE, Other: Cliffs

Date(s) Inspected: 5/30/81

VEGETATION⁽²⁾

Cover Type(s): Shrublands

Trees: Occasional white spruce

Shrubs: Alder, birch, heaths

Herbaceous: Violets, rock jamsmine, alp lily etc.,

WILDLIFE

Cover: Fair

Mammals: Moose

Birds: Gyrfalcon, dark-eyed junco

AQUATIC RESOURCES

Habitat Type: Stream

Name: Moody Creek

Bottom Type: Gravel and boulders

Turbidity: Moderate

Water Quality: High

Apparent Use: Spawning and nursery

Note: (1) Refer to Figure 13 for location.

(2) Vegetation is major species only.

N/A — Not Applicable

ECOLOGICAL STUDY SITES⁽¹⁾
ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE

Site Number 27

Location: T. 12 S, R. 7 W, Section 21, Meridian: FM

Altitude: 1300', Aspect: N/A, Other: _____

Date(s) Inspected: 5/28/81

VEGETATION⁽²⁾

Cover Type(s):

Trees: N/A

Shrubs: N/A

Herbaceous: N/A

WILDLIFE

Cover: Poor

Mammals: Domestic dog

Birds: Mew gull, robin

AQUATIC RESOURCES

Habitat Type: River

Name: Healy Creek

Bottom Type: Sand, gravel, some rock

Turbidity: High

Water Quality: Unknown

Apparent Use: Migration, spawning

Note: (1) Refer to Figure 13 for location.
(2) Vegetation is major species only.
N/A — Not Applicable

APPENDIX D

COMPARATIVE VEGETATION STUDIES

TABLE A
BOTTOMLAND SPRUCE-POPLAR COVER TYPE

	Viereck And Little	Woodward/ Clyde	NPS	Neiland And Viereck	USFWS - RBS 10-12-2	TES	Commonwealth 4 6
<u>Betula papyrifera</u>							x
<u>Ledum decumbens</u>						x	
<u>Alnus sp.</u>							x x
<u>A. crispa</u>	x	x	x	x			
<u>A. sinuata</u>	x						
<u>A. tenuifolia</u>	x		x	x			
<u>Salix sp.</u>		x			x		x
<u>S. arbusculoides</u>	x		x		x		
<u>S. alaxensis</u>	x	x	x				
<u>Rosa acicularis</u>	x			x			x
<u>Viburnum edule</u>	x		x	x	x		x
<u>Shepherdia canadensis</u>		x					
<u>Oplopanax horridum</u>				x			x
<u>Vaccinium sp.</u>							x
<u>V. uliginosum</u>						x	
<u>V. vitis-idaea</u>						x	
<u>Ribes triste</u>							x
<u>Headysarum boreale</u>		x					
<u>Astragalus americanus</u>		x					
<u>Equisetum sp.</u>				x	x		x x
<u>Calamagrostis canadensis</u>				x	x		x x
<u>Geocaulon lividum</u>				x			
<u>Galium boreale</u>				x			x x
<u>Mertensia paniculata</u>				x			x
<u>Geranium erianthum</u>					x		x
<u>Ferns</u>					x		
<u>Sanguisorba stipulata</u>					x		
<u>Cornus canadensis</u>					x		
<u>Epilobium angustifolium</u>					x		x
<u>Rubus idaeus</u>					x		
<u>Veratrum viride</u>					x		
<u>Streptopus amplexifolius</u>					x		x x
<u>Heracleum lanatum</u>					x		x
<u>Aconitum delphinifolium</u>					x		
<u>Matteuccia struthiopteris</u>							x x
<u>Gymnocarpium dryopteris</u>							x
<u>Polemonium acutiflorum</u>							x
<u>Erigeron acris subsp. politus</u>							x
<u>Artemisia tilesii subsp. unalaschcensis</u>							x
<u>Empetrum nigrum</u>						x	
<u>Spirea beauverdiana</u>						x	

TABLE B
BOTTOMLAND SPRUCE-POPLAR COVER TYPE
BOTTOMLAND SPRUCE FORESTS

	Neiland And Viereck	TES	Viereck 1970	Woodward/ Clyde	Commonwealth Site 21
<u>Picea spp.</u>					x
<u>P. glauca</u>	x	x		x	
<u>P. mariana</u>		x	x		
<u>Rosa acicularis</u>	x				x
<u>Viburnum edule</u>	x				
<u>Alnus crispa</u>	x				
<u>Vaccinium uliginosum</u>		x	x	x	x
<u>V. vitis-idaea</u>		x	x	x	
<u>Salix sp.</u>				x	x
<u>Empetrum nigrum</u>		x		x	x
<u>Betula spp.</u>					x
<u>Ledum decumbens</u>			x		
<u>L. groelandicum</u>		x	x		
<u>Equisetum spp.</u>	x	x			x
<u>Linnaea borealis</u>	x				
<u>Geocaulon lividum</u>	x				
<u>Pyrola spp.</u>	x				x
<u>Cornus canadensis</u>					x
<u>Petasites sp.</u>					x
<u>Mertensia paniculata</u>					x
<u>Rubus arcticus</u>		x			

TABLE C
LOWLAND SPRUCE-HARDWOOD COVER TYPE

	Laroi	TES	Neiland Vioreck	Dyrness And (1)	Grigal (2)	USFWS RBS 13-1 10-12-9	Commonwealth Site 2 Site 3 Site 7
<u>Populus tremuloides</u>						x	
<u>Picea mariana</u>	x	x	x		x	x	x x x
<u>P. glauca</u>	x	x		x		x	x
<u>Betula papyrifera</u>	x		x				x x
<u>Alnus sp.</u>			x	x			
<u>A. crispa</u>						x	
<u>Salix sp.</u>	x	x				x	x
<u>S. arbusculoides</u>	x					x	
<u>S. planifolia subsp.</u>							
<u>pulchra</u>			x				
<u>S. glauca</u>	x						
<u>S. myritillifolia</u>	x						
<u>S. bebbiana</u>	x		x				
<u>S. alaxensis</u>			x				
<u>Ledum sp.</u>						x	x
<u>L. groenlandicum</u>	x	x	x			x	
<u>L. decumbens</u>		x	x		x		
<u>Rosa acicularis</u>	x			x		x	x x
<u>Potentilla fruticosa</u>	x					x	
<u>Shephardia canadensis</u>	x						
<u>Spirea beauverdiana</u>						x	x
<u>Betula glandulosa</u>			x		x	x x	x
<u>Vaccinium sp.</u>						x	x
<u>V. vitis-idaea</u>	x	x		x	x	x	x
<u>V. uliginosum</u>	x	x	x	x	x		
<u>V. ovalifolium</u>						x	
<u>Arctostaphylos sp.</u>							x x
<u>A. rubra</u>			x				
<u>Viburnum edule</u>							x
<u>Cornus canadensis</u>	x			x		x	
<u>Empetrum nigrum</u>	x	x				x	
<u>Equisetum sp.</u>	x					x	x x
<u>E. silvaticum</u>		x					
<u>Rubus sp.</u>							x
<u>R. arcticus</u>		x				x x	
<u>R. chamaemorus</u>				x	x		x
<u>Sedges</u>						x x	
<u>Calamagrostis canadensis</u>				x			x
<u>Eriophorum vaginatum</u>			x		x		
<u>Ribes triste</u>							x x
<u>Trientalis europea</u>							x x
<u>Sanguisorba stipulata</u>							x
<u>Linnaea borealis</u>	x						x
<u>Viola sp.</u>							x
<u>Saussurea viscida</u>						x	
<u>Rumex spp.</u>						x	
<u>Ranunculus eschscholtzii</u>						x	
<u>Mertensia paniculata</u>						x	
<u>Lupinus spp.</u>						x	
<u>Iris setosa</u>						x	
<u>Epilobium angustifolium</u>						x	
<u>Deschampsia spp.</u>						x	
<u>Allium schoenoprasum</u>						x	

- (1) White Spruce/Alder/Calamagrostis Zone
(2) Black Spruce Woodland/Eriophorum Zone

TABLE D
UPLAND SPRUCE-HARDWOOD COVER TYPE
PAPER BIRCH FORESTS

	Woodward/ Clyde Ridges	TES Open Closed		Hettinger And Janz	Neiland And Vioreck	USFWS RBS 10-12-2 10-12-5		Commonwealth Site 9
<u>Populus tremuloides</u>	x							
<u>Picea glauca</u>	x	x	x			x	x	x
<u>Arctostaphylos sp.</u>								x
<u>Betula glandulosa</u>							x	
<u>Salix sp.</u>	x				x			
<u>Alnus spp.</u>				x		x	x	x
<u>A. sinuata</u>	x							
<u>A. crispa</u>					x			
<u>Viburnum edule</u>			x	x	x	x	x	
<u>Ledum decumbens</u>		x						
<u>L. groenlandicum</u>		x						
<u>Menziesia ferruginea</u>								x
<u>Vaccinium sp.</u>						x	x	x
<u>V. uliginosum</u>		x	x					
<u>V. vitis-idaea</u>	x	x	x	x				
<u>Rosa aciculatus</u>		x			x			
<u>Ribes triste</u>					x			
<u>Juniperus communis</u>						x		
<u>Sorbus scopulina</u>						x		x
<u>Empetrum nigrum</u>						x		x
<u>Linnaea borealis</u>	x							x
<u>Cornus canadensis</u>	x	x	x			x	x	x
<u>Heracleum lanatum</u>								x
<u>Grasses</u>	x							x
<u>Calamagrostis canadensis</u>			x	x		x	x	
<u>Equisetum sp.</u>					x		x	
<u>E. sylvaticum</u>			x					x
<u>Mertensia paniculata</u>			x				x	x
<u>Rubus arcticus</u>					x			x
<u>Geranium sp.</u>						x		
<u>Ferns</u>						x	x	x
<u>Gymnocarpium dryopteris</u>			x					
<u>Sanguisorba stipulata</u>						x	x	
<u>Aconitum delphinifolium</u>						x		
<u>Streptopus amplexifolius</u>						x	x	x
<u>Epilobium angustifolium</u>						x		x
<u>Rubus chamaemorus</u>						x		x
<u>Spirea beauverdiana</u>						x	x	x
<u>Veratrum viride</u>							x	x
<u>Rumex sp.</u>							x	
<u>Viola sp.</u>								x
<u>Trientalis europaea</u>								x
<u>Cassiope sp.</u>								x

TABLE E
 UPLAND SPRUCE-HARDWOOD COVER TYPE
 WHITE SPRUCE/MIXED FORESTS

	Laroi	Nieland And Vioreck	USFWS - RBS		Commonwealth			
			10-12-5	10-12-9	Site 14	Site 15	Site 5	Site 22
<u>Betula papyrifera</u>	x			x			x	x
<u>Picea mariana</u>	x							x
<u>Populus balsamifera</u>	x					x		x
<u>Alnus sp.</u>			x					
<u>A. crispa</u>	x	x				x		
<u>Salix spp.</u>		x		x	x			x
<u>S. arbusculoides</u>	x							
<u>Vaccinium spp.</u>			x	x	x	x	x	x
<u>V. uliginosum</u>		x						
<u>Empetrum nigrum</u>		x	x	x	x	x	x	x
<u>Rosa acicularis</u>	x	x					x	
<u>Viburnum edule</u>	x	x					x	
<u>Ribes triste</u>	x	x	x			x		
<u>Ledum sp.</u>				x	x			x
<u>L. groenlandicum</u>	x							
<u>Shepherdia canadensis</u>	x	x						
<u>Spiraea beauverdiana</u>			x	x	x	x	x	
<u>Betula glandulosa</u>				x	x			x
<u>Oplopanax horridum</u>						x		
<u>Sorbus scopulina</u>						x		
<u>Arctostaphylos sp.</u>								x
<u>Carex sp.</u>								x
<u>Linnaea borealis</u>	x	x	x	x			x	
<u>Cornus canadensis</u>	x		x	x			x	
<u>Vaccinium vitis-idaea</u>	x	x	x					x
<u>Epilobium angustifolium</u>		x	x	x				
<u>Equisteum sp.</u>		x						x
<u>Listera cordata</u>		x					x	
<u>Pyrola spp.</u>		x						x
<u>Ferns</u>			x	x		x		
<u>Rubus chamaemorus</u>			x					
<u>R. pedatus</u>							x	
<u>Veratrum viride</u>			x					
<u>Calamagrostis canadensis</u>			x					
<u>Viola sp.</u>				x				
<u>Streptopus amplexifolius</u>				x			x	
<u>Trientalis europaea</u>						x		
<u>Tofieldia pusilla</u>								x
<u>Eriophorum spp.</u>								x
<u>Epilobium angustifolium</u>								x
<u>Lupinus arcticus</u>								x
<u>Parnassia palustris</u>								x
<u>Saussurea angustifolia</u>								x
<u>Parrya nudicaulis</u>								x
<u>Mertensia paniculata</u>								x
<u>Petasites sp.</u>								x

TABLE F
 UPLAND SPRUCE-HARDWOOD COVER TYPE
 TREELINE SITES

	Shelton	Open Spruce Forest	Woodward/Clyde Sub Alpine Meadow	Windswept Terrace	Commonwealth Site 26
<u>Picea glauca</u>	x	x	x		x
<u>P. mariana</u>			x		
<u>Populus tremuloides</u>		x		x	
<u>Betula nana</u>		x	x	x	x
<u>Salix spp.</u>			x		x
<u>S. reticulata</u>	x				
<u>S. richardsonii</u>	x				
<u>Alnus sp.</u>					x
<u>Rhododendron lapponicum</u>	x				x
<u>Arctostaphylos alpina</u>	x	x			
<u>Vaccinium vitis-idaea</u>		x	x		
<u>V. uliginosum</u>			x	x	
<u>V. sp.</u>					x
<u>Potentilla fruticosa</u>		x		x	
<u>Ledum decumbens</u>			x		
<u>L. sp.</u>					x
<u>Carex sp.</u>			x		
<u>Grasses</u>			x	x	x
<u>Lupinus sp.</u>				x	
<u>Viola sp.</u>				x	
<u>Corydalis pauciflora</u>					x
<u>Androsace chamaejasme</u>					x
<u>Dryas integrifolia</u>					x
<u>D. octopetala</u>					
<u>Parrya nudicaulis</u>					x
<u>Cassiope tetragona</u>	x				x
<u>Anemone sp.</u>					x
<u>Lloydia serotina</u>					x
<u>Oxyria digyna</u>	x				x
<u>Mertensia paniculata</u>					x
<u>Trientalis europaea</u>					x
<u>Saxifraga oppositifolia</u>					x
<u>S. tricuspidata</u>	x				x
<u>Valeriana capitata</u>					x
<u>Empetrum nigrum</u>	x				
<u>Epilobium latifolium</u>	x				
<u>Stellaria longipes</u>	x				
<u>Polygonum viviparum</u>	x				
<u>Tofieldia pusilla</u>	x				

TABLE G
UPLAND SPRUCE-HARDWOOD COVER TYPE
ASPEN OR SPRUCE/ASPEN STANDS

	Nieland Windswept Location	And Viereck Normal Location	Woodward/ Clyde Ridge	Commonwealth Site 23	Site 22 (Partial)
<u>Betula papyrifera</u>			x		
<u>Picea glauca</u>			x	x	x
<u>Populus balsamifera</u>				x	x
<u>Arctostaphylos</u> spp.	x				
<u>Elaeagnus commutata</u>	x				
<u>Shepherdia canadensis</u>	x	x		x	
<u>Rosa acicularis</u>		x		x	
<u>Salix</u> spp.		x	x		
<u>Viburnum edule</u>		x			
<u>Alnus sinuata</u>			x		
<u>Potentilla fruticosa</u>				x	x
<u>Juniperus communis</u>				x	
<u>Betula</u> spp.					x
<u>Empetrum nigrum</u>					x
<u>Diapensia lapponica</u>					x
<u>Achillea</u> spp.		x			
<u>Artemisia</u> spp.		x			
<u>A. arctica</u>				x	
<u>Epilobium angustifolium</u>		x			
<u>Pedicularis labradorica</u>		x			
<u>Linnaea borealis</u>		x	x	x	
<u>Galium boreale</u>		x			
<u>Vaccinium vitis-idaea</u>			x		
<u>Cornus canadensis</u>			x		
Grasses			x	x	
<u>Senecio</u> sp.				x	x
<u>Zygadenus elegans</u>				x	
<u>Aster sibiricus</u>				x	
<u>Delphinium glaucum</u>				x	
<u>Moehringia lateriflora</u>				x	
<u>Lupinus arcticus</u>					x
<u>Valeriana capitata</u>					x
<u>Saussurea angustifolia</u>					x
<u>Anemone</u> sp.					x

TABLE H
UPLAND SPRUCE-HARDWOOD COVER TYPE
BLACK SPRUCE STANDS

	Neiland And Viereck 45' & 8" dbh	Scattered	Dyrness And Grigal Open Ridgetop	Commonwealth Site 13 (Partial)
<u>Betula sp.</u>				x
<u>Empetrum nigrum</u>	x	x		x
<u>Ledum groenlandicum</u>	x	x	x	x
<u>Spiraea beauverdiana</u>	x	x		x
<u>Vaccinium uliginosum</u>	x	x	x	x
<u>V. vitis-idaea</u>	x	x	x	
<u>Rosa acicularis</u>	x	x	x	
<u>Salix sp.</u>	x	x		x
<u>Geocaulon lividum</u>	x	x		
<u>Rubus chamaemorus</u>		x		
<u>Oxycoccus sp.</u>		x		
<u>Andromeda polifolia</u>		x		
<u>Ledum decumbens</u>		x		
<u>Alnus crispa</u>			x	
<u>Calamagrostis canadensis</u>			x	
<u>Equisetum sylvaticum</u>			x	
<u>Cassiope sp.</u>				x
<u>Petasites sp.</u>				x
<u>Anemone sp.</u>				x

TABLE I
SHRUBLAND⁽¹⁾

	Woodward Clyde	NPS	NPS (Upland bogs)	Neiland And Vioreck	USFWS RBS 10-12-5	USFWS RBS 10-12-4	Commonwealth			
							Site 15	Site 8	Site 12	Site 20
<u>Alnus</u> spp.					x	x	x			x
<u>A. crispa</u>	x	x		x						
<u>Vaccinium uliginosum</u>	x	x	x	x						
<u>Arctostaphylos alpina</u>		x								
<u>Betula glandulosa</u>		x	x	x		x		x	x	
<u>Potentilla fruticosa</u>		x								x
<u>Salix</u> spp.				x		x			x	x
<u>S. barclayi</u>		x	x							
<u>S. fuscescens</u>		x	x							
<u>S. planifolia</u> subsp.		x	x							
<u> pulchra</u>										
<u>S. myrtillofolia</u>			x							
<u>S. richardsonii</u>		x								
<u>Spiraea beauverdiana</u>		x		x	x	x	x	x	x	
<u>Empetrum nigrum</u>		x				x		x	x	x
<u>Ledum decumbens</u>		x	x	x					x	x
<u>L. groenlandicum</u>			x	x						
<u>Vaccinium</u> sp.									x	
<u>Vaccinium vitis-idaea</u>	x	x	x							x
<u>V. oxycoccos</u>			x							
<u>Myrica gale</u>			x						x	
<u>Rosa acicularis</u>				x					x	x
<u>Ribes triste</u>					x		x			
<u>Rubus idaeus</u>					x	x				
<u>R. chamaemorus</u>					x		x			
<u>Sorbus scopulina</u>					x	x				
<u>Linnaea borealis</u>	x									
<u>Grass</u>	x		x					x	x	
<u>Agrostis</u> sp.						x				
<u>Calamagrostis canadensis</u>				x	x		x			
<u>Sedges</u>			x						x	
<u>Ferns</u>					x	x	x	x		
<u>Geranium erianthum</u>								x		
<u>Veratrum viride</u>					x	x				
<u>Equisetum</u> sp.					x	x	x			
<u>Rumex</u> sp.					x					
<u>Mertensia paniculata</u>					x		x			
<u>Streptopus amplexifolius</u>					x	x	x			
<u>Solidago</u> sp.					x					
<u>Sanguisorba stipulata</u>					x	x				
<u>Cornus canadensis</u>					x	x		x		x
<u>Senecio</u> sp.										x
<u>Senecio triangalaris</u>						x				
<u>Epilobium angustifolium</u>						x				
<u>Oplopanax horridum</u>							x			
<u>Boschniakia rossica</u>							x			
<u>Galium boreale</u>										x
<u>Valeriana capitata</u>										x
<u>Parnassia palustris</u>										x
<u>Hedysarum alpinum</u>										x
<u>Dodecatheon frigidum</u>										x
<u>Anemone</u> sp.								x	x	x
<u>Pyrola</u> sp.								x		x
<u>Lupinus arcticus</u>										x
<u>Aster sibiricus</u>								x		x

(1) Upland areas except for site 20 which is located in a floodplain.

TABLE J

TUNDRA

	N.P.S. Alpine	Woodward/Clyde	USFWS Ridgetop	RBS 10-R-Y	Commonwealth Site 19	Commonwealth Site 10
<u>Salix</u> sp.		X			X	X
<u>S. arctica</u>	X					
<u>Arctostaphylos alpina</u>	X	X				
<u>Betula</u> spp.					X	
<u>B. nana</u>		X				
<u>B. glandulosa</u>	X		X			
<u>Dryas</u> sp.						X
<u>Dryas octopetala</u>	X	X			X	
<u>Empetrum nigrum</u>	X	X	X		X	X
<u>Ledum</u> sp.			X		X	X
<u>L. decumbens</u>	X					
<u>Vaccinium</u> sp.			X		X	X
<u>Rhododendron lapponicum</u>					X	
<u>Spirea beauverdiana</u>						X
<u>Silene acaulis</u>	X					
<u>Oxytropis nigrescens</u>	X				X	
<u>Minuartia arctica</u>	X					
<u>Rubus chamaemorus</u>			X			
<u>Equisetum</u> sp.			X			
<u>Carex</u> spp.			X		X	
<u>Anemone</u> sp.					X	
<u>Parrya nudicaulis</u>					X	
<u>Aconitum delphinifolium</u>						X
<u>Saxifraga tricuspidata</u>					X	
<u>Geum rossii</u>						X
<u>Stellaria crassifolia</u>						X
<u>Mertensia paniculata</u>						X
<u>Claytonia sarmentosa</u>						X
<u>Polygonum viviparum</u>						X
<u>Rumex arcticus</u>						X
<u>Sedum rosea</u>						X
<u>Valeriana capitata</u>						X
<u>Aster sibiricus</u>						X
<u>Campanula lasiocarpa</u>						X
<u>Moehringia lateriflora</u>						X
<u>Polemonium acutiflorum</u>						X
<u>Senecio lugens</u>						X
<u>Swertia perennis</u>						X

TABLE K
TUNDRA - TES (1981)

	Herbaceous Alpine	Wet Sedge/Grass	Mesic Sedge/Grass	Mat/Cushion
<u>Lycopodium alpinum</u>	X			
<u>Polytrichum spp.</u>	X			
<u>Salix polaris</u>	X			
<u>Salix reticulata</u>	X			
<u>Petasites frigidus</u>	X			
<u>Rumex arcticus</u>	X			
<u>Sanguisorba stipulata</u>	X			
<u>Sedum rosea</u>	X			
<u>Calamagrostis purpurascens</u>	X			
<u>Carex bigelowii</u>	X	X	X	
<u>Eriophorum angustifolium</u>	X			
<u>Anemone narcissiflora</u>	X			
<u>Diapensia lapponica</u>	X			
<u>Luzula confusa</u>	X			
<u>Luzula tundricola</u>	X			
<u>Valeriana capitata</u>	X			
<u>Aster sibiricus</u>	X			
<u>Senecio atropurpeus</u>	X			
<u>Saxifraga tricuspidata</u>	X			
<u>Aconitum delphinifolium</u>	X			
<u>Sibbaldia procumbens</u>	X			
<u>Deschampsia caespitosa</u>	X			
<u>Polygonum bistorta</u>	X			
<u>Salix rotundifolia</u>	X			
<u>Campanula lasiocarpa</u>	X			
<u>Artemisia arctica</u>	X			
<u>Myosotis alpestris</u>	X			
<u>Cassiope tetragona</u>	X			
<u>Lycopodium annotinum</u>	X			
<u>Lycopodium selago</u>	X			
<u>Boykinia richardsonii</u>	X			
<u>Festuca rubra</u>	X			
<u>Silene acaulis</u>	X			
<u>Epilobium latifolium</u>	X			
<u>Veronica wormskjoldii</u>	X			
<u>Carex filifolia</u>	X			
<u>Polemonium acutiflorum</u>	X			
<u>Salix phlebophylla</u>	X			
<u>Juncus sp.</u>	X			
<u>Caltha leptosepala</u>	X			
<u>Phleum commutatum</u>	X			
<u>Equisetum sp.</u>	X			
<u>Salix spp.</u>		X	X	
<u>S. pulchra</u>		X		
<u>S. fuscescens</u>		X		
<u>Calamagrostis canadensis</u>		X		
<u>Carex spp.</u>		X	X	
<u>C. aquatilis</u>		X		
<u>Empetrum nigrum</u>				X
<u>Ledum decumbens</u>				X
<u>Vaccinium uliginosum</u>				X
<u>Arctostaphylos spp.</u>				X
<u>Betula nana</u>				X
<u>B. glandulosa</u>				X

TABLE L
LOW BRUSH MUSKEG - BOG

	Sphagnum	Calmes ⁽¹⁾		Commonwealth		
		Grass/sedge	Cottongrass	Site 7	Site 2	Site 13
<u>Andromeda polifolia</u>	x					
<u>Ledum sp.</u>				x	x	R
<u>L. decumbens</u>	x					
<u>Arctostaphylos rubra</u>			x	x		
<u>Betula sp.</u>	x		x	x	x	R
<u>Alnus sp.</u>					x	
<u>Vaccinium sp.</u>					x	R
<u>V. uliginosum</u>					x	R
<u>V. vitis-idaea</u>			x			
<u>Salix sp.</u>			x		x	R/S
<u>Potentilla fruticosa</u>			x		x	
<u>Spiraea beauverdiana</u>					x	
<u>Iris setosa</u>				x		
<u>Eriophorum sp.</u>				x		S
<u>E. vaginatum</u>			x			
<u>Sedges</u>		x		x		
<u>Grasses</u>		x		x		S
<u>Empetrum nigrum</u>				x		R
<u>Pedicularis</u>				x		
<u>Eleocharis</u>				x		
<u>Rubus sp.</u>				x		
<u>Drosera rotundifolia</u>				x		
<u>Menyanthes trifoliata</u>				x		
<u>Platanthera hyperborea</u>				x		
<u>Anemone sp.</u>					x	
<u>Equisetum sp.</u>					x	
<u>Rumex sp.</u>						S
<u>Petasites sp.</u>						S

Location on patterned ground
R - Ridge
S - Swale

(1) In Neiland and Viereck

TABLE M
STREAM SIDES AND MEADOWS

	Site 5	Commonwealth Site 11	Site 8
<u>Populus balsamifera</u>		X	
<u>Betula papyrifera</u>	X		
<u>Picea glauca</u>		X	
<u>Rubus idaeus</u>	X		
<u>Rosa acicularis</u>	X		
<u>Sambucus callicarpa</u>	X		
<u>Salix sp.</u>		X	
<u>Alnus sp.</u>		X	
<u>Potentilla fruticosa</u>			X
<u>Viburnum edule</u>		X	
<u>Sorbus scopulina</u>		X	
<u>Spirea beauverdiana</u>		X	
<u>Epilobium angustifolium</u>	X		
<u>Heracleum lanatum</u>	X	X	X
<u>Polemonium acutiflorum</u>	X		
<u>Galium boreale</u>	X	X	
<u>Thalictrum sparsiflorum</u>	X		
<u>Sanguisorba stipulata</u>	X		X
<u>Streptopus amplexifolius</u>	X	X	
<u>Equisetum sp.</u>	X	X	
<u>Mertensia paniculata</u>	X	X	
<u>Geum macrophyllum</u>	X		
<u>Parnassia palustris</u>	X		
<u>Delphinium glaucum</u>	X		
<u>Veronica americana</u>	X		
<u>Mimulus guttatus</u>	X		
<u>Aconitum delphinifolium</u>	X		
<u>Viola sp.</u>		X	
<u>V. epipsila</u>			X
<u>Trientalis europaea</u>		X	
<u>Pyrola sp.</u>		X	
<u>Veratrum viride</u>		X	X
<u>Geranium erianthum</u>		X	
<u>Anemone sp.</u>		X	
<u>Senecio triangularis</u>			X
<u>Caltha leptosepala</u>			X
<u>Ranunculus sp.</u>			X
<u>Valeriana capitata</u>			X
<u>Petasites sp.</u>			X

APPENDIX E

PLANT SPECIES OBSERVED

APPENDIX E

Preliminary list of plant species identified during 1981 in the Intertie project area.

Pteridophyta

Aspidiaceae

Dryopteris dilatata subsp. americana
Dryopteris fragrans
Gymnocarpium dryopteris

Shield fern
Fragrant shield-fern
Oak-fern

Athyriaceae

Matteuccia struthiopteris

Ostrich fern

Equisetaceae

Equisetum sp.
Equisetum silvaticum L.

Horsetail
Woodland horsetail

Gymnospermae

Cupressaceae

Juniperus communis

Common juniper

Pinaceae

Picea glauca
Picea mariana

White spruce
Black spruce

Monocotyledoneae

Cyperaceae

Carex spp.
Eriophorum spp.

Sedge
Cottongrass

Gramineae

Calamagrostis canadensis

Bluejoint

Monocotyledoneae (Cont.)

Iridaceae

Iris setosa

Wild Flag

Liliaceae

Lloydia serotina

Alp lily

Streptopus amplexifolius

Twisted-stalk

Tofieldia pusilla

Scotch asphodel

Veratrum viride subsp. Eschscholtzii

False hellebore

Zygadenus elegans

White camas

Orchidaceae

Listera cordata

Twayblade

Platanthera hyperborea

Bog orchis

Dicotyledoneae

Araliaceae

Oplopanax horridum

Devilsclub

Betulaceae

Alnus crispa

American green alder

Alnus sinuata

Sitka alder

Betula glandulosa

Resin birch

Betula nana

Dwarf arctic birch

Betula papyrifera

Paper birch

Boraginaceae

Mertensia paniculata

Bluebell

Campanulaceae

Campanula lasiocarpa

Bellflower

Caprifoliaceae

Linnaea borealis

Twin-flower

Sambucus callicarpa

Pacific red elder

Viburnum edule

High bushcranberry

Dicotyledoneae (Cont.)

Caryophyllaceae

Stellaria crassifolia
Moehringia lateriflora

Chickweed
Grove sandwort

Compositae

Arnica frigida
Artemisia arctica subsp. arctica
Artemisia tilesii subsp. unalaschcensis
Aster sibiricus
Erigeron acris subsp. politus
E. purpuratus
Petasites frigidus
Petasites sp.
Saussurea angustifolia
Senecio sp.
Senecio lugens
Senecio triangularis

Arnica
Wormwood
Wormwood
Siberian aster
Fleabane
Fleabane
Arctic sweet coltsfoot
Sweet coltsfoot
Saussurea
Ragwort
Ragwort
Groundsel

Cornaceae

Cornus canadensis

Bunchberry

Crassulaceae

Sedum rosea

Roseroot

Cruciferae

Draba aurea
Parrya nudicaulis

Rockcress
Parrya

Diapensiaceae

Diapensia lapponica

Diapensia

Droseraceae

Drosera rotundifolia

Sundew

Dicotyledoneae (Cont.)

Elaeagnaceae

Shepherdia canadensis

Buffaloberry

Empetraceae

Empetrum nigrum

Crowberry

Ericaceae

Arctostaphylos alpina

Alpine bearberry

Arctostaphylos rubra

Red-fruit bearberry

Arctostaphylos uva-ursi

Bearberry

Cassiope tetragona

Four-angle mountain
heather

Ledum decumbens

Northern Labrador tea

Ledum groenlandicum

Labrador tea

Loiseleuria procumbens

Alpine azalea

Menziesia ferruginea

Rusty menziesia

Rhododendron lapponicum

Lapland rosebay

Vaccinium uliginosum

Bog blueberry

Vaccinium vitis-idaea

Mountain cranberry

Fumariaceae

Corydalis pauciflora

Few-flowered corydalis

Gentianaceae

Menyanthes trifoliata

Buckbean

Swertia perennis

Gentian

Geraniaceae

Geranium erianthum

Cranesbill

Leguminosae

Hedysarum alpinum subsp. americanum

Alpine-sweet-vetch

Lupinus arcticus

Arctic lupine

Oxytropis nigrescens

Blackish oxytrope

Dicotyledoneae (Cont.)

Myricaceae

Myrica gale

Sweet gale

Onagraceae

Epilobium angustifolium

Fireweed

Epilobium latifolium

River beauty

Orobanchaceae

Boschniakia rossica

Poque

Polemoniaceae

Polemonium acutiflorum

Jacob's ladder

Polygonaceae

Oxyria digyna

Mountain sorrel

Polygonum viviparum

Alpine bistort

Rumex arcticus

Arctic dock

Portulacaceae

Claytonia sarmentosa

Spring-beauty

Primulaceae

Androsace chamaejasme subsp. Lehmanniana

Rock jasmine

Dodecatheon frigidum

Northern shooting star

Trientalis europaea subsp. arctica

Arctic starflower

Pyrolaceae

Pyrola sp.

Wintergreen

Dicotyledoneae (Cont.)

Ranunculaceae

<u>Aconitum delphinifolium</u> subsp. <u>delphinifolium</u>	Monkshood
<u>Actaea rubra</u>	Baneberry
<u>Anemone narcissiflora</u>	Anemone
<u>Anemone parviflora</u>	Northern anemone
<u>Anemone richardsonii</u>	Anemone
<u>Caltha leptosepala</u>	Mountain marsh-marigold
<u>Delphinium glaucum</u>	Larkspur
<u>Ranunculus</u> sp.	Buttercup
<u>Thalictrum sparsiflorum</u>	Few-flower meadowrue

Rosaceae

<u>Dryas drummondii</u>	Drummond mountain-avens
<u>Dryas integrifolia</u>	White mountain-avens
<u>Geum macrophyllum</u> subsp. <u>perincisum</u>	Avens
<u>Geum rossii</u>	Ross avens
<u>Potentilla fruticosa</u>	Bush cinquefoil
<u>Potentilla palustris</u>	Marsh fivefinger
<u>Rosa acicularis</u>	Prickly rose
<u>Rubus arcticus</u>	Nagoon-berry
<u>Rubus chamaemorus</u>	Cloudberry
<u>Rubus idaeus</u> var. <u>strigosus</u>	Raspberry
<u>Rubus pedatus</u>	Five-leaf bramble
<u>Sanguisorba stipulata</u>	Sitka burnet
<u>Sorbus scopulina</u>	Greene mountain-ash
<u>Spiraea beauverdiana</u>	Beauverd spirea

Rubiaceae

<u>Galium boreale</u>	Northern bedstraw
<u>Galium</u> sp.	Bedstraw

Salicaceae

<u>Populus balsamifera</u>	Balsam poplar
<u>Populus tremuloides</u>	Quaking aspen
<u>Salix</u> sp.	Willow

Dicotyledoneae (Cont.)

Saxifragaceae

Parnassia palustris subsp. neogaea

P. Kotzebuei

Ribes triste

Saxifraga oppositifolia

Saxifraga tricuspidata

Northern Grass-of-Parnassus

Grass-of-Parnassus

Red currant

Purple mountain saxifrage

Three-tooth saxifrage

Scrophulariaceae

Castilleja sp.

Mimulus guttatus

Pedicularis sp.

Pedicularis kanei

Pedicularis labradorica

Veronica americana

Indian paintbrush

Yellow monkey flower

Lousewort

Kane lousewort

Labrador lousewort

Brooklime

Umbelliferae

Heracleum lanatum

Cow parsnip

Valerianaceae

Valeriana capitata

Capitate valerian

Violaceae

Viola epipsila subsp. repens

Viola biflora

Marsh violet

Violet

APPENDIX F
WATERCOURSES CROSSED

APPENDIX F WATERCOURSES CROSSED¹

LINK 1s - PREFERRED ROUTE

<u>Watercourse²</u>	<u>Status³</u>	<u>Location⁴</u>			
		<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Meridian</u>
Willow Creek	L	20N	5W	34	SM
Unnamed Slough	HP	19N	4W	6	SM
Rogers Creek	HP	20N	5W	24	SM
Unnamed Creek	HP	20N	4W	19	SM
Little Willow Creek	HP	20N	5W	27	SM
Unnamed Creek	HP	20N	5W	24	SM
Unnamed Creek	HP	21N	4W	20	SM
196 Mile Creek	HP	21N	5W	24	SM
197-1/2 Mile Creek	HP	21N	4W	19	SM
Kashwitna River	L	21N	5W	13	SM
Caswell Creek	L	21N	4W	6	SM
Sheep Creek	L	22N	4W	30	SM

LINK 3s - PREFERRED ROUTE

Unnamed Creek	HP	23N	4W	21	SM
Goose Creek	L	23N	4W	30	SM
Unnamed Creek	HP	24N	4W	33	SM
Montana Creek	L	23N	4W	7	SM
Unnamed Creek	L	25N	4W	34	SM
Answer Creek	L	24N	4W	6	SM
Unnamed Creek	HP	26N	3W	30	SM

LINK 3s - PREFERRED ROUTE

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			<u>Meridian</u>
		<u>Township</u>	<u>Range</u>	<u>Section</u>	
Talkeetna River and Sloughs	L	26N	5W	24	SM
Unnamed Creek ⁽³⁾	HP	26N	4W	3	SM
Unnamed Creek	HP	27N	4W	10	SM
Chunilna Creek	L	26N	4W	4	SM
Unnamed Creek	HP	29N	3W	21	SM
Lane Creek	L	28N	5W	12	SM
Deadhorse Creek	L	29N	4W	10	SM
Unnamed Creek	LP	29N	4W	1	SM

LINK 6s - PREFERRED ROUTE

Unnamed Creek	HP	30N	4W	25	SM
Unnamed Creek	HP	30N	3W	20	SM
Unnamed Creek	HP	30N	3W	16	SM
Unnamed Creek	LP	30N	3W	15	SM
Sherman Creek	L	30N	3W	3	SM
Unnamed Creek	HP	30N	3W	2	SM
Unnamed Creek	HP	31N	3W	36	SM
Gold Creek	L	31N	2W	20	SM
Susitna River	L	14N	7W	29	SM
Unnamed Creek	HP	31N	2W	4	SM
Indian River ⁽²⁾	L	31N	2W	9	SM
Unnamed Creek	HP	32N	2W	14	SM
Unnamed Creek	HP	33N	2W	27	SM
Pass Creek	L	33N	3W	36	SM
Unnamed Creek	HP	33N	2W	27	SM
Unnamed Creek	HP	33N	2W	23	SM
Unnamed Creek	HP	33N	2W	23	SM

LINK 6s - PREFERRED ROUTE

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			
		<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Meridian</u>
Unnamed Creek	HP	33N	2W	15	SM
Unnamed Creek	HP	22S	11W	27	FM
Granite Creek	L	33N	2W	19	SM

LINK 7s - PREFERRED ROUTE

Hurricane Gulch	HP	22S	11W	15	FM
Little Honolulu Creek	L	21S	11W	36	FM

LINK 9s - PREFERRED ROUTE

Unnamed Creek	HP	21S	11W	36	FM
Honolulu Creek	L	21S	11W	35	FM
Antimony Creek	HP	21S	10W	8	FM
Unnamed Creek	HP	21S	10W	4	FM
Hardage Creek	L	20S	10W	34	FM
East Fork Chulitna River	L	21S	10W	7	FM
Fourth of July Creek ⁽³⁾	HP	20S	9W	6	FM

LINK 12s - PREFERRED ROUTE

Unnamed Creek	HP	19S	9W	23	FM
Coal Creek	HP	19S	9W	23	FM
Middle Fork Chulitna River	L	21S	10W	7	FM

LINK 12s - PREFERRED ROUTE

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			<u>Meridian</u>
		<u>Township</u>	<u>Range</u>	<u>Section</u>	
Unnamed Creek	HP	19S	9W	22	FM
Unnamed Creek	HP	18S	7W	7	FM
Unnamed Creek	HP	18S	7W	18	FM
Unnamed Creek	HP	18S	7W	18	FM
Unnamed Creek	HP	18S	7W	4	FM
Jack River	HP	17S	7W	12	FM
Unnamed Creek	LP	17S	7W	27	FM
Unnamed Creek	LP	17S	7W	27	RM
Unnamed Creek	LP	17S	7W	14	FM

LINK 13s - PREFERRED ROUTE

Unnamed Creek	LP	17S	7W	13	FM
Nenana River and Sloughs	LP	4S	8W	14	FM
Unnamed Creek	HP	17S	7W	12	FM
Slime Creek	HP	16S	7W	24	FM
Carlo Creek	HP	16S	7W	1	FM
Yanert Fork	HP	14S	6W	19	FM
Unnamed Creek	LP	14S	6W	18	FM

LINK 15s - PREFERRED ROUTE

Unnamed Creek	HP	14S	7W	11	FM
Montana Creek	HP	14S	7W	3	FM
Unnamed Creek ⁽²⁾	HP	14S	6W	5	FM
Unnamed Creek ⁽²⁾	HP	13S	6W	22	FM
Unnamed Creek	HP	13S	6W	8	FM
Unnamed Creek	HP	13S	6W	7	FM
Unnamed Creek	HP	13S	6W	7	FM

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			
		<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Meridian</u>
Copeland Creek	HP	12S	7W	26	FM
Healy Creek	HP	12S	7W	28	FM

LINK 16s - PREFERRED ROUTE

No Stream Crossings	-	-	-	-

LINK 2s - ALTERNATIVE SEGMENT

Unnamed Creek	HP	23N	4W	21	SM
Goose Creek	L	23N	4W	30	SM
Montana Creek	L	23N	4W	7	SM
Unnamed Creek	HP	23N	4W	6	SM
Unnamed Creek	HP	24N	4W	31	SM
Unnamed Creek	HP	23N	4W	6	SM
Unnamed Creek	HP	24N	5W	24	SM
Susitna River	L	14N	7W	29	SM
Queer Creek	HP	24N	5W	9	SM
Unnamed Creek	HP	25N	5W	20	SM
Sawmill Creek	HP	25N	5W	20	SM
Unnamed Creek	HP	25N	5W	6	SM
Unnamed Creek	HP	25N	5W	5	SM
Trapper Creek	L	25N	5W	15	SM
Unnamed Creek	HP	26N	5W	35	SM
Unnamed Creek	HP	27N	5W	32	SM
Unnamed Creek	HP	26N	5W	5	SM
Unnamed Creek	HP	27N	5W	8	SM

LINK 5s - ALTERNATIVE SEGMENT

Unnamed Creek ⁽⁴⁾	HP	28N	5W	29	SM
Unnamed Creek	HP	28N	5W	31	SM
Unnamed Creek	HP	28N	5W	20	SM

LINK 5s - ALTERNATIVE SEGMENT

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			
		<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Meridian</u>
Chulitna River	L	26N	5W	23	SM
Unnamed Creek	HP	29N	5W	29	SM
Unnamed Creek	HP	29N	5W	21	SM
Unnamed Creek	HP	29N	5W	17	SM
Unnamed Creek	HP	29N	5W	16	SM
Unnamed Creek	HP	29N	5W	16	SM
Unnamed Creek	HP	29N	5W	8	SM
Troublesome Creek	L	29N	5W	8	SM
Unnamed Creek	HP	29N	5W	4	SM
Unnamed Creek	HP	30N	5W	29	SM
Unnamed Creek	HP	30N	5W	2	SM
Unnamed Creek	HP	31N	4W	30	SM
Unnamed Creek	HP	31N	4W	30	SM
Unnamed Creek	HP	31N	4W	16	SM
Byers Creek ⁽⁵⁾	L	31N	5W	36	SM
Unnamed Creek	HP	31N	3W	6	SM
Unnamed Creek	HP	32N	3W	30	SM
Unnamed Creek	HP	32N	3W	21	SM
Unnamed Creek	HP	32N	3W	9	SM
Unnamed Creek	HP	32N	3W	1	SM
Little Coal Creek	L	32N	3W	2	SM
Unnamed Creek ⁽²⁾	HP	33N	2W	32	SM
Pass Creek	L	33N	3W	36	SM
Unnamed Creek ⁽²⁾	HP	33N	2W	29	SM
Division Creek	HP	33N	2W	20	SM
Unnamed Creek	HP	22S	11W	27	FM
Granite Creek	L	33N	2W	19	SM
Unnamed Creek	HP	22S	11W	26	FM

LINK 10s - ALTERNATIVE SEGMENT

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			
		<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Meridian</u>
Middle Fork Chulitna River	L	21S	10W	7	FM
Unnamed Creek	HP	19S	9W	28	FM
Unnamed Creek	HP	19S	9W	16	FM

LINK 11s - ALTERNATIVE SEGMENT

Unnamed Creek	HP	19S	9W	16	FM
Unnamed Creek		18S	8W	20	FM
Unnamed Creek		18S	8W	16	FM
Cantwell Creek		17S	7W	32	FM
Unnamed Creek		18S	8W	11	FM
Unnamed Creek		17S	7W	32	FM
Windy Creek		17S	7W	22	FM
Little Windy Creek		17S	7W	21	FM
Jack River and Sloughs		17S	7W	12	FM
Unnamed Slough		17S	7W	12	FM
Unnamed Creek	LP	17S	7W	14	FM

LINK 14s - ALTERNATIVE SEGMENT

Montana Creek		14S	7W	3	FM
Lynx Creek		14S	7W	3	FM
Kingfisher Creek		13S	7W	34	FM
Junco Creek		13S	7W	34	FM
Iceworm Gulch		13S	7W	28	FM
Hornet Creek		13S	7W	28	FM

LINK 14s - ALTERNATIVE SEGMENT

<u>Watercourse</u> ²	<u>Status</u> ³	<u>Location</u> ⁴			
		<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Meridian</u>
Grizzly Creek	LP	13S	7W	21	FM
Fox Creek	LP	13S	7W	21	FM
Eagle Creek	LP	13S	7W	16	FM
Dragonfly Creek	LP	13S	7W	16	FM
Coyote Creek	LP	13S	7W	9	FM
Nenana River ⁽²⁾	L	4S	8W	14	FM
Bison Gulch	LP	13S	7W	8	FM
Unnamed Creek	LP	12S	7W	32	FM
Healy Creek	HP	12S	7W	28	FM

¹All crossings are singular unless otherwise noted, (multiple crossings).

²Name of the watercourses were obtained from 7.5 minute U.S.G.S. quadrangle maps.

³Status refer to the importance of the indicated watercourse to anadromous fisheries. The symbols meanings are as follows:

L: The watercourse is afforded protection under Alaska Statute 16.05.870 as listed in Catalog of Waters Important for Spawning and Migration of Anadromous Fishes as revised March 1976.

HP: The watercourse has a "high probability" of being important to anadromous fisheries although it is not listed.

LP: The watercourse has a "low probability" of being important to anadromous fisheries.

⁴Location refers to the mouth of the indicated watercourse.

APPENDIX G

EXISTING LANDSCAPES AND
VISUAL SIMULATION PHOTOGRAPHY



Photo 1
Susitna River Lowland looking east near Willow.



Photo 2
Susitna River Lowlands, Mile Post 104.3 south from the Susitna River Bridge.

FIGURE 21

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes



Photo 3
Susitna River Lowlands, Petersville Road.

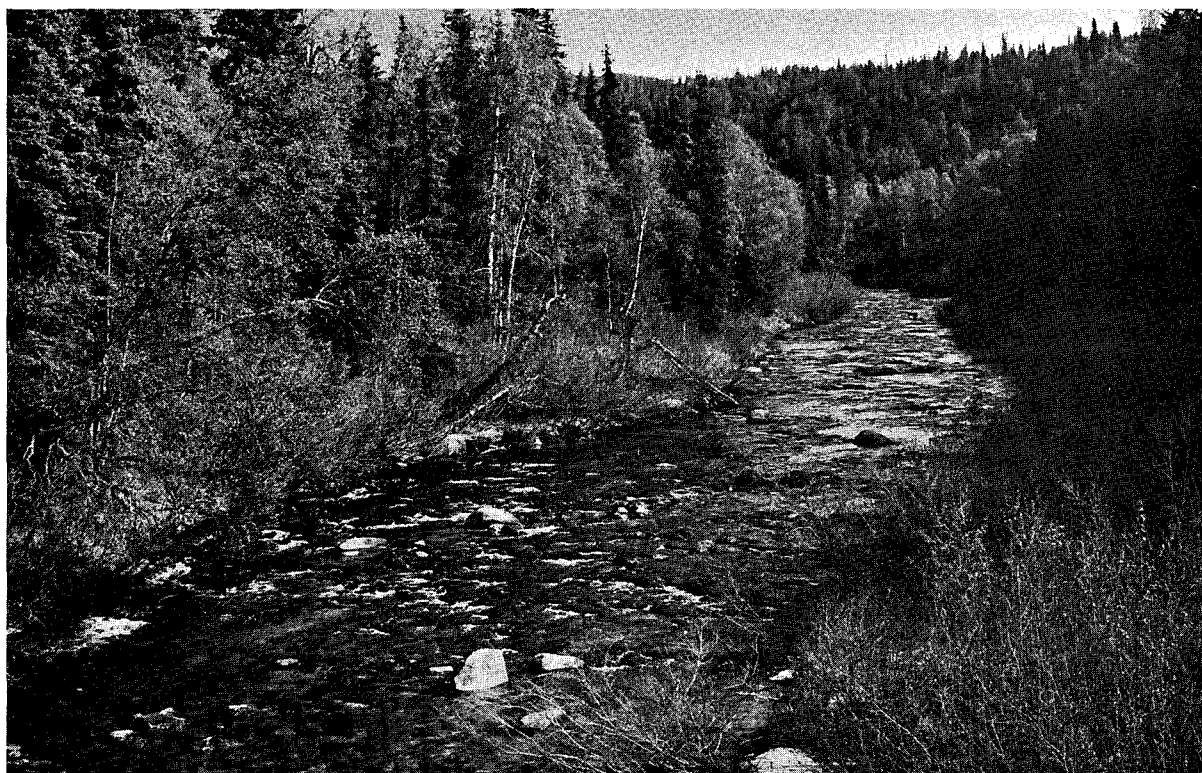


Photo 4
Mile Post 144.
Looking east up Byers Creek.

FIGURE 22

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes



Photo 5
Byers Lake, looking toward Curry Ridge.



Photo 6
Mile Post 168.
Looking at the north end of Curry Ridge, Pass Creek in foreground.

FIGURE 23

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes



Photo 7
 Railroad Mile Post 264.
 Looking up the Susitna River north of Gold Creek.



Photo 8
 Mile Post 170.
 Looking west across the Chulitna River towards the Alaska Range.

FIGURE 24

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

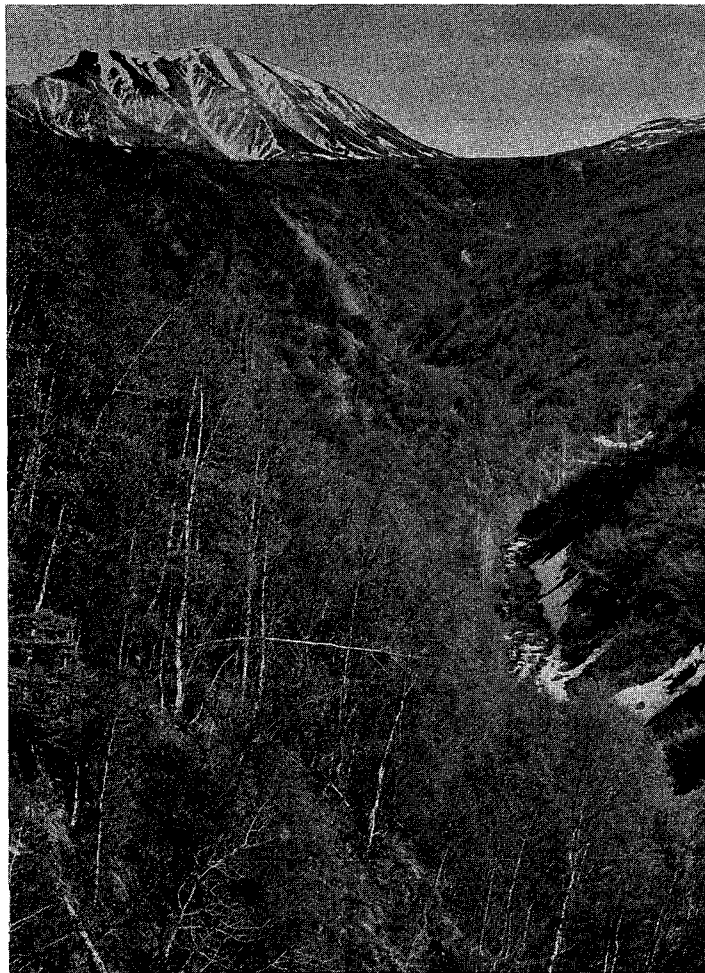


Photo 9
Mile Post 174.
Looking east up Hurricane
Gulch.

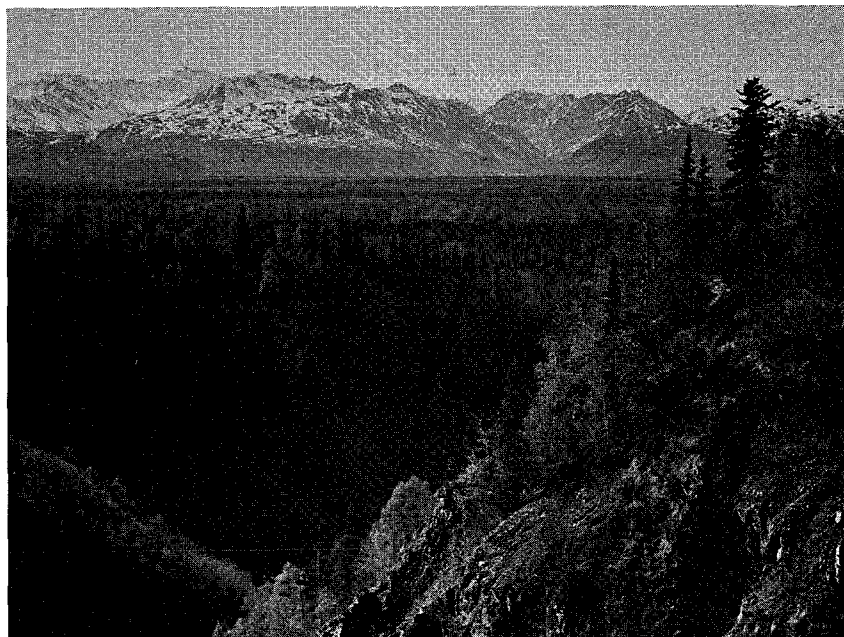


Photo 10
Mile Post 174.
Looking west down Hurricane Gulch.

Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

FIGURE 25

Existing Landscapes

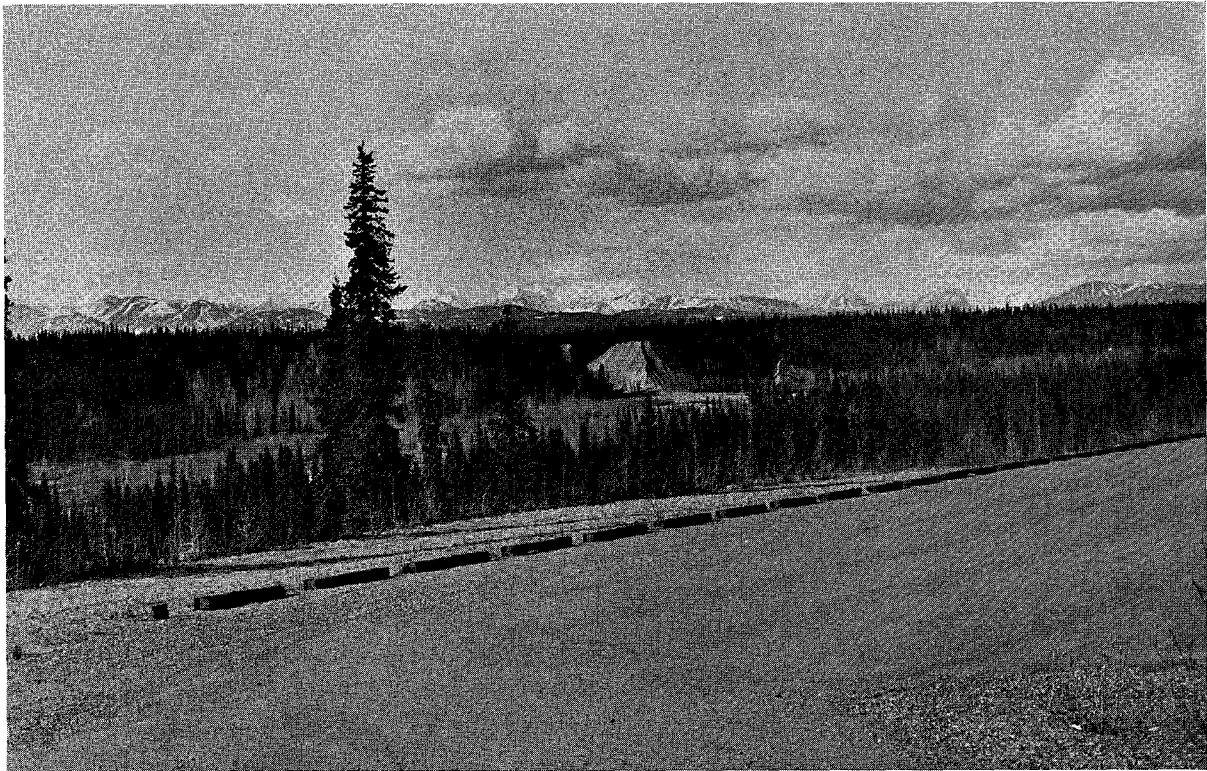


Photo 11
 Mile Post 179.3.
 Looking northwest across the Chulitna River.

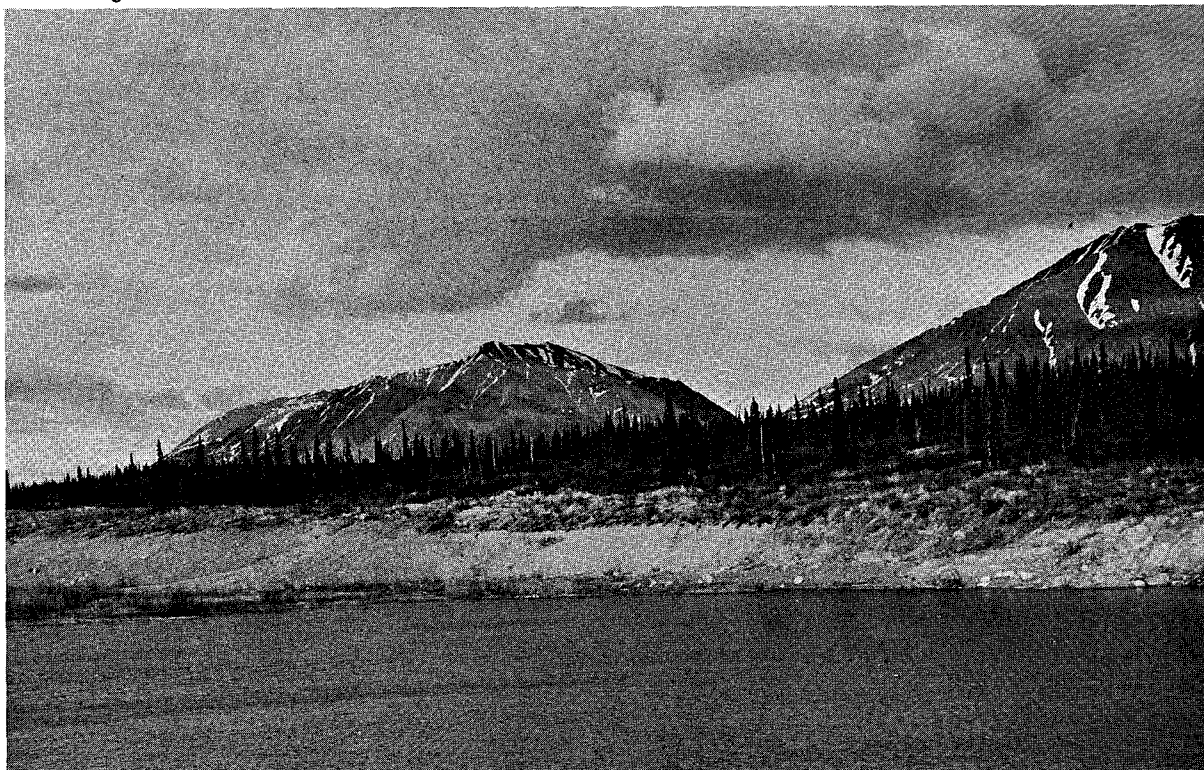


Photo 12
 Mile Post 194.3.
 Looking east across the south end of Broad Pass.

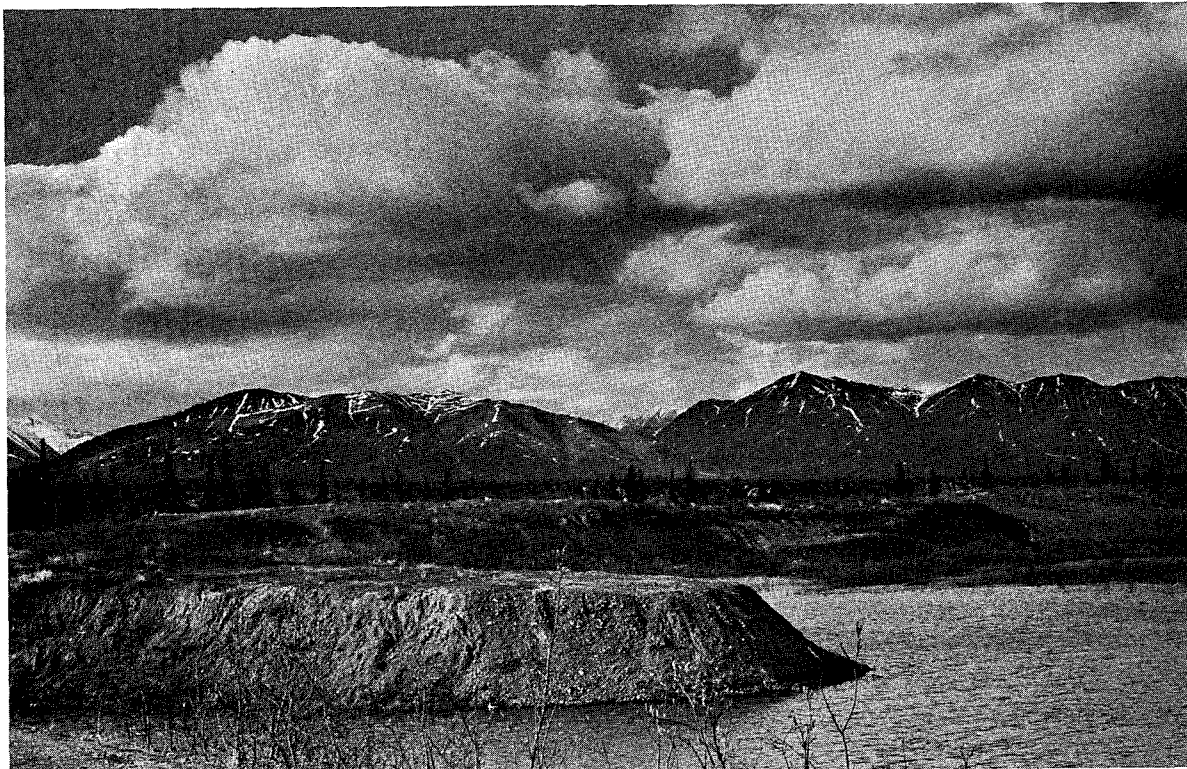


Photo 13

Mile Post 194.3.

Looking northeast toward the Alaska Range from the south end of Broad Pass.



Photo 14

Mile Post 198.

Looking southwest toward Mt. McKinley from Broad Pass.

FIGURE 27

Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

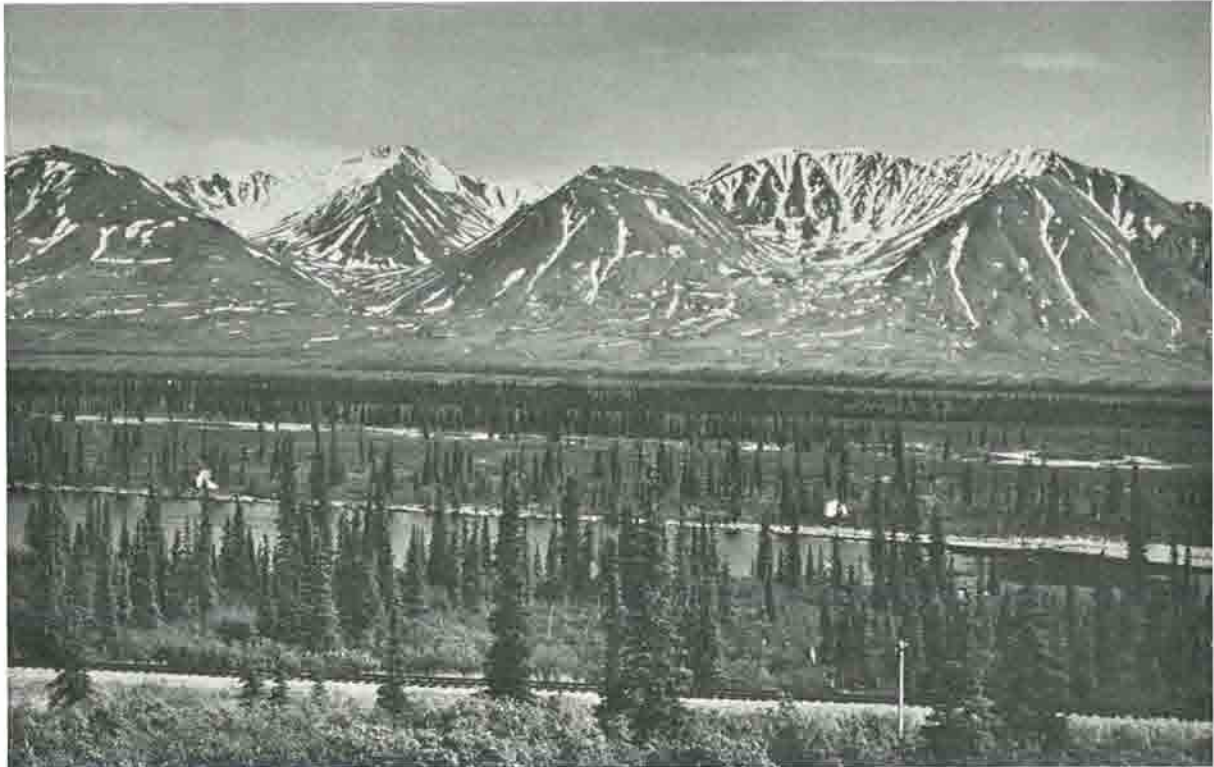


Photo 15
Mile Post 199.
Looking east across Summit Lake from Broad Pass.



Photo 16
Mile Post 209.9.
Looking east toward the Denali Highway juncture with the Parks Highway.

FIGURE 28

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

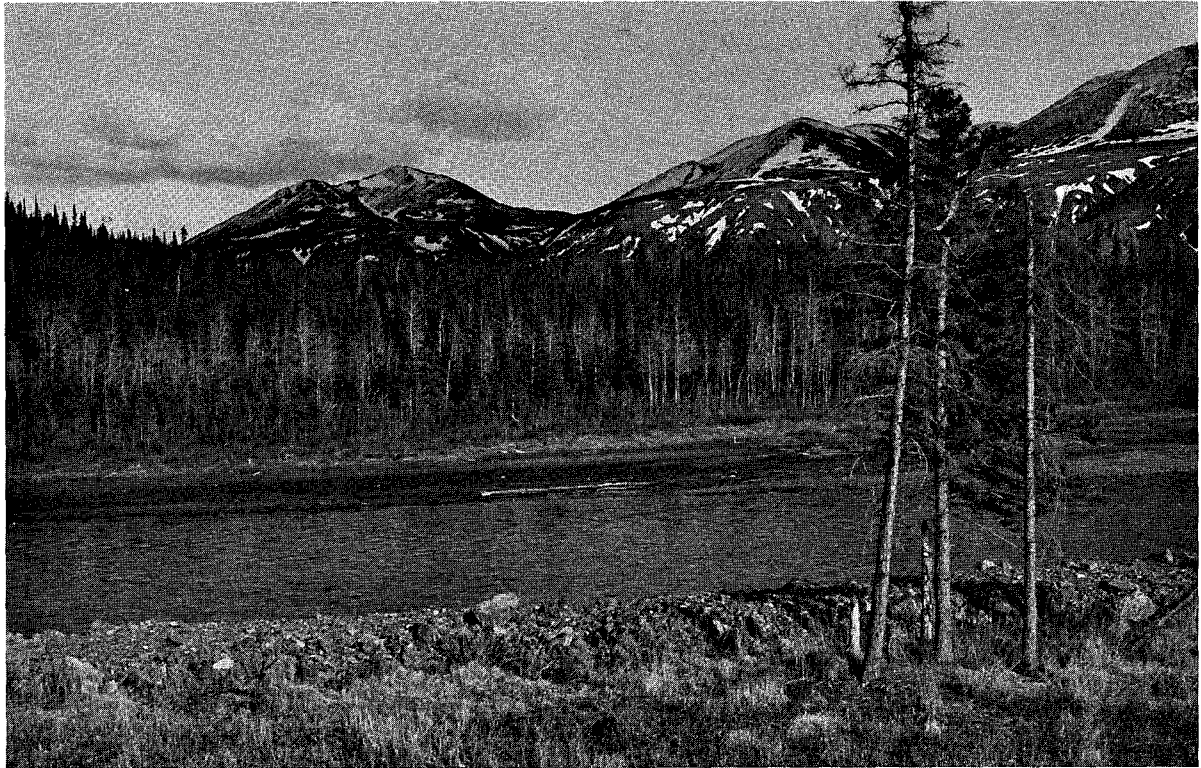


Photo 17

Mile Post 215.6.

Looking east across the Nenana River prior to entering Windy Pass from the south.

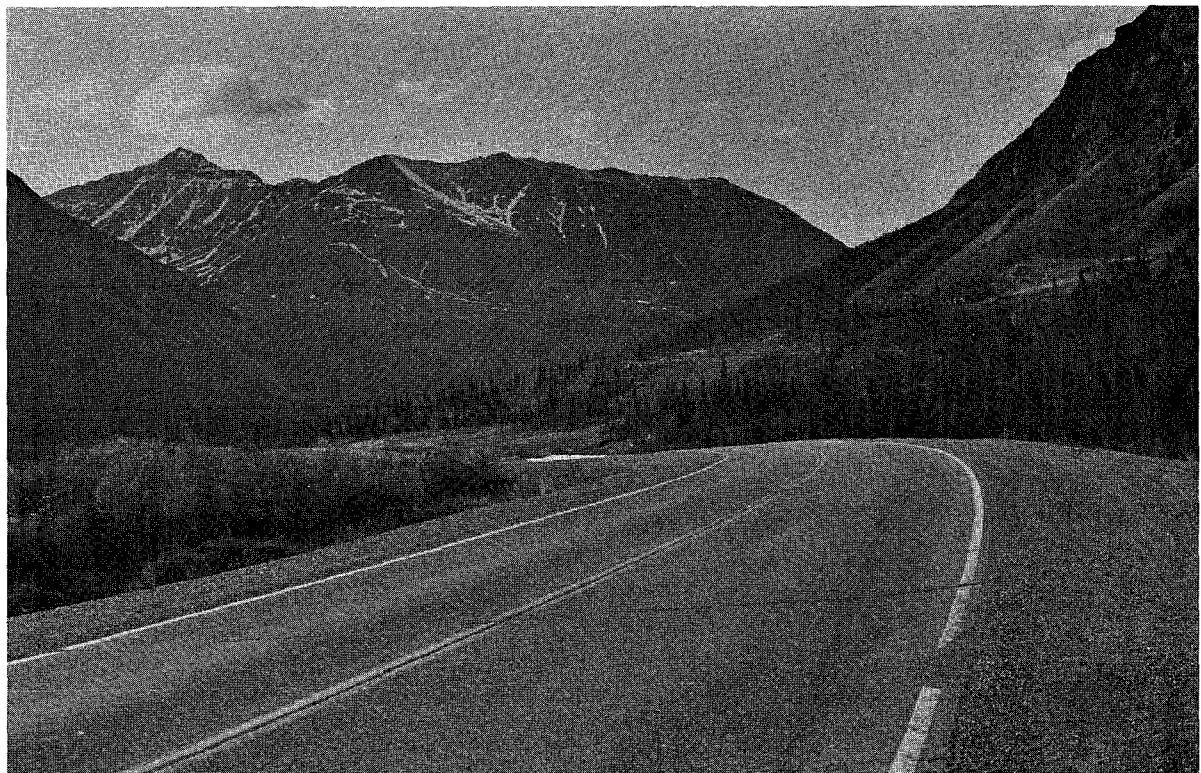


Photo 18

Mile Post 216.1.

Looking north up Windy Pass in the Alaska Range.

FIGURE 29

Alaska Power Authority

ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

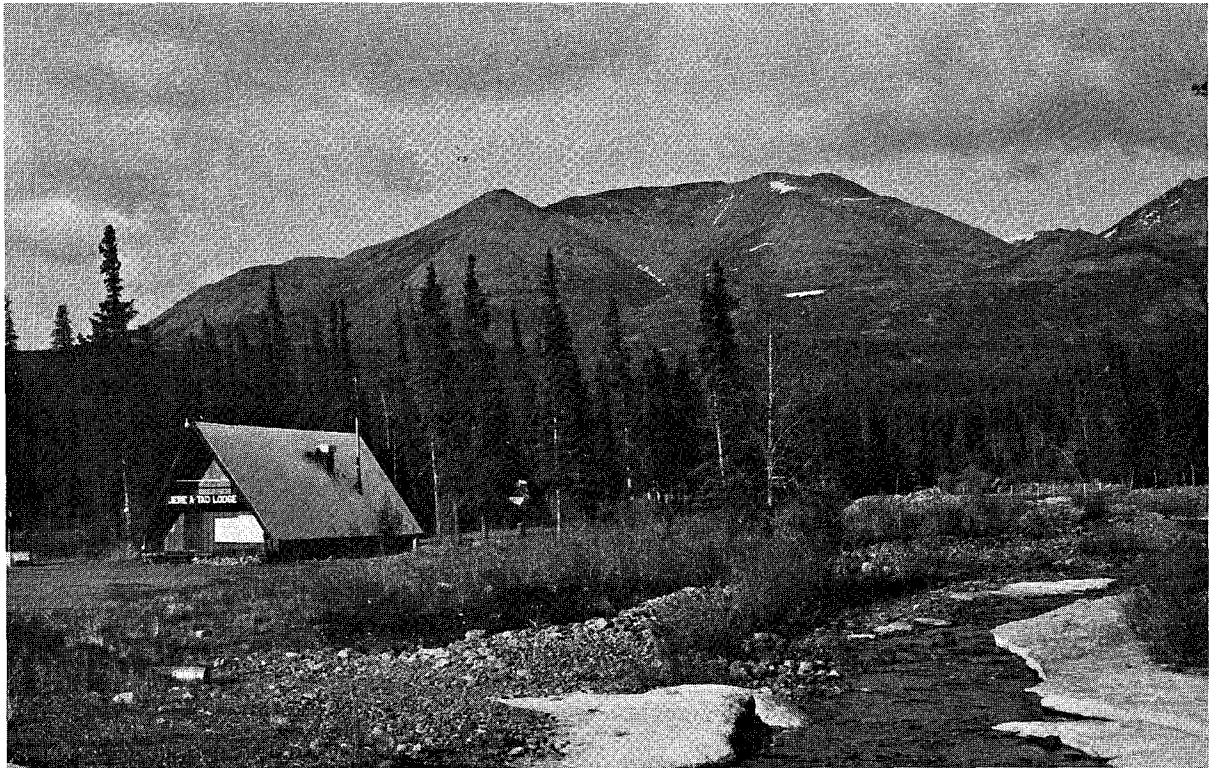


Photo 19
 Mile Post 224.
 Looking east up Carlo Creek in the Alaska Range.



Photo 20
 Mile Post 237.
 South of the Denali National Park entrance looking northeast.

FIGURE 30

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes



Photo 21
Mile Post 241.
Looking north up the Nenana Gorge.



Photo 22.
Mile Post 242.
Looking south down Nenana Gorge from the Dragonfly Creek area.

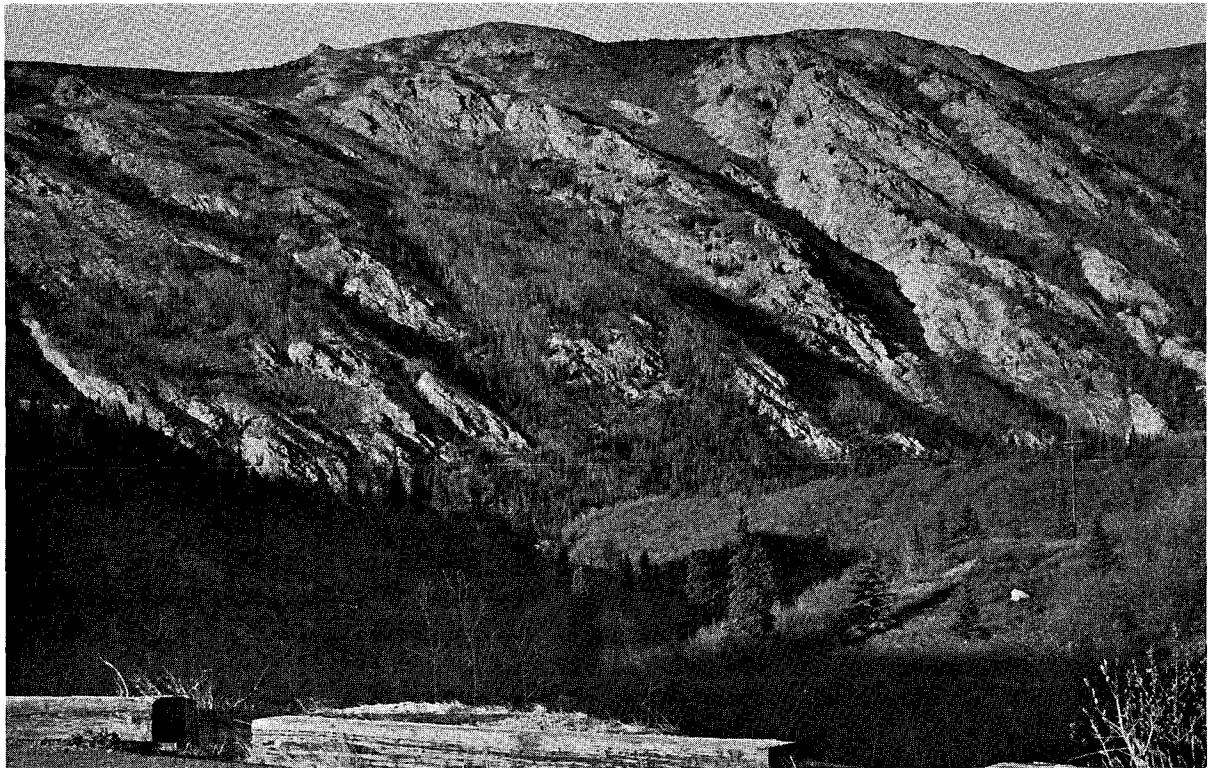
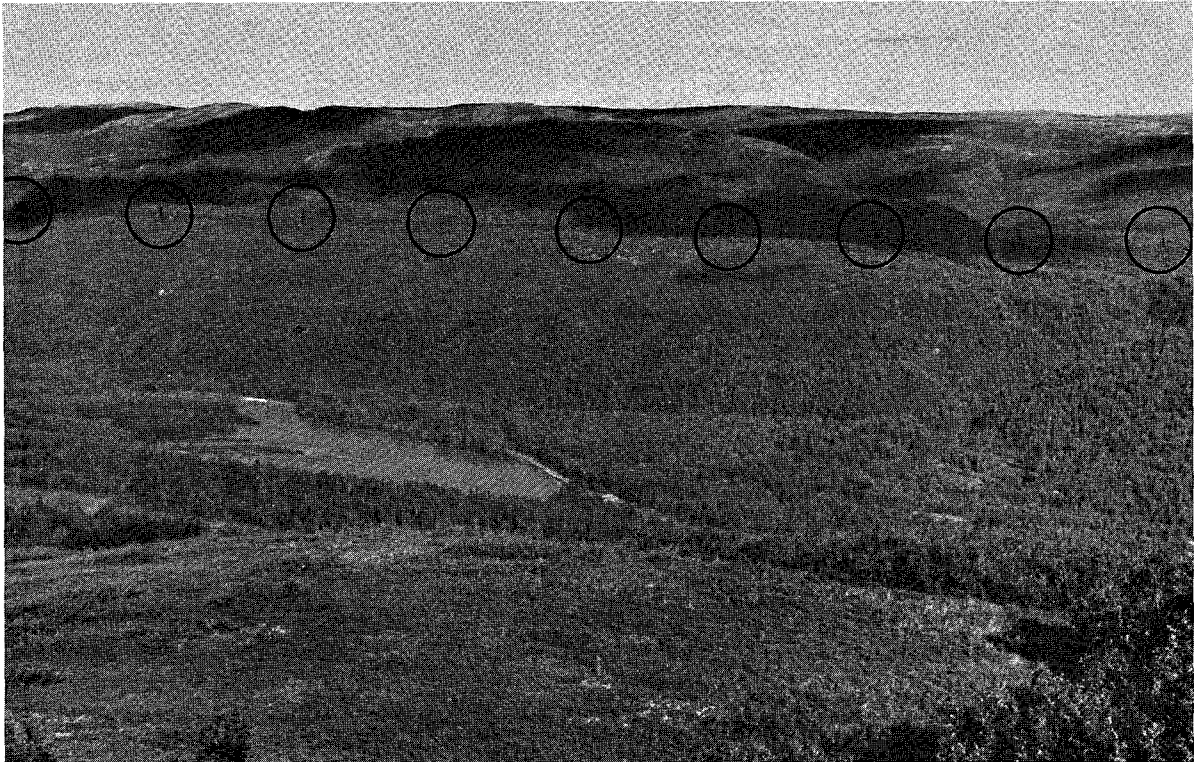


Photo 23
 Mile Post 243.8.
 Looking east from Bison Gulch within the Nenana Gorge.



1. Visual Simulation
Looking east at link 6s from Curry Ridge lookout.



2. Visual Simulation
Looking east at link 6s from Troublesome Creek on Curry Ridge.



3. Visual Simulation
Looking east at link 9s from the Parks Highway just south of Colorado.



4. Visual Simulation
Looking east at link 12s in Broad Pass, 3 miles south of Summit Lake.

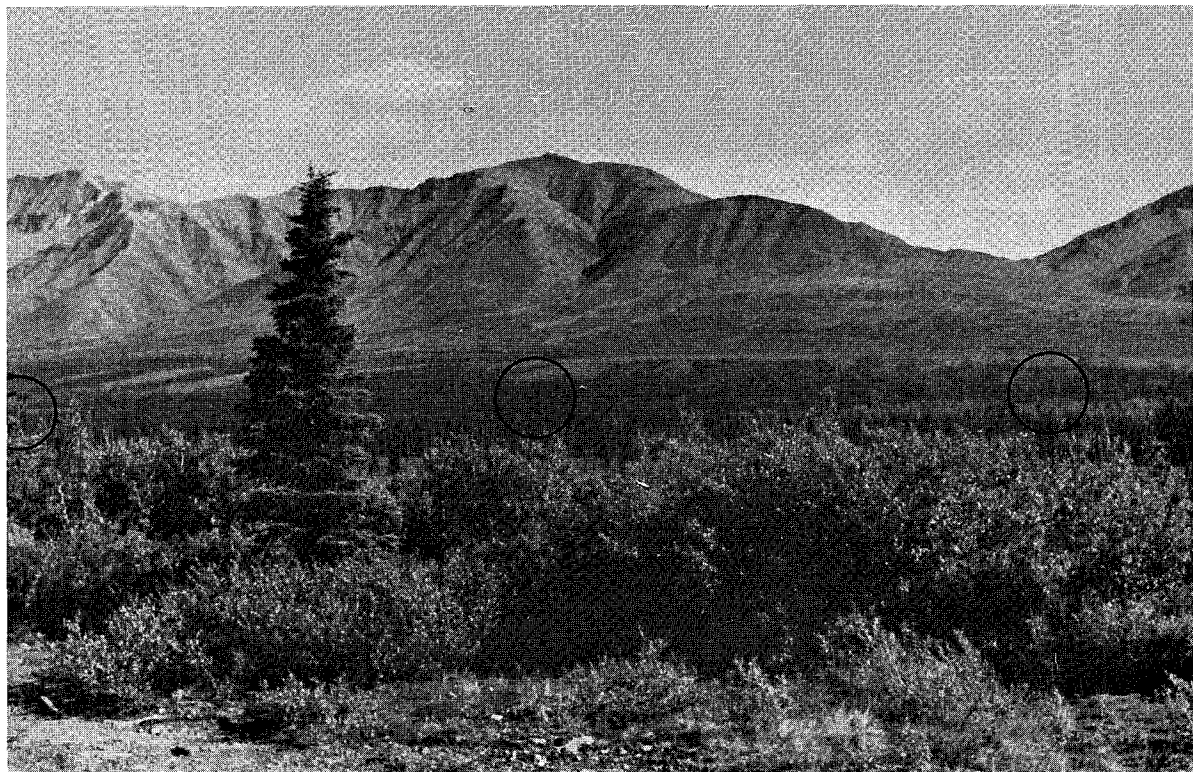
FIGURE 34

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Visual Simulations



5. Visual Simulation
Looking east across Mirror Lake at link 12s in Broad Pass.

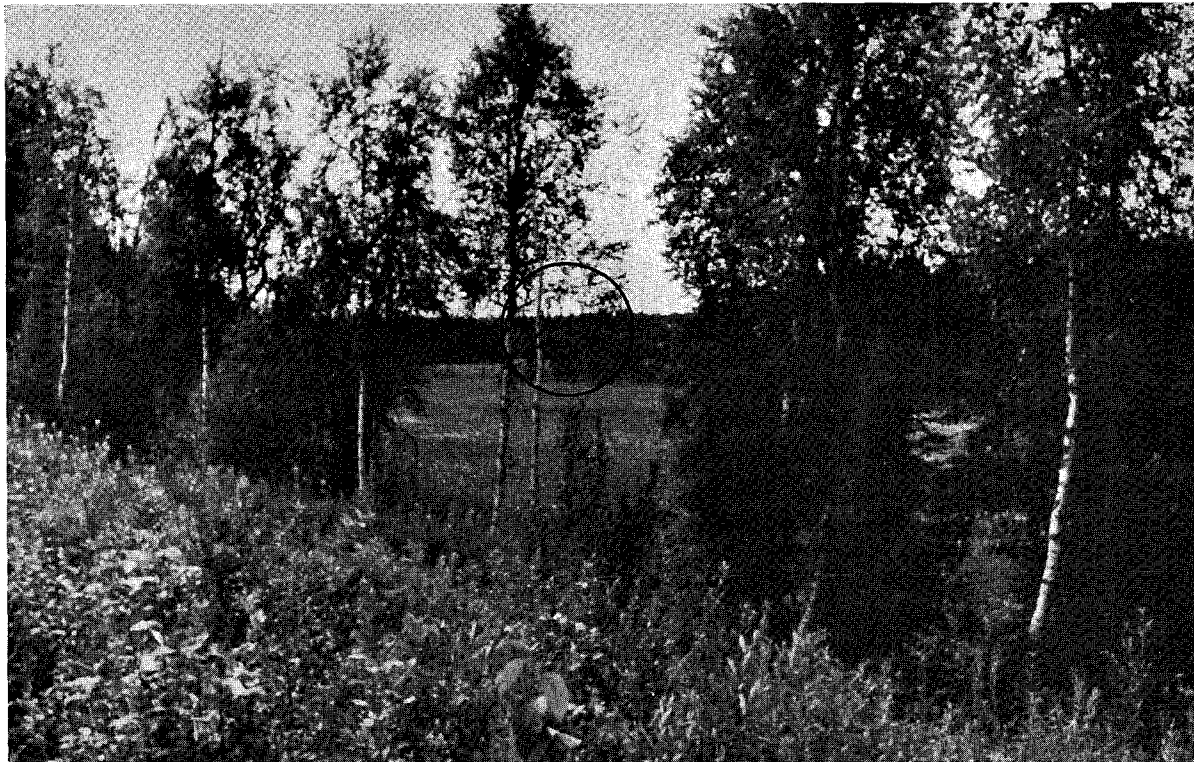


6. Visual Simulation
Looking east at link 12s from the Parks Highway just south of Cantwell.

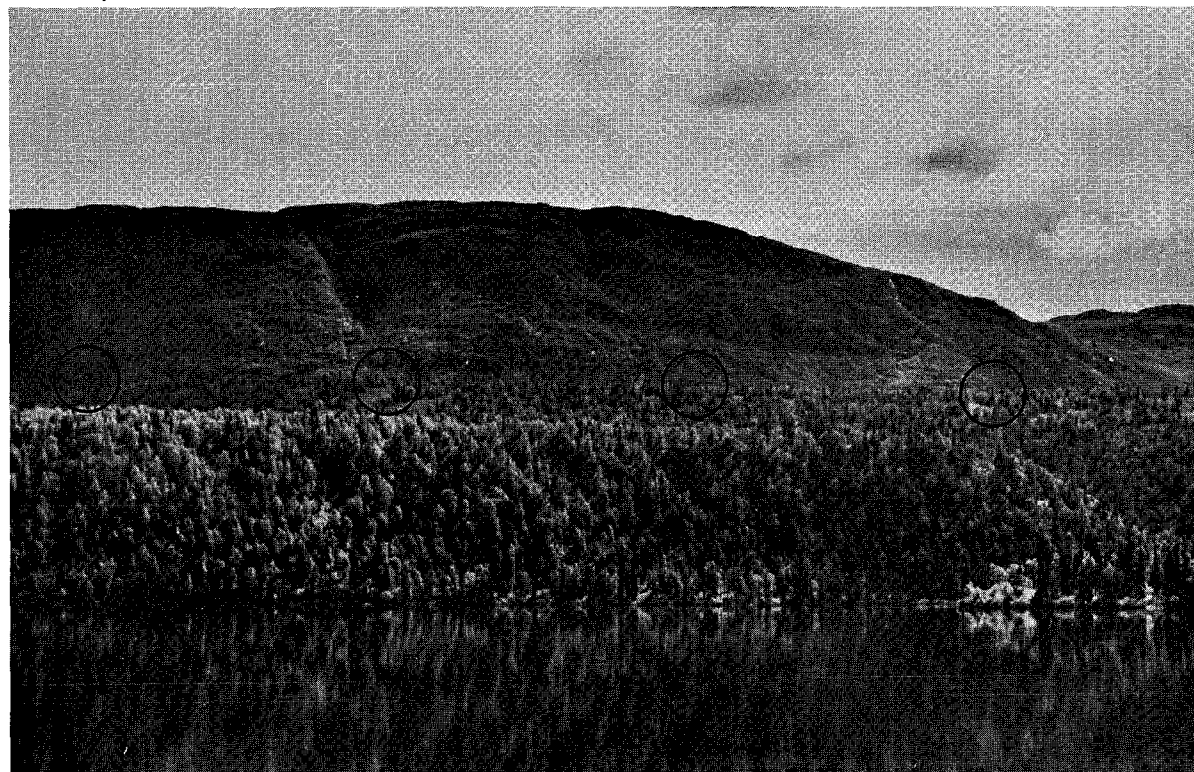
FIGURE 35

Alaska Power Authority | ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Visual Simulations



7. Visual Simulation
Looking west at link 2s through foreground vegetation along the Parks Highway near Trappers Creek.

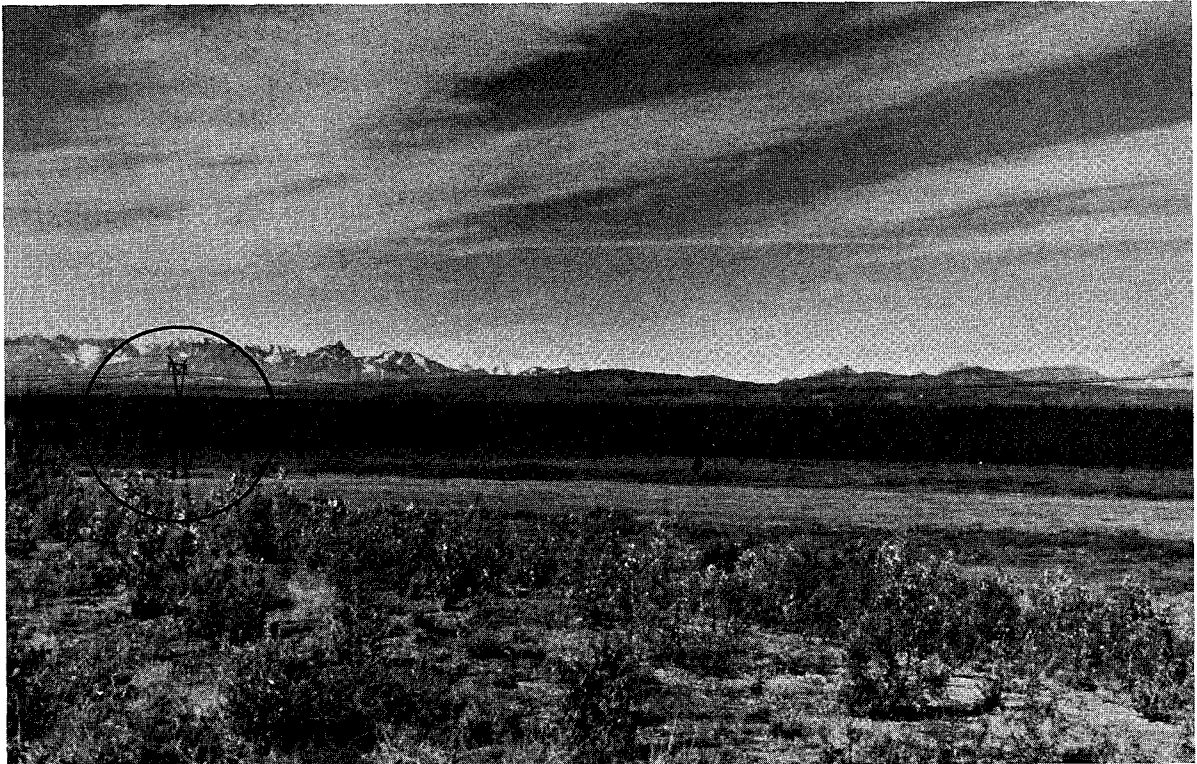


8. Visual Simulation
Looking at link 5s below Curry Ridge from above Byers Lake.

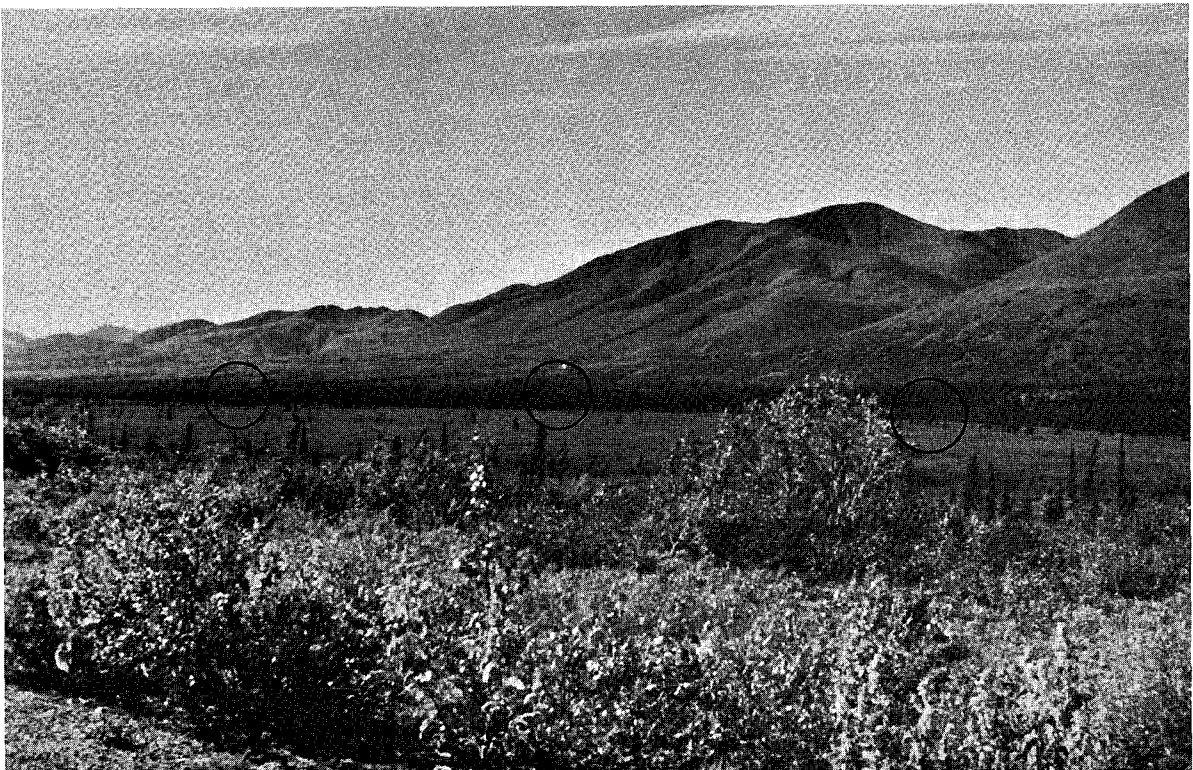
FIGURE 36

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Visual Simulations



9. Visual Simulation
Looking west at link 10s from the Parks Highway just before the highway makes a sharp right turn and enters Broad Pass from the south.

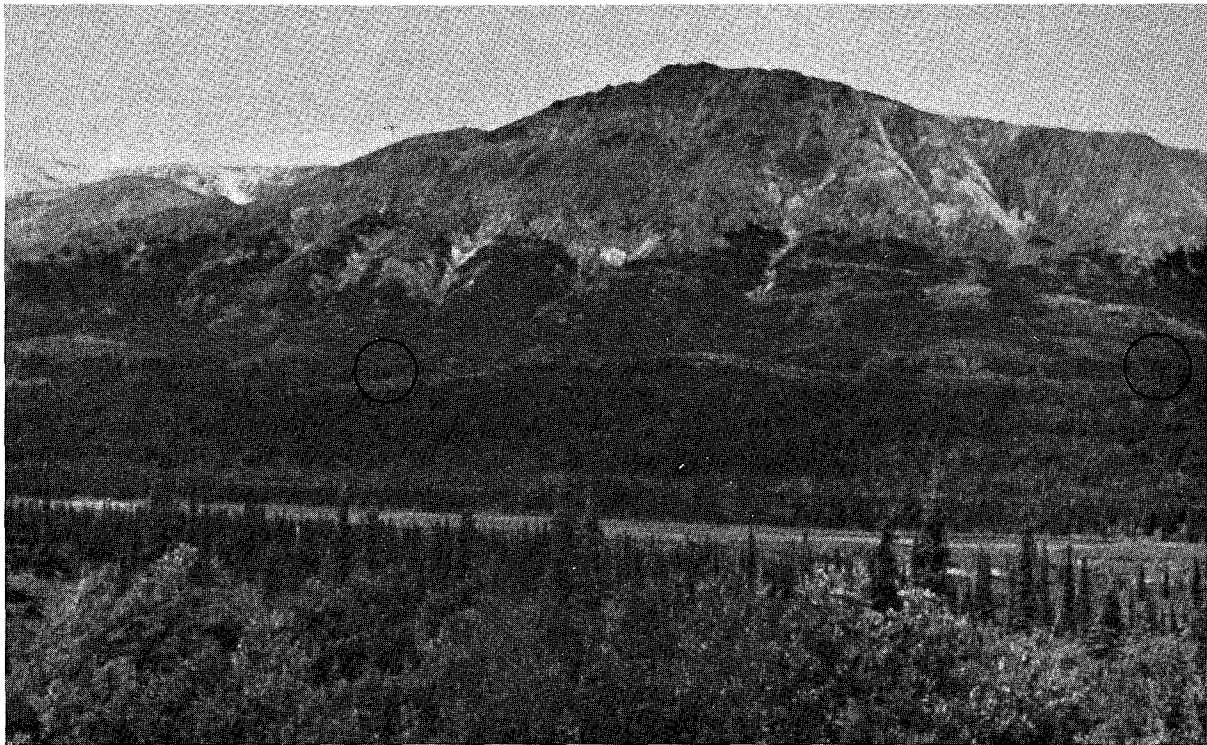


10. Visual Simulation
Looking west at link 11s from the Parks Highway at Mirror Lake.

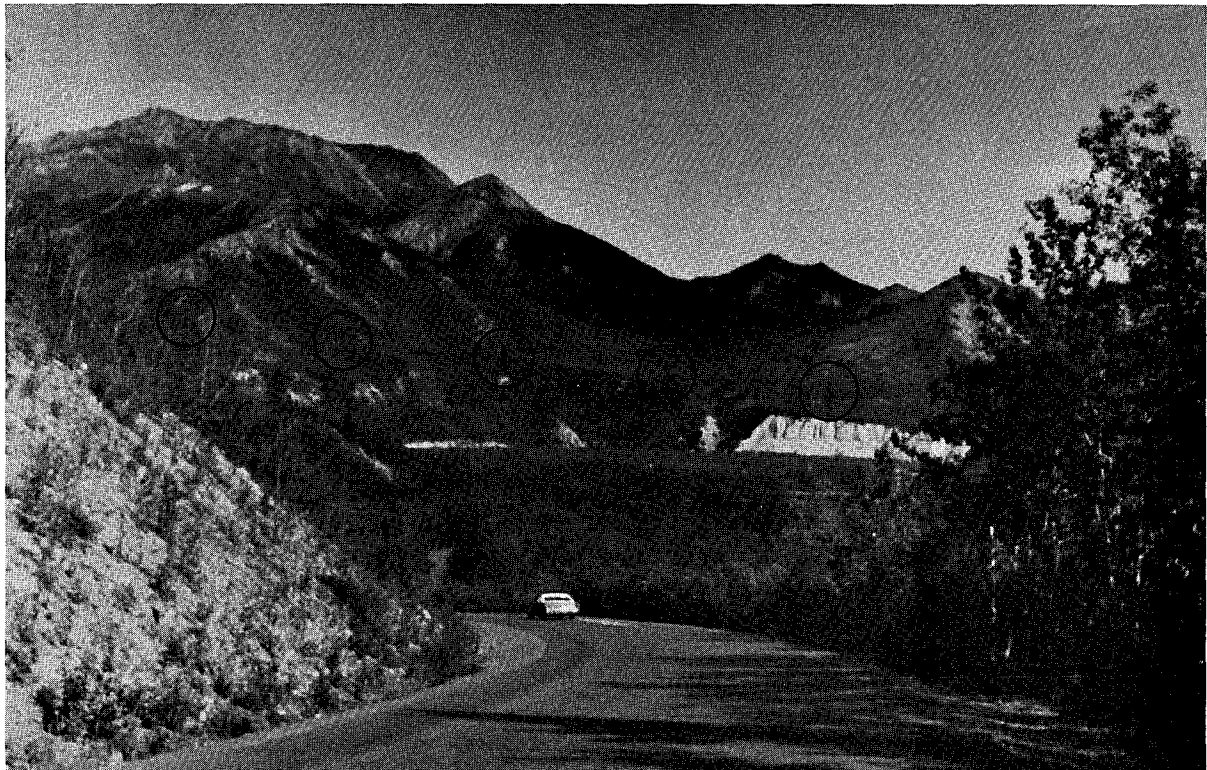
FIGURE 37

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Visual Simulations



11. Visual Simulation
Looking west at link 11s from the Parks Highway in Broad Pass just south of Cantwell.



12. Visual Simulation
Looking northeast at link 14s from the Denali National Park Entrance Road.

FIGURE 38

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Visual Simulations

APPENDIX H
CONSULTATION AND COORDINATION
WITH OTHERS

APPENDIX H
CONSULTATION AND COORDINATION
WITH OTHERS

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Guy McConnell
Jim Wolfe

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National Park Service

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John Dalle-Molle
Dave Dapkus
Jack Mosby
Richard Stenmark
Jules Tilleson

Fish and Wildlife Service

Dan Benfield
Mike Emerol
Jon Hall
John King
Dennis Money
Mel Munson
Jerry Stroebelle
John Trapp
Wilma Zellhoefer

Bureau of Land Management

John Bosworth
Dick Bouts
Cary Brown
Leroy Cooke
Bruce Durtche
Don Hinrichsen
Mike Hinkes
Pete Jerome
John Rego
Mike Scott
Maryanne See
Mike Small
Bob Ward
Bill Ziegler
Max Wheeler

DEPARTMENT OF AGRICULTURE

U.S. Forest Service

Dr. John Zasada

Soil Conservation Service

Lewis Flecher
T. Sterling Powell

DEPARTMENT OF TRANSPORTATION

The Alaska Railroad

William Coghill

STATE

DEPARTMENT OF FISH AND GAME

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John Clark
Jack Didrickson
Jerry Hallberg
Larry Jennings
Don McKnight
Margo Paine
Dan Timm
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Carl Yanagawa

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Division of Parks

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Chip Dennerlein
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David Porter
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Jack Wiles

Land and Resource Planning

Linda Arndt
Bill Beaty
Randy Cowart
Dennis Kuklok
Bob Loeffler
Reed Stoops

Division of Forest, Land and Water Management,
North-Central District

Bill Copeland
Don Parks
Frank Sullivan
Rich Thompson

South-Central District

Bob Aiken
Romie Clark
Dennis Daigger
Mike Franger
Len Johnson
Marilyn Morris
Joe Wehrman

Division of Research and Development

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Stephen M. Reeve

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Mike Stewart

UNIVERSITY OF ALASKA

Allen Battens
Dr. William W. Mitchell

ALASKA PLANT MATERIALS CENTER

Joseph Steahlik

DIVISION OF TOURISM

Terry Miller

ALASKA VISITORS ASSOCIATION

Gary Walker

REGIONAL

COOK INLET REGIONAL CORP. (CIRI)

Curt McGee
Don Marks
Marge Sagerser

AHTNA, INC.

Herbert Smelcer

MATANUSKA-SUSITNA BOROUGH

Norma Coleman
Ken DeCamp
Rich Feller
Rodney Schulling
Len Sines
Pamela Strahan
Bob Tucker
Vern Ungerecht
Ellen Wloff
Guy Woodings

REFERENCES CITED

REFERENCES CITED

- Alaska Department of Community and Regional Affairs. 1981. Alaska Taxable 1980. Juneau.
- Alaska Department of Fish and Game. 1975. Catalog of Waters Important for Spawning and Migration of Anadromous Fishes, Region 2 and 4. State of Alaska, Juneau.
1975. Catalog of Waters Important for Spawning and Migration of Anadromous Fishes, Region 3. State of Alaska, Juneau.
1978. Alaska's Fisheries Atlas, Volume I. State of Alaska, Juneau.
1978. Alaska's Wildlife and Habitat. State of Alaska, Juneau.
1980. Alaska Game Management Units. State of Alaska, Anchorage.
1981. Alaska Hunting Regulations, No. 22. State of Alaska, Juneau.
1981. Research and Analysis. Alaska Economic Trends. State of Alaska, Juneau.
- Alaska Department of Labor. 1981. Research and Analysis. Alaska Economic Trends. State of Alaska, Juneau.
- Alaska Statistical Quarterly. State of Alaska, Juneau.
- Labor Force Highlights. State of Alaska, Juneau.
- Alaska Department of Natural Resource. Division of Forest, Land, and Water Management. 1981. Land for Alaskans. State Land Disposal Brochure. Anchorage.
- Division of Land and Resource Planning. 1981. Scenic Resources Along the Parks Highway. Anchorage.
- Division of Parks. 1975. Denali State Park. A Master Plan. Anchorage.
- Division of Research and Planning. 1981. Draft Land Use Plan for Public Lands in the Willow Sub-Basin. Anchorage.
- Alaska Division of Parks. 1975. Heritage Resources Along the Upper Susitna River. Miscellaneous Publications, History and Archaeology Series No. 14.
- Alaska Regional Profiles. 1974. Yukon Region, State of Alaska. Juneau.
- Alaska Rural Development Council. 1977. A Revegetative Guide for Alaska. Cooperative Extension Service, University of Alaska, Fairbanks.

- Alt, K. T. 1969. Taxonomy and ecology of the inconnu, *Stenodus leucichthys nelina*, in Alaska. Biological Papers of the University of Alaska 12:1-61.
- Anderson, D. 1971. Environmental and Cultural Change in the North American Arctic. Unpublished Ms.
- 1968a. A Stone Age Campsite at the Gateway to America. Scientific American 218 (6).
- 1968b. Early Notched Point and Related Assemblages in the Western American Arctic. Unpublished Ms.
- Anderson, S. H. 1979. Changes in Forest Bird Species Composition Caused by Transmission Line Corridor Cuts. Am. Birds 33(1): 3-6.
- Anderson, S. H., Kathleen Mann, and H. H. Shugart, Jr. 1977. The Effect of Transmission Line Corridors on Bird Populations. Am. Midl. Nat. 97:216-221.
- Armstrong, R. H. 1980. A Guide to the Birds of Alaska. Alaska Northwest Publishing, Anchorage.
- Avery, M. T. (ed.) 1978. Impact of Transmission Lines on Birds in Flight. U.S.D.I. Fish and Wildlife Service. FWS/OBS-78/48.
- Bacon, G. 1977. The Prehistory of Alaska: A Speculative Alternative. Prehistory of the North American Sub-Arctic: The Athapaskan Question. Proceedings of the Ninth Annual Conference of the Archaeological Association of the University of Calgary, pp. 1-10.
- Bacon, G. H. and C. E. Holmes. 1980. Archeological Survey and Inventory of Cultural Resources at Fort Greely, Alaska, 1979. Report prepared under Contract DACA85-78-C-0045, Alaska District, Corps of Engineers.
- Batten, A. R., 1981. University of Alaska Museum, Fairbanks. Personal Communication.
- Bellrose, F. C. 1976. Ducks, Geese and Swans of North America. Stackpole Books, Harrisburg.
- Belovsky, G.E. 1981. Food Plant Selection by a Generalist Herbivore: The Moose. Ecology 62:1020-1030.
- Bent, A. C. 1961. Life Histories of North American Birds of Prey. Dover Publishing, New York.
- Bent, A. C. 1962. Life Histories of North American Shorebirds. Dover Publishing, New York.

- Brown, J. M. 1972. The Effect of Overstory Removal upon Surface Wind in a Black Spruce Bog. Res. note NC-137. U.S. Forest Service, St. Paul, Minn.
- Brown, J. 1976. Ecological and Environmental Consequences of Off-Road Traffic in Northern Regions. USDI.
- Brown, R. J. E., G. H. Johnston, J. R. Mackay, N. R. Morgenstern, and W. W. Shults. 1981. Permafrost Distribution and Terrain Characteristics in Permafrost Engineering Design and Construction. John Wiley and Sons, New York.
- Brown, R. W., R. S. Johnston, and K. VanCleve. 1978. Rehabilitation Problems in Alpine and Arctic Regions in Reclamation of Drastically Disturbed Lands. USGPO:1979-67-019/66 Reg 8.
- Burns, J. W. 1972. Some Effects of Logging and Associated Road Construction on Northern California Streams. Transactions of the American Fisheries Society 101:1-17.
- Burt, W. H. and R. P. Grossenheider, 1976. A Field Guide to the Mammals. Houghton-Mifflin Co., Boston.
- Calmes M. A. 1976. Vegetation Pattern of Bottomland Bays in the Fairbanks Area. M. S. Thesis. University of Alaska.
- Carvell, K. L. and P. A. Johnston. 1978. Environmental Effects of Right-Of-Way Management on Forested Ecosystems. E.P.R.I. Research Project 103-3. Palo Alto.
- Commonwealth Associates Inc. 1982. Communication Tower Survey, Appendix B, Electrical Environmental Effects Report, Anchorage-Fairbanks Transmission Intertie, Engineering Report R-2394. Jackson, Michigan.
1982. Electrical Environmental Effects Report, Anchorage-Fairbanks Transmission Intertie, Engineering Report R-2394. Jackson, Michigan.
1982. Route Selection Report. Jackson, Michigan.
1982. Study of the Feasibility of Electrical Interconnection Between Anchorage and Fairbanks. Engineering Report R-2274, Jackson, Michigan.
1982. Radio and TV Preconstruction Measurements, Appendix A, Electrical Environmental Effects Report, Anchorage-Fairbanks Transmission Intertie, Engineering Report R-2394. Jackson, Michigan.

- Cook Inlet Nature Association 1975. Cook Inlet Region Inventory of Native Historic Sites and Cemeteries.
- Cook, J. 1975. Archaeology of the Interior. Western Canadian Journal of Anthropology, (3-4).
1968. The Prehistory of Healy Lake, Alaska. Ph. D. dissertation, University of Wisconsin, Madison.
- Cook, J. and R. McKennan. 1970. The Village Site at Healy Lake, Alaska. Unpublished Ms.
- Craighead, F. C., Jr. 1979. Track of the Grizzly. Sierra Club Books, San Francisco.
- Csejtey, B., W. H. Nelson, D. L. Jones, N. J. Silberling, R. M. Dean, M. S. Morris, M. A. Lanphere, J. G. Smith, M. L. Silberman. 1978. Reconnaissance Geologic Map and Geochronology, Talkeetna Mountains Quadrangle, Northern Part of Anchorage Quadrangle, and Southwest Corner of Healy Quadrangle, Alaska. U.S. Geological Survey Open-file Report 78-558-A.
- DeLaguna, F. 1972. Under Mount St. Elias: The History and Culture of the Yakutat Tlingit. Smithsonian Contributions to Anthropology, Vol. 7. Smithsonian Institution, Washington, D.C.
- Dice, L. R. 1921. Notes on Mammals of Interior Alaska. J. Mammal. 2:20-28.
- DOWL Engineers. 1981. File data compiled and calculated by D. Cole.
- Drury, W. H., Jr. 1956. Bog Flats and Physiographic Processes in the Upper Kuskokwim River Regions, Alaska. Contribution Gray Herb No. 178. Harvard University.
- Dyrness, C. T., and D. F. Grigal. 1979. Vegetation-Soil Relationship Along a Spruce Forest Transect in Interior Alaska. Canadian Journal of Botany 57(23):2644-2656.
- Ebner, J. G. 1976. Surface Protection Aspects of Dams and Transmission Lines. USDI.
- Eldridge, G. 1900. A Reconnaissance in the Susitna Basin and Adjacent Territory, Alaska, in 1898. Twentieth Annual Report of the United States Geological Survey, 1898-99. pp. 7-29. Government Printing Office, Washington, D.C.
- Ender, Richard L. 1980. Mat-Su Housing and Economic Development Study: Survey Findings, prepared for the Alaska Department of Community and Regional Affairs, Matanuska-Susitna Borough. Cook Inlet Native Association and Mat-Su OEDP, Inc. Anchorage.

Ferrians, Jr., O. J. 1965. Permafrost Map of Alaska: U.S. Geological Survey Map I-445.

Fitch, E. 1967. The Alaska Railroad. Praeger, New York.

Hall, E. R. and K. R. Kelson. 1959. The Mammals of North America. Ronald Press Co., New York.

Hanson H. C. 1953. Vegetation Types in Northwestern Alaska and Comparisons with Communities in Other Arctic Regions. Ecology, 34:111-140.

Hegg, K. M., and R. M. Dippold. 1973. Areas of Nonforest and Noncommercial Forest Land by Cover Types and by Topographic Site for Interior Alaska. USDA For. Serv. Resour. Bull. PNW-47.

Hettinger L. R. and A. J. Janz 1974. Vegetation and Soils of Northeastern Alaska. Arctic Gas Biol. Rep. Series 21. North Eng. Serv., Co., Ltd., Edmonton, Canada.

Holmes, Charles E. 1974a. New Evidence for a Late Pleistocene Culture in Central Alaska. Unpublished Ms.

1974b Preliminary Testing of a Microblade Site at Lake Minchumina, Alaska. International Conference on the Prehistory and Paleoecology of Western North American Arctic and Sub-Arctic, edited by S. Raymond and P. Schlederman, University of Calgary Archaeological Association, pp. 101-112.

Hooper, R. G., E. F. Smith, H. S. Crawford, B. S. McGinnes, and V. J. Walter. 1975. Nesting Bird Populations in a New Town. The Wildlife Society Bulletin: 111-118.

Gabrielson, I. and F. Lincoln. 1959. The Birds of Alaska. Wildlife Management Inst., Washington, DC.

Godfrey, W. E. 1979. The Birds of Canada. National Museum of Canada, Ottawa.

Hall, E. R. and K. R. Kelson. 1959. The Mammals of North American. Ronald Press Company, New York.

Hall, J. D., and R. L. Lantz. 1969. Effects of Logging on the Habitat of Coho Salmon and Cutthroat Trout in Coastal Streams. In Symposium of Salmon and Trout Streams; T. G. Northcote, editor. Institute of Fisheries, The University of British Columbia, Vancouver.

- Hansen, H. A., P. E. K. Shepherd, J. G. King, and W. A. Troyer. 1971. The Trumpeter Swan in Alaska. Wildlife Monog. No. 26.
- Hegg, K. M. 1970. Forest Resources of the Susitna Valley, Alaska. USDA For. Serv. Pub. PNW-32.
- Hodge, R. P. 1976. Amphibians and Reptiles in Alaska, the Yukon, and the Northwest Territories. Alaska Northwest Publ. Co., Anchorage.
- Horejsi, B. 1976. Some Thoughts and Observations on Harassment and Bighorn Sheep. Proceedings Northern Wild Sheep Council Symp. Jackson, WY.
- Hulten, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Palo Alto.
- International Engineering Company. 1979. Anchorage-Fairbanks Transmission Intertie Economic Feasibility Study Report.
- James, B. W. and B. A. Haak. 1979. Factors Affecting Avian Flight Behavior and Collision Mortality at Transmission Lines. U.S. Department Energy, Bonneville Power Admin.
- Johnsgard, P. A. 1975. North American Game Birds of Upland and Shoreland. University Nebraska Press, Lincoln.
- Joint Federal-State Land Use Planning Commission of Alaska. 1973. Major ecosystems of Alaska (map).
- Kari, J. Ahtna. n.d. Place Names List and Dena'ina Place Names List. Alaska Native Language Center, University of Alaska, Fairbanks.
- Karlstrom, T. N. V. 1964. Quaternary Geology of the Kenai Lowlands and Glacial History of the Cook Inlet Region, Alaska. U.S. Geological Survey Professional Paper 443.
- Kessel, Brina. 1979. Avian Habitat Classification for Alaska. Murrelet 60(3): 86-94.
- Krapu, G. L. 1974. Avian Mortality from Collisions with Overhead Wires in North Dakota. The Prairie Naturalist. 6 (1).
- Krauss, M. 1980. Alaska Native Languages: Past, Present, and Future. Alaska Native Language Center Research Papers No. 4.
- La Roi, G. H. 1967. Ecological Studies in the Boreal Spruce-Fir Forests of the North American Taiga. Ecological Monographs 37:229-253.

- Leopold, A. S. and F. F. Darling. 1953. Effects of Land Use on Moose and Caribou in Alaska. Trans. No. Am. Wildl. Conf. 18:553-582.
- MacNeish, R. 1964. Investigations in the Southwest Yukon. Papers of the Robert S. Peabody Foundation for Archaeology 6 (2): 201-488.
- McPhail, J. D., and C. C. Lindsey. 1970. Freshwater Fishes of Northwestern Canada and Alaska. Fisheries Research Board of Canada Bulletin 173.
- McPhail, J. D. and W. M. Mitchell, 1981. Agricultural Experiment Station Palmer, Personal communication.
- Manville, R. H. and S. P. Young. 1965. Distribution of Alaskan Mammals. Bur. Sport Fish. Wildl. Circular 211.
- Matanuska-Susitna Borough Planning Department. 1978. Comprehensive Development Plan--Phase I: Background Report. Palmer.
- Moffit, F. 1912. Headwater Regions of Gulkana and Susitna Rivers, Alaska. United States Geological Survey Bulletin 498.
- Morrow, J. E. 1980. Freshwater Fisheries of Alaska. Alaska Northwest Publishing Company, Anchorage.
- Murie, A. 1962. Mammals of Mount McKinley National Park, Alaska. Alaska National Parks and Mon. Assoc., Anchorage.
- Murphy, D. and K. Kertell. 1977. Birds of Mount McKinley National Parks. National Park Service.
- Murray, B. J. 1978. Rehabilitation of Base Sites in Interior Alaska. Agroborealis 10:21-25.
- Murray, D. F. 1980. Threatened and Endangered Plants of Alaska. U.S. Forest Service.
- National Park Service. Pacific Northwest Region, 1976. Final Environmental Impact Statement: Proposed Electric Distribution Line Extension to McKinley Park, Mount McKinley National Park, Alaska.
- National Oceanic and Atmospheric Administration. 1980. Supplement Alaska. Washington, D.C.
- Neiland, B. J. and L. A. Viereck, 1977. Forest types and Ecosystems. North American Forest Lands at Latitudes North of 60 Degrees Symposium, pp. 909-136. University of Alaska, Fairbanks.

- Osgood, C. 1966. The Ethnography of the Tanaina. Yale University Publications in Anthropology, New Haven.
- Peace, T. R. 1962. Pathology of Trees and Shrubs. Oxford Press, New York.
- Page, R. A. 1972. Crustal deformation on the Denali Fault, Alaska, 1942-1970. J. Geophys. Res. 77(8): 1528-1533.
- Pewe, T. L. 1975. Quaternary Geology of Alaska. U.S. Geological Survey Professional Paper 835.
- Pirone, P. P. 1972. Tree Maintenance Oxford Press, New York.
- R. M. Parsons Company. 1962. Generation and Transmission Interconnection Study. A Report to the Central Alaska Power Pool. Anchorage.
- Rausch, R. C. 1950. Notes on the Distribution of Some Arctic Mammals. J. Mammal. 31:464-466.
- Reger, D. 1977. Prehistory in the Upper Cook Inlet, Alaska. Prehistory of the North American Sub-Arctic: The Athapaskan Question. Proceedings of the Ninth Annual Conference of the Archaeological Association of the University of Calgary, pp. 16-22.
- Reynolds, H. V. and J. Hechtel. 1980. Structure, Status Reproductive Biology, Movement, Distribution and Habitat Utilization of a Grizzly Bear Population. Alaska Department Fish and Game, Juneau.
- Shelton, N. 1962. A Study of Vegetational Zonation in Mount McKinley National Park, Alaska. M. S. thesis. Duke University.
- Smith, O. R. 1940. Placer Mining Silt and Its Relation to Salmon and Trout on the Pacific Coast. Transactions of the American Fisheries Society. 40:225-230.
- Spencer, D. L. and E. F. Chatelain. 1953. Progress in the Management of the Moose of South Central Alaska. Trans. No Am. Wildl. Conf. 18:539-552.
- Soil Conservation Service. 1979. Exploratory Soil Survey of Alaska. U. S. Department of Agriculture.
- Soutiere, E. C. 1979. Effects of Timber Harvesting on the Marten in Maine. J. Wildl. Manage. 43:850-860.
- Stapleton, J. and E. Kiviat. 1979. Rights of Birds and Rights-Of-Way. Am. Birds 33(1); 7-10.

- Starr, E. C., R. J. Tallman, and N. G. Butler. 1969. Generation and Transmission Interconnection Studies Between Interior and South Central Alaska. American Power Conference.
- Stephenson, B. 1978. The Wolf in Alaska. Alaska Department Fish and Game, Wildl. Note. Series. (mimeo).
- Sylvester, J. R. 1973. Effects of Light on Vulnerability of Heat-Stressed Sockeye Salmon to Predation by Coho Salmon. Transactions of the American Fisheries Society 102:139-141.
- Terrestrial Environmental Specialists, Inc. 1981. Environmental Studies Annual Report 1980. Subtask 7.12. Plant Ecology Studies.
- Thompson, L. S. 1978. Transmission Line Wire Strikes: Mitigation Through Engineering Design and Habitat Modification. In Impacts of Transmission Lines on Birds in Flight. Avery M. T., Editor. pp. 27-52. USDI Fish and Wildl. Serv.
- Thompson, L. S. 1977. Overhead Transmission Lines: Impact on Wildlife. Montana Department Nat. Res. and Conserv.
- Todd, W. E. C. and H. Friedmann. 1947. A Study of the Gryfalcons with Particular Reference to North America. Wilson Bull. 59:139-150.
- U.S. Department of the Army Corps of Engineers. 1975. Hydroelectric Power and Related Purposes.
- U.S. Department of Commerce, Bureau of the Census. 1981. 1980 Census of Population and Housing, Preliminary Reports, Washington, D.C.
- U.S. Department of the Interior, Bureau of Reclamation, Alaska District. 1959. Proposed Plan for Power Development in the Railbelt Area, Alaska.
- U.S. Geological Survey. 1981. Water Resources Data for Alaska 1980. U.S. Department of the Interior.
- U.S. Fish and Wildlife Service. n.d. Northern Alaska Ecological Services. Field Notes. Fairbanks.
1980. Endangered and Threatened Wildlife Plants: Review of Plant Taxa for Listing as Endangered and Threatened Species. Federal Register: 45(242): 82480-82560. December 15, 1980.
- U.S. Forest Service. 1974. National Forest Landscape Management, Volume 2. The Visual Management System. Washington.

- University of Alaska, Agricultural Experiment Station and Terrestrial Environmental Specialists, Inc. 1981. Alaska Power Authority Susitna Hydroelectric Project: Environmental Studies Annual Report 1980, Subtask 7.12, Plant Ecology Studies. Acres American, Inc. Buffalo.
- Viereck, L. A. and C. T. Dyrness. 1980. A Preliminary Classification for Vegetation of Alaska. Pacific N. W. Forest and Range Exp. Sta., Gen. Tech. Rep. PNW-106.
- Viereck, L. A. and E. L. Little, Jr. 1972. Alaska Trees and Shrubs. Agric. Handbook No. 410. USDA For. Serv.
- Wahrhaftig, C. and R. F. Black. 1958. Quarternary and Engineering Geology in the Central Part of the Alaska Range. U.S. Geological Suvey Professional Paper 293.
- Walkinshaw, L. 1956. Sandhill Cranes Killed by Flying into Power Lines. Wilson Bull. 68:325-326.
- Watsyolds, D. 1981. Alaska Department of Fish and Game, Anchorage, Alaska, USA. Personal communication.
- Weeden, R. B. 1978. The Ptarmigan in Alaska. Alaska Department Fish and Game. Wildlife Note. Series.
- Weeden, R. B. and L. N. Ellison. 1968. Upland Game Birds of Forest and Tundra Alaska Department Fish and Game, Wildlife Book 1. (3).
- Welsh, S. L. 1974. Anderson's Flora of Alaska and Adjacent Parts of Canada. Brigham Young University Press, Provo, Utah.
- West, F. 1957. Dating the Denali Complex. Arctic Anthropology, 12(1):76-81.
1974. Late Palaeolithic Cultures in Alaska.
1967. The Donnelly Ridge Site and the Definition of an Early Core and Blade Complex in Central Alaska. American Antiquity 32 (3). .
- Woodward-Clyde Consultants. 1979. Biological Studies of a Proposed Power Plant Site Near Healy, Alaska. Anchorage.
- Workman, W. 1977. Ahtna Archaeology: A Preliminary Statement. Pre-history of the North American Sub-Arctic: The Athapaskan Question. Proceedings of the Ninth Annual Conference of the Archaeological Association of the University of Calgary, pp. 22-40.

Zasada, J. C. and A. C. Epps. 1976. Use of Woody Plant Material in Soil and Site Stabilization and Rehabilitation. USDI.

Zasada, J. C., L. A. Viereck, M. J. Foote, R. H. Parkenson, J. O. Wolff and L. A. Lampford Jr. 1981. Natural Regeneration of Balsam Poplar Following Harvesting in the Susitna Valley, Alaska. Forestry Chronicle 57:57-65.

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