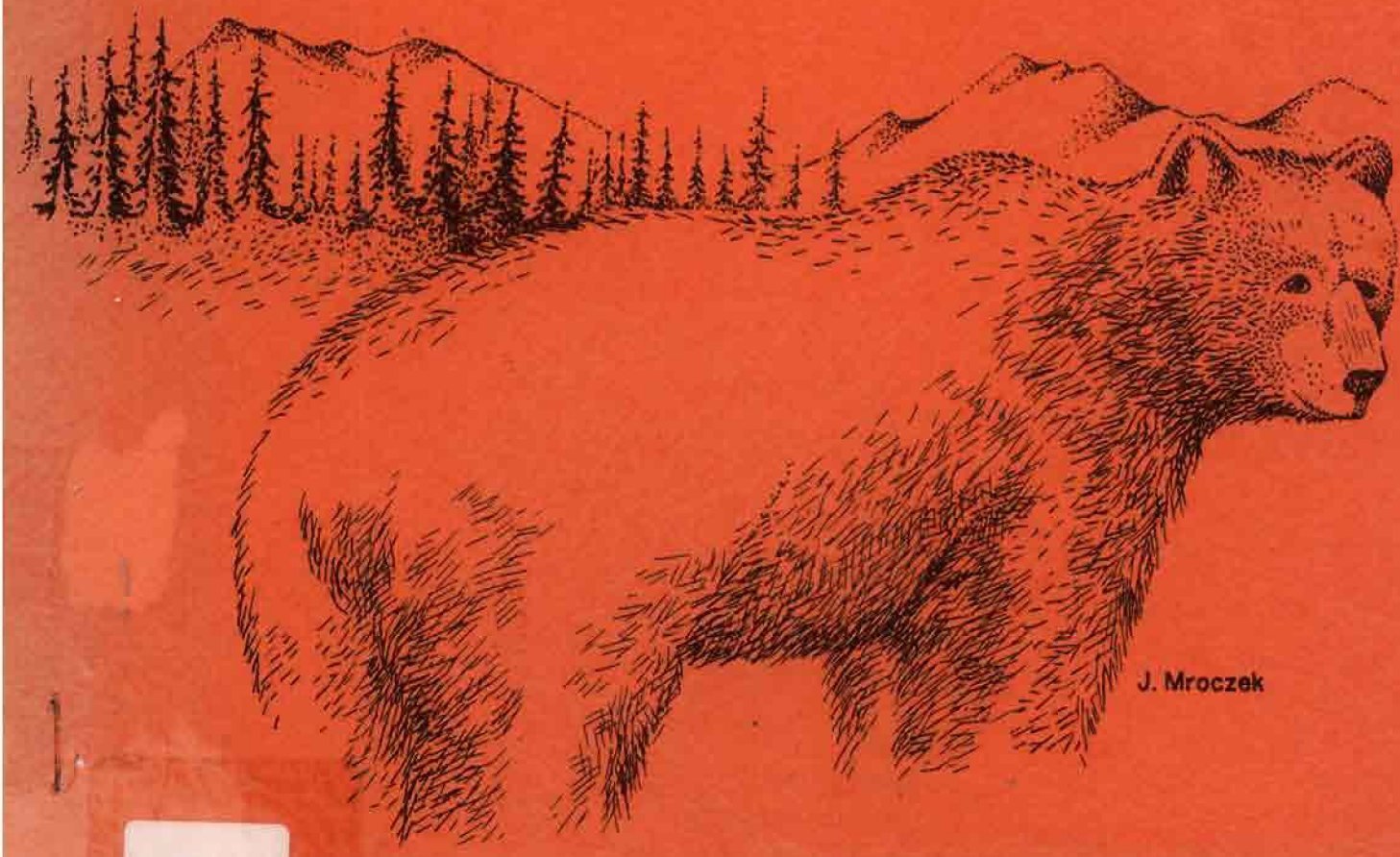
Final Environmental Assessment Record

Susitna Hydropower Feasibility Study

APPLICANT, ALASKA POWER AUTHORITY



J. Mroczek

U.S. Department of the Interior
Bureau of Land Management
Anchorage, Alaska

Case No. AK-017-9025 (2920) no. 2956

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FINAL ENVIRONMENTAL ASSESSMENT RECORD

SUSITNA HYDROPOWER FEASIBILITY STUDY

Applicant: Alaska Power Authority

February 1979

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IN REPLY REFER TO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

Anchorage District Office
4700 East 72nd Avenue
Anchorage, Alaska 99507

March 7, 1979

Dear Alaskan:

Thank you for submitting comments on the Draft Environmental Assessment Record for the proposed Susitna Hydroelectric Feasibility Study.

Enclosed is a copy of the final assessment and accompanying maps. The assessment describes the study activities proposed by the Alaska Power Authority (APA), assesses potential impacts associated with the activities, recommends ways for mitigating impacts and identifies impacts which could not be mitigated.

BLM has reviewed APA's application in light of the assessment, public comment, and the laws, regulations and policies under which the Bureau of Land Management operates. Based on this review, a decision has been made to permit portions of the study.

Section 603 of the Federal Land Policy and Management Act of 1976 directs BLM to manage lands having wilderness characteristics in a manner that would maintain the suitability of such areas for future wilderness designation by Congress. The proposed project area has a wilderness character. Consequently, only those activities which would not result in long-term changes in the landscape may be authorized.

More specifically, activities which can be authorized include winter trail access, temporary field camp placement, drilling operations, seismic monitoring, limited test pit excavations, and hydrological, geological and biological studies.

Construction of an airstrip, permanent roads, permanent structures and other long-term site alterations will not be authorized.

A summary of the decision process and rationale for decisions rendered are provided in a Lands Report addressing APA's application. Copies of this document are available from the BLM Anchorage District Office.

Sincerely,

Richard W. Tindall

Richard W. Tindall
District Manager

Enclosure

1. PROJECT DESCRIPTION

1.1 PURPOSE

The Alaska Power Authority (APA) has filed an application with the Bureau of Land Management (BLM) for authorization to proceed with activities associated with a hydroelectric feasibility analysis for the upper Susitna River basin.

The project feasibility analysis will consist of engineering, economic, social, and biological studies necessary to establish the feasibility of developing the upper Susitna hydropower potential, if authorized.

This environmental assessment is a systematic examination of the environmental impacts and of ways to minimize and mitigate adverse impacts of the proposed activities.

1.2 PROJECT AREA

Most of the exploration activities are proposed to occur within the upper Susitna River basin (Map 1). Biological studies would be conducted along the entire Susitna River extending downstream as far as the estuarine area and possibly into the Cook Inlet. Transmission line studies and related archeological surveys would be conducted within the proposed transmission corridor, some portions of which extend beyond the upper Susitna River basin (Map 4).

1.3 PROPOSED ACTION AND ALTERNATIVES

The Alaska Power Authority proposes to conduct engineering, economic, social, and environmental studies beginning early in 1979 and

ending approximately 46 months later. These studies are described in the "Plan of Study (POS) for Susitna Hydropower Feasibility Analysis" prepared in June 1978. The following major categories, as described in the POS, will entail field work: field camp (including site access), survey, hydrology, environmental water quality, recreation, foundations and materials, design, real estate, cultural resources, and biological studies. A tabulation of the field activities according to season and year of accomplishment is provided as Appendix C.

The support facilities proposed include a field camp and airstrip at Watana and a field camp at Devil Canyon. Both the Watana and Devil Canyon field camps are discussed under discrete headings that describe the intended action.

1.3.1 Support Facilities - Watana

1.3.1.1 Field Camp. The proposed Watana field camp, to be constructed at the Watana damsite (Map 2), will provide housing and support facilities for about 75 people. The camp will be utilized year-round, but by only a few workers during winters.

Delays due to funding, permits, and contract scheduling preclude major mobilization of the camp during winter of 1979. Some equipment may be mobilized by helicopter to support the first year's activities. The existing camp facilities, consisting of one trailer and two plywood structures, may be enlarged to provide interim housing during the first summer, as discussed under "Interim Field Camp." Major mobilization,

including mobilization of the larger camp, is proposed for the winter of 1980.

Two alternate 75-man campsites are being studied. The proposed camp lies within Section 22, T32N, R5E Seward Meridian, adjacent to the proposed airstrip (see Map 2). It will be contained within an area of approximately 10 acres (660 by 660 feet). The area of disturbance will be considerably less, depending on the final configuration of the camp. The camp will consist of up to 40 portable trailer-type modules which will be transported and assembled on site.

An alternative housing scheme would consist of support modules and a barracks and dining hall composite structure of prefabricated wood or metal panels which would be transported and assembled on site. Tent units may also be installed as a temporary interim measure.

A tent-type equipment maintenance enclosure will be provided with either scheme.

Camp construction will require gravel pads to support buildings. As presently envisioned, the configuration will consist of a main pad with an area of something less than an acre. Smaller "satellite" pads will be provided for sewage disposal, fuel storage, equipment maintenance and storage, etc. These pads will be interconnected with access trails (to be discussed later).

Approximately 5,000 cubic yards of gravel will be required for pads. The dimensions of the pads are unknown at this time; they will vary

depending on the final configuration. The pads will generally extend no more than 5 feet past the building line.

Water will be supplied from a well to be drilled adjacent to the camp. Well capacity will be about 5,000 gallons per day. Water treat ment will consist of disinfection and, possibly, iron removal.

The majority of the solid wastes produced will be disposed of by incineration, in compliance with all State and Federal air pollution regulations. Those materials which cannot be incinerated (glass and metal) will be hauled to an existing approved disposal site (e.g., Talkeetna) or buried in the borrow and waste disposal area onsite. Empty fuel drums will be returned for reuse or salvage or, if damaged, will be crushed and buried in the borrow and waste disposal area onsite.

Waste oil will be incinerated onsite or transported by air to an approved disposal facility.

Sewage will be handled in a 5,000-gallon per day treatment plant located in a module adjacent to the camp. The plant will discharge into an adjacent lake or pond through a surface-laid outfall pipe. The feasibility of this scheme is dependent upon the depth of the ponds and the depth of freezing, which are not yet known. Effluent from the treatment plant could also be discharged into the Susitna River. Effluent discharges will meet all applicable State and Federal standards. Sludge from the treatment plant will be digested in the treatment facility, then buried in the waste disposal area on site, as allowed by

the Alaska Department of Environmental Conservation, or incinerated in the camp incinerator.

An alternate means of sewage treatment would be a gray-black water system. The black water (human waste) could be treated by incinerating toilets. The gray water (shower, laundry, etc.) could be disinfected and discharged to a gravel pad near the camp, or to a pond or river. Other gray-black water systems are commercially available, some of which require incineration (either on site or at an approved facility) of the black water fraction. Offsite incineration would require air transport of the wastes.

Power will be supplied by diesel generators located within a module adjacent to the camp.

Heating will be by fuel oil furnace.

Fuel for all onsite activities will be stored within impervious diked areas adjacent to the camp. Fuel will be stored both in drums and in bulk in bladder tanks. The amount of fuel stored on site will not exceed 50,000 gallons. The area reserved for fuel storage will be about 10,000 square feet. Earthen containment dikes will be about 4 feet high and about 15 feet wide at the base. A spill prevention control and countermeasure plan will be prepared and implemented for all fuel storage and handling operations in accordance with applicable regulations.

1.3.1.2 Alternate 75-Man Field Camp. An alternate 75-man field camp site lies approximately 1,500 feet south of the proposed location. The

configuration would lie entirely within Native-selected lands. The major differences between the proposed and alternate locations are:

1. The discharge of treated waste water through surface-laid piping is less feasible for the alternate site due to the longer distance from a suitable lake.

2. The haul trail from the proposed borrow area would be approximately 1,500 feet shorter for the proposed site.

3. An archeological survey was conducted in the fall of 1978 for a portion of the proposed location but not for the alternate location. This survey resulted in "clearance" of the land required for the proposed location in that no archeological or historic resources were found. If the alternate site were selected, an archeological survey would be conducted.

1.3.1.3 Interim Field Camp. An alternate interim measure may also be implemented during the first summer. This would consist of an initial 35-man camp to be mobilized by helicopter during summer 1979. This camp would be located in approximately the same place as the existing site used in the 1978 studies. This area is not as flat or wet as the proposed camp site. Gravel pads would not be constructed; rather, the trailer-type modules would be placed on timber cribbing. The structure would measure approximately 50 feet by 100 feet. Major walkways would be wood planking. Water, sewage, incineration, heating, and power generation would be similar to those of the 75-man camp, but on a smaller scale. Fuel for the camp would be stored in either double wall

tanks, or in drums within a lined wooden revetment. This entire camp structure would be temporary in nature, and could be relocated to either the proposed or alternate 75-man camp location.

1.3.1.4 Airstrip. An airstrip up to 5,000 feet long will be constructed adjacent to either the proposed or alternate field camp. The airstrip may serve Electra and Hercules C-130 aircraft depending on length. The gravel embankment may vary in width from 60 to 150 feet. Depth of embankment may vary from 2 to 5 feet. All obstruction within 150 feet of centerline will be removed. A short access trail will connect the camp and the strip. The total disturbed area will not exceed 40 acres. Up to 250,000 cubic yards of material will be required.

1.3.1.5 Intrasite Trails. A low grade trail will be constructed from the field camp area to Borrow Area D and to the right abutment to provide a buffer to the ground surface. This system will consist of a nominal 12-inch gravel overlay approximately 3 miles long and 12 feet wide. Total disturbed area will not exceed 5 acres. Approximately 10,000 cubic yards of gravel will be required. Vehicles will travel from the field camp via the trail system to its terminus, then overland to the main work areas. All types of equipment (to be discussed later) will use this trail system.

1.3.1.6 Borrow Source. Construction of the proposed camp, airstrip, and trails will require up to 265,000 cubic yards of gravel. The proposed borrow area for gravel fill for these facilities is located in the east half of Section 16, T32N, R5E, Seward Meridian (Borrow Area F).

The haul trail to the camp site and airstrip will be approximately 1.5 miles long. The area involved is a bluff based on a terrace adjacent to Tsusena Creek. An archeological clearance of this borrow area and this haul trail alinement was obtained in September 1978.

The borrow plan will involve removing material from the face of the bluff, using a bulldozer and front loader, thereby moving the face of the bluff eastward.

There is little timber and only a light covering of brush in the borrow area and little overburden which will not be suitable for use as borrow material.

The removal of the material will not significantly change the shape or appearance of the terrain. The very small quantities of brush and timber removed can be disposed of in one of several draws intersecting the face of the bluff. All manmade debris will be removed at the completion of excavation. The resulting work face will be graded to match existing contours.

The equipment required may include a large bulldozer, a front loader, scrapers, a small bulldozer and four or five dump trucks. All equipment will be transported to the site over a winter trail from the Denali Highway.

1.3.1.7 Alternate Borrow Source. An alternate borrow area is located in the northeast quadrant of the confluence of Tsusena Creek and the Susitna River, approximately 3.5 miles southwest of the proposed camp.

This area is in the southwest quarter of Section 30 and the northwest quarter of Section 31, T32N, R5E, Seward Meridian and the northeast quarter of Section 36, T32N, R4E, Seward Meridian.

The area is at the foot of a ridge which separates the Susitna River and Tsusena Creek. Gravel will be taken from the alluvium at the confluence and from the lower portions of the ridge. Both areas have been explored and are known to contain acceptable material. An archeological clearance will be obtained prior to any clearing or excavation.

The borrow plan will involve removing material from an area at the base of the ridge and progressing into the base of the ridge using bulldozers, front loaders, and trucks.

Clearing of timber and brush will be required as a first step in the borrow operation. The heaviest timber, on a fringe of the described area on the banks of both streams, will not be removed and will screen the borrow area from the Susitna River.

Timber, brush, and overburden which are removed will be placed in several of the numerous depressions in the area and graded to drain. Topsoil will be stockpiled in one of the several open areas in the alluvial flat adjacent to the borrow area. This topsoil, composed mostly of silty sand, will be replaced on the resulting backslopes and the floor of the borrow area as a step in the restoration of the area. All resulting backslopes will be graded to 1 vertical on 2 horizontal and terraced with 5-foot terraces every 30 feet to minimize erosion.

All excavated areas will be seeded. All manmade debris will be removed at the completion of excavation and restoration.

The equipment required may include a large bulldozer, a front loader, scrapers, a small bulldozer, and four or five dump trucks. All the equipment will be transported to the site over a winter trail from the Denali Highway.

Advantages of the proposed source over the alternate source are discussed under the "Haul Trail" section. The amount of suitable material available in the proposed area is unknown. This information is required prior to selection of the borrow source.

1.3.1.8 Haul Trail. A 1-mile haul trail will be constructed from the proposed borrow source to the field camp area. This 20-foot-wide trail will be one way with turnouts at selected locations. The depth of embankment will be 1 to 2 feet, requiring approximately 10,000 cubic yards of borrow material. Total disturbed area will not exceed 5 acres. Should the alternate borrow source be selected, a 4-mile haul trail (alternate A, Map 2) will be constructed from the borrow area to the field camp area. Again, this will be a 20-foot-wide trail with turnouts. Total disturbed area will not exceed 50 acres. The alternate A route would proceed along the north canyon wall of the Susitna River, (within Native-selected lands) requiring massive cuts and fills and scarring of the canyon wall. Should the dam be constructed, this will be the contractor's major haul road. It is assumed that sufficient

borrow will be selected from excavation for construction of the haul trail. An alternate haul trail (alternate B) would be a 3-mile route overland through BLM lands to the camp site, and would not be visible from the Susitna River canyon. Approximately 15,000 cubic yards of borrow would be required and, should the dam be constructed, the alternate A alinement would also be constructed. The total disturbed area of alternate B would not exceed 25 acres.

1.3.2 Watana Site Access

1.3.2.1 Winter Trail. Initial access to the Watana site will be by winter trail from the Denali Highway near Butte Lake during the winter of 1979, generally following the same route used during the winter of 1978 (Map 5). The winter trail will also be used in succeeding years. Personnel may be housed in public facilities in Talkeetna or in local lodges until a field camp is complete.

Winter trail usage in the first winter would then be limited to bringing out a bulldozer, two sleds, three Nodwells, and two Nodwell trailers from Watana to the Denali Highway. This equipment would be loaded and taken back from the Denali Highway to Watana along with a bulldozer and two more Nodwells equipped with drills. During the second winter it is anticipated that the winter trail will be used extensively to bring in equipment to construct the airstrip and 75-man camp. Use during the second winter will include movement of scrapers, trucks, front loaders, graders, bulldozers, and camp units. In addition, the

equipment utilized in the first winter will make one trip out and one trip in. The third winter, trail use will include bringing the trucks, loaders, and bulldozers, which were used to construct the airstrip, back to the Denali Highway and will also include one trip out and one trip in with drilling supplies. The camp will be demobilized as the last step in the fourth year.

1.3.2.2 Pioneer Road. An alternative means of access would involve the construction of a 41-mile pioneer trail from the Denali Highway near Canyon Creek, generally following the winter trail. This pioneer trail would serve 4-wheel drive vehicles and larger wheeled or tracked vehicles. The trail would be 16 feet wide with turnouts spaced approximately 1 mile apart, constructed on a nominal 12-inch gravel overlay using conventional earthmoving equipment. Total disturbed area (excluding borrow areas) would not exceed 200 acres. The trail would not be utilized during spring breakup, but would provide access throughout the remainder of the year. Construction would require approximately 16 stream crossings, either by installing culverts or fording; it would require approximately 200,000 cubic yards of borrow material from sources along the trail alinement. If project construction is authorized, the pioneer trail could be upgraded to a permanent access road.

If the pioneer trail alternative were selected, a 2,000-foot airstrip would be required at the Watana site rather than a 5,000-foot airstrip, reducing borrow requirements to 25,000 cubic yards.

Advantages of the winter trail-pioneer trail-short airstrip combination are:

1. Mobilization, demobilization, and helicopter support costs would be decreased. Experience during 1978 shows that supplies and personnel movement by air may be delayed by adverse weather for days, while operating costs and rental costs accumulate. Lack of a trail would necessitate leasing heavy equipment at higher costs from prebreakup until after freezeup, although the actual time in use might be only a few weeks.

2. Year-round access would result in more efficient operations and more precise data since specialized equipment or drills could easily be mobilized when required. The large volume of test samples could also be transported from the site in a timely manner at lower cost.

3. Helicopter operations for 3 years under adverse weather conditions could result in accidents and fatalities. A trail would insure capability to evacuate injured personnel under all weather conditions, a high priority for heavy equipment workers.

Construction of a pioneer trail is not now proposed because of wilderness considerations. If land status changes, construction of a pioneer trail will be considered.

Another alternative method of personnel and light freight access would be by float plane, landing on the small lake in the eastern half of Section 21, T32N, R5E. Access to the drill sites or camp from the lake would be by low ground pressure vehicles, foot, or helicopter.

1.3.2.3 Erosion Control and Maintenance. Erosion control measures will depend greatly on the types of subgrade materials encountered. Generally, cuts in ice-rich soils will be vertical, and vegetative mats will remain undisturbed to the maximum extent possible. Areas susceptible to slides, excessive settlement and severe erosion will be avoided wherever possible. Road grades will generally be limited to 6 percent except for short stretches of canyon haul trail which may be as steep as 10 percent. Streams will be crossed at right angles if possible. Drain swales, where constructed through streams, will be of coarse material and will not impact fish movement. Slopes of ditches and culverts will be designed to avoid excessive velocities. Cross drains and diversion ditches will be provided where required. Roads will be crowned to facilitate drainage.

Road and airfield maintenance will include inspections, cleaning of drainage ways, grading, and reconstruction of subgrade failures. Vehicular loads and movement during breakup will be restricted.

1.3.3 Support Facilities - Devil Canyon

1.3.3.1 Field Camp. The field camp will use modules similar to those at Watana. The camp will house up to 25 people for each of the 4 years. The camp will be located on 1 acre near the existing airstrip (Map 3) on exposed sand and gravel. The camp and existing airstrip will be cleared of the minimal vegetation now present.

A water well will be constructed.

Approximately 1,000 gallons per day of sewage will be treated, using a septic tank and leaching pit at least 200 feet from the well.

All solid wastes will be transported to Talkeetna or to the Watana camp for disposal, except that burnables will be burned on site.

Fuel storage will be in barrels or bladders and will not exceed 10,000 gallons. Storage will be inside a bermed area 50 feet on a side. Approximately 50 cubic yards of material required for berms will be obtained through regrading of the area.

1.3.3.2 Alternate Field Camp. An alternate would be installation of a combination office, work shop, and emergency shelter consisting of a small house trailer and plywood structures. Personnel would travel daily by helicopter from the Watana camp or private lodging. Only portable or chemical-type toilets would be provided, with contents disposed of as approved by the State of Alaska.

1.3.3.3 Roads and Trails. Initial mobilization will be by tracked vehicle across the existing 4-wheel drive road from Gold Creek beginning in the first summer. Personnel will be transported to the site by helicopter. Camp supplies and replacement drill equipment will be transported by either helicopter or over the road. The road would be used 'as is' except for removal of regrowth brush. Multiple tracked vehicle trips will be made to support the camp and to remove aggregate samples.

Road maintenance requirements are considered negligible, limited to repair of damages attributed to this operation. There will be no new

roads or trails constructed on site at Devil Canyon. However, existing trails may be cleared for usage.

1.3.4 Survey

River channel cross sections will be obtained using conventional survey and electronic sounding equipment during the winter months or during late summer and early fall when discharges are low.

This first year activity will obtain river cross sections at the following preliminary sites: Olson; Devil Canyon; High Devil Canyon (Susitna I); Vee (Susitna III); and Watana. An estimated 70 river cross sections will be surveyed from the Olson damsite downstream to highway bridge #3 below Talkeetna. Potential reservoir sites will be surveyed at Olson, Devil Canyon, High Devil Canyon, Watana, and Vee.

Summer/fall data will be obtained by using small boats, and winter data will be obtained by working on the ice. Access to cross section sites will be by helicopter. This activity will be conducted by two crews of four men each during the summer, fall, and winter. Surface disturbance will be limited to the clearing of brush for helicopter access and survey line clearing of brush from a line of sight approximately 2 feet wide.

Controlled aerial photo mapping will be accomplished along possible access routes, transmission line corridors, and at the proposed Devil Canyon and Watana damsites. Helicopters will be utilized for ground access.

1.3.5 Hydrology

Hydrology activities involve the collection of field data for the river basin and potential transmission corridors.

Three climatological stations will be established in upper Susitna River basin (Map 4). Specific locations will be determined by field reconnaissance; however, the sites will be located adjacent to lakes, where possible, to enhance access by fixed-wing aircraft for winter snow surveys and summer site inspection and maintenance. The stations will be equipped with telemetry equipment, a transmitter, batteries, antenna tower, solar panel, tipping bucket precipitation station, temperature sensors, and a snow pillow. The 20-foot antenna tower will be anchored to a 4-foot square prefabricated wooden base and will be vertically supported by three guy lines. Batteries and telemetry equipment will be housed in a wooden box approximately 4 feet wide by 6 feet long by 2 feet deep. The precipitation gage and protective windshield will be mounted on a 6-foot stand supported by a prefabricated wooden platform. The snow pillow will be supported by a prefabricated wooden frame. A snow survey course in the vicinity of the site will be marked by colored stakes.

Installation of climatological stations began in late summer and early fall of 1978 and will be completed in 1980. Each site can be installed by two persons in 3 days, remaining at the site for the duration of the installation period and living in small tent camps. Site preparation will be limited to leveling areas suitable for each

piece of equipment, using hand tools. Prefabrication will be maximized to keep disturbance at the site to a minimum. All refuse will be removed from the site by helicopter when fabrication and installation are complete. In addition to the installation of the three proposed sites, seven existing sites will be upgraded by installing precipitation equipment, telemetry equipment, and a snow pillow, similar to the new stations.

Data collection at climatological sites is planned for the duration of the proposed action.

Sixteen anemometers will be installed to evaluate wind velocities at anticipated critical areas along the proposed transmission corridor (Map 4). Anemometer Sites 1 through 7 will be located along the Alaska Railroad right-of-way, if possible. Where appropriate, they will be placed on existing buildings or structures, accessible from the Parks Highway or the Alaska Railroad right-of-way. Anemometer Sites 8 through 16 will be located at remote sites in areas of maximum exposure to high velocity winds, established at maximum elevations along individual legs of corridors, in uninhabited areas. Access to the sites for installation and maintenance will be by helicopter.

Each anemometer site will be equipped with a 20- or 30-foot metal tower with an anemometer, antenna, and solar panel attached. The tower will be anchored to a 4-foot square prefabricated wooden base and will be vertically supported by three guy lines. Batteries and telemetry

equipment will be housed in a wooden box approximately 4 feet wide by 6 feet long by 2 feet deep. Several of the sites will also be equipped with a small recording precipitation gage and protective windshield mounted on a 6-foot stand. Site preparation and installation will be similar to that for the climatological stations. Data collection at the majority of anemometer stations will continue for the duration of the study period.

Stream gaging sites will be established or upgraded (Map 4) to obtain streamflow data. The new stream gaging sites will be established at locations with stable river cross sections. The sites will have a cableway for sampling suspended and bedload sediments, and collecting flow data. The cableway will be anchored in bedrock or suspended from an 'A' frame adjacent to the stream. Anchors will be drilled in rock where possible, otherwise deadmen will be buried. Where stream velocities permit, a boat requiring a small prefabricated storage shed will be used in place of the cableway. A manometer-activated recorder will be used to measure the river stage. Manometer cables will be buried to prevent damage by ice or by animals. Each manometer will be equipped with a 20- or 30-foot metal tower with an antenna, solar panel, radio transmitter, and associated telemetry equipment similar to the climatological stations.

Site preparation and installation will be limited to leveling small areas by using hand tools.

Operation of the stream gaging stations will require a two-man crew about once a month. Data collection will continue for the duration of the study period.

1.3.6 Environmental (Water Quality)

Physical, chemical, and biological water quality data will be collected at the following four gaging stations: (1) the confluence of the Susitna and Tyone Rivers; (2) below the Watana damsite (within 1/2 mile); (3) below the Devil Canyon damsite (within 1/2 mile); and (4) the confluence of the Susitna River and Gold Creek. The data collection will occur on a monthly basis. In some instances, sampling may occur on a more frequent basis. All sampling will be conducted with hand held equipment. Data collection will coincide with stream gaging and biological activities using a two-man crew with access by helicopter.

1.3.7 Recreation

Visual inspections will be conducted by two individuals to develop measures for enhancing environmental quality and esthetics during the second summer. Helicopter overflights will be conducted, with some landings.

1.3.8 Foundations and Materials

An extensive program of field reconnaissance, seismic monitoring, drilling, and materials testing is planned for Watana, Devil Canyon, and other possible sites. In addition, foundations and materials activities will be conducted along the proposed access road and transmission corridors.

Equipment required for the foundations and materials activities includes: four to six helicopters; four bulldozers; one rough terrain crane; one screening plant; two to five 4-wheel drive trucks; three large rotary drills; six core drills; two auger drills; two tracked personnel carriers; four support Nodwells with air compressors; one grizzly; two wagon drills; four separate air compressors; four large pumps; and four underground loaders.

1.3.8.1 Seismic Monitoring. A seismic monitoring system of eight stations will be installed and monitored within the upper Susitna River basin. The exact locations are as yet undetermined; however, they will be within a 50- to 60-mile radius of the proposed damsites. Each station will consist of a geophone covered by a 3-foot square box, a battery or solar cell, a transmitter, and a 20- or 30-foot-high antenna supported by three guy lines. Site preparation will entail minimal amounts of leveling. Each geophone will be buried approximately 6 inches deep. Installation of all sites will require approximately 4 weeks during the first summer.

Station maintenance will occur once every 3 months with access by helicopter. All stations will be removed at the end of the study period, if the project is not approved.

1.3.8.2 Access Road Studies. Permanent access road studies will include: geological and soils studies and detailed foundations and materials exploration and testing. Corridors for studies, within which

the access roads will lie include: Parks Highway to Devil Canyon to Watana, (Map 6) and the Denali Highway to Watana (Map 5). The corridors are 2 miles wide and 64 and 40 miles in length respectively.

A field reconnaissance of the alternate access routes within the study corridors, to be performed concurrently with geologic and soils mapping, will involve a team of geologists, soils engineers, and design personnel. Occasional hand samples and photographs will be taken. Access will be by helicopter during the late spring and early summer.

Foundations and materials exploration and testing along the road corridors will involve drilling to verify foundation conditions and materials quality and quantity. Approximately 400 holes will be drilled along the corridor between the Denali Highway and Watana damsite, and 700 holes along the route from the Parks Highway to Devil Canyon and Watana damsites. Three augers, mounted on Nodwells or similar vehicles, will be used to drill holes to a depth of 10 to 20 feet. In areas of heavy vegetation, a brushed centerline would be needed. Heavily forested areas would be avoided as drill sites, if possible, and if not possible, drill sites would be selected so Nodwells could move to the site with little or no clearing. Terrain which is surrounded by streams, lakes or which is too steep for overland movement would require helicopter transport of the auger. Generally drill sites would be selected which require little or no clearing to facilitate use of helicopters.

Occasionally a frost tube or piezometer will be set in a hole; it will consist of a 3/4-inch galvanized pipe capped on both ends extending 48 inches above ground. All augered holes will be backfilled.

Borrow source investigations will include reconnaissance of likely areas and a limited number of auger holes, not to exceed a total of 100 on each route, to determine possible quantities of borrow available. The borrow source investigations will be confined to the corridors outlined. The route investigations from the Parks Highway to Watana dam by way of Devil Canyon dam will require approximately 120 days for the centerline and 45 days for the borrow sources. The Denali Highway to Watana investigations will require 90 days and 45 days respectively. Daily access will be by helicopter. Some clearing of helicopter pads may be required. All manmade debris will be removed by helicopter. The drilling work is not likely to begin until the second or third year, although some reconnaissance activity will be undertaken during the first summer to aid in preliminary route selection.

1.3.8.3 Transmission Corridor Studies. Field activity for transmission corridor studies will be much the same as for the access road studies, except that only limited drilling will be done. A thorough reconnaissance of the corridors will be made by geologists and soils engineers operating from a small helicopter. Drilling will be accomplished using a small helicopter-transportable auger at approximately 50 sites along the transmission line corridors to check typical foundation conditions. Drilling will generally be done in areas which require no clearing. Holes will be less than 20 feet deep and will be backfilled. All trash and debris will be removed from the site. Investigations will begin in

the first year and continue intermittently through the fourth year, and will be confined to the summer months.

1.3.8.4 Watana Site Geology. The Watana site geology study will investigate geologic features in detail. This study will be conducted during the first 2 years from March through September. Approximately 1,000 survey points will be marked with stakes and flagging. Rock and soil samples will be collected using hand tools. Access will be by helicopter.

1.3.8.5 Watana Borrow Site Exploration and Testing. Borrow site exploration and testing will be conducted at Watana (Map 2) to verify material sources and to determine material quality. In Quarry Site B, work will consist of core drilling four holes to a depth of about 150 feet with a skid mounted core drill. In Quarry Site A, approximately 20 holes will be core drilled up to a depth of about 350 feet. To determine techniques required to produce rock of the sizes required for dam construction, an opening shot and at least two test shots will be detonated in the third or fourth summer of the study. The opening shot will consist of the detonation of approximately 1,000 pounds of low explosive to open a hole about 200 feet long and less than 20 feet deep. Two separate test shots, each of approximately 3,000 pounds of low explosive will then be detonated, resulting in an actual hole approximately 200 feet long, 40 feet into the cliff face and 30 feet deep. The disturbed area will be about 300 feet long. The test shots will be made along the north flank of the area outlined as Quarry Source A. The face

which will result from the test shot will likely be developed from, and represent an extension of one of several natural faces which are visible from the north. The face will be parallel to the contours or perpendicular to the slope.

A glacial till source will be evaluated in Borrow Area D for core and semipervious materials. Approximately 20 drill holes, averaging about 200 feet in depth, will be drilled to define the horizontal and vertical extent of materials. This will be supplemented by about 80 auger holes, averaging 40 feet in depth, and 20 test pits 30 feet deep, to obtain adequate amounts of representative materials for testing and analysis.

Two sources of sands and gravel for embankment material and concrete aggregate have been identified. Borrow Area E will require approximately 20 test pits, averaging 30 feet deep, to define the limits of the borrow area and to obtain samples for analysis. A small screening plant will be set up for test processing of aggregate and filter materials. The screening plant will be used to process materials from test pits in both Borrow Areas E and D. It is anticipated that four small stockpiles of materials will be produced in each area. These stockpiles will then be sampled and the remainder of all material will be returned to the test pits and all areas will be graded, raked, and seeded. The placement of the screening plant will be such that clearing of trees is not required, and stockpiles will be placed on ground which is covered with

plastic or cloth tarps so that all material w
natural ground surface. It is not anticipatec
and stockpiles will remain in place longer tha
screening plant will be confined to the 4th ye a
elimination if the results of work up to that t
use.

Test pits and drilling may be required in B ro
materials are not located in areas nearer the pr

Equipment required for borrow site activitie
on skids; two wagon drills on tracked vehicles; e
on a tracked vehicle; one dragline or rough terr
on a tracked vehicle; and one bulldozer.

Test pits will be dug using a bulldozer to clear brush and overburden and a backhoe or dragline for excavation. Test pits will generally be located to avoid clearing of trees for either excavation or access. Brush will be cleared from an area not to exceed 100 by 50 feet for each test pit. All debris and material removed from the pit, with the exception of several hundred pounds of samples, will be stockpiled adjacent to the test pit. The test pit will be 20 to 50 feet deep, depending on equipment used. Samples will be taken at varying depths and generally will not exceed 500 pounds per test pit. On completion of excavation, the test pit will be backfilled with the stockpiled material and the surface will be graded, raked, and seeded to blend with the existing ground surface. All manmade trash and debris will be removed.

1.3.8.6 Watana Damsite Drilling. Drilling at the damsite area will be done with light core drills. Holes will be located based on geologic and project features and will average 200 feet in depth. It is anticipated that approximately 50 drill holes will result from this effort. Appurtenant structures will require from 50 to 100 additional core holes with an average depth of 200 feet. At the higher elevations exploration holes will be drilled to determine materials present and to obtain samples for testing. A backhoe will excavate test pits and a dozer will excavate trenches to expose inplace materials for examination and to obtain test samples. Approximately 20 trenches will be opened on each abutment in areas having no trees. Each trench will be backfilled and graded. The trenches will be approximately 10 feet wide, 50 feet long, and 10 to 15 feet deep, and will be alined perpendicular to the slope. A pneumatic drill will be used to drill vertical shafts at selected sites to study inplace permeabilities and soil temperatures. Equipment required for this activity includes: four skid-mounted core drills; two track-mounted rotary air drills; one track-mounted auger drill; one track-mounted backhoe; and three bulldozers.

A typical core drilling operation will use a light diamond drillrig weighing less than 4,500 pounds. Drill sites are generally located to avoid unsuitable terrain, heavy standing timber, stream channels or other features which would increase site preparation or cause excessive environmental damage. The drills will be moved to upland sites on tracked vehicles or by skidding, using a winch on the drill, and will be

moved to steeper river abutments by helicopter. Clearing of some timber will be necessary to allow helicopter placement but it will seldom be necessary to cut more than three or four trees. If the surface is not level, timber shoring will be used to construct a drilling platform approximately 10 feet square. Timber cut during clearing operations will usually be incorporated into the platform. During the drilling operations, cuttings will be allowed to settle into low spots in the adjacent ground surface, generally covering only 4 or 5 square yards. Existing vegetation is usually not entirely covered or killed and the cuttings are no longer visible in a few months. All core samples will be removed from the sites. The core holes, 3 inches in diameter, will be grouted shut when drilling is completed. Upon completion of drilling, the drill will be removed, the pad dismantled, all manmade debris removed, and the area raked and seeded.

1.3.8.7 Watana Geophysical Investigation. Geophysical investigations will be conducted at Watana and Devil Canyon each summer to study presence, depth, and configuration of certain underground formations. Ground level explosive charges, averaging 5 to 10 pounds (maximum 50 pounds), will generate vibrations that strike formations of differing densities and reflect back to ground level sensors (a refraction seismic survey). Holes uncovered by the explosions will be small, averaging about 5 feet in diameter and 3 feet deep. About 200,000 feet of seismic line is planned. Approximately 70,000 feet of seismic line has already been completed in the project area under previous authority. These

lines are not visible and cannot be located except by the people who were actually involved in the work. Very little clearing of brush or trees is required and the brush is not cut to the ground but only pruned to provide a line of sight. Generally wooded areas are avoided as are areas heavily overgrown with brush. Access will be by helicopter.

1.3.8.8 Watana Features Design. Field activity for spillway, powerhouse, and outlet work design will consist of reconnaissance by one- to six- person teams of geologists and engineers. No equipment will be required, and access will be by helicopter. Reconnaissance trips will be required throughout during the 4 years of the study.

1.3.8.9 Devil Canyon Geology. The Devil Canyon site geology study will concentrate on the right abutment, left abutment, and the river channel. Inspections by geologists will be conducted during the summer months, and samples will be taken.

1.3.8.10 Devil Canyon Damsite Drilling. Drilling of the Devil Canyon site will occur in the right abutment, left abutment, and the river channel beginning in the first summer. Two core drill rigs, moved by helicopter, will be used. Where possible, existing clearings will be used. In the fourth year an adit consisting of a vertical shaft and horizontal tunnel may be sunk in the left abutment to extend beneath the river channel. The vertical shaft will be 7 feet square and 100 feet deep and the horizontal adit will be 7 feet square and 150 feet long. Rock rubble generated will be left close to the mouth of the shaft. The

shaft will be closed using a reinforced concrete lid doweled into the rock. Equipment to be used includes four jackleg drills, four rubber tired loaders, and two underground core drills.

The in situ rock conditions will be evaluated by lowering test instruments into drilled holes. Activity at Devil Canyon will take place during all 4 years.

1.3.8.11 Devil Canyon Aggregate Studies. The Cheechako Creek aggregate source will be explored to determine the quality of material available, with removal of approximately 50 cubic yards of material. Aggregate samples will be taken the first summer, generally from test pits excavated during an earlier study. The samples, to be removed from the site over the 4-wheel drive trail, will be loaded on rail cars at Gold Creek. Limited sampling may be undertaken in succeeding summers depending on results of laboratory testing.

1.3.9 Design

The field work associated with this activity will be ground and aerial visual inspections. Any activity which would have a direct impact within the project area is discussed elsewhere.

1.3.10 Real Estate

Real estate field investigations will be conducted so that personnel can be familiarized with physical characteristics affecting land value in the project area. Inspections of the proposed transmission corridors will be accomplished by overflight in a fixed-wing aircraft during the summer months of the first 2 years. No onground access will be required.

1.3.11 Cultural Resources Studies

An archeological and historic resource reconnaissance will be conducted of areas of potential project impacts. Specific sites will be cleared so that feasibility analysis activities can be undertaken. These site-specific clearances will be conducted for all activities which will disturb the surface in any way. This reconnaissance will be conducted during the summer months of the first 3 years of the analysis. In general, small test pits will be dug and recontoured; however, in some cases larger excavations may be required. It is anticipated that four archeological crews of two persons each will be utilized. Access will be by helicopter with foot movement on the ground. Personnel may be housed in small two-person tent camps or in other facilities as provided. If any sites are discovered, BLM will be notified so that BLM and the Corps of Engineers can jointly make a determination of appropriate action. If cultural resources which might be eligible for the National Register of Historic Places are identified, procedures required by Section 106 of the National Historic Preservation Act, as outlined by Corps of Engineers regulations and CFR 800, will be followed.

1.3.12 Biological Resources Studies

The biological activities will determine the abundance, distribution, and habitat requirements of fish and wildlife species throughout the project area.

Fisheries-related field activities will be conducted from the confluence of the Tyone and Susitna rivers downstream to the estuarine

area. Studies will be confined primarily to the mainstem river and its clearwater tributaries and lakes.

The total number of persons required for field activities will vary from 4 to 30. Activities are expected to be the most extensive from May through October, although monitoring will be conducted on a year-round basis. Individual field camps will range in size from two to six persons, depending on the activity.

Access to remote field camps will be by helicopters and fixed-wing aircraft. Trains and snow machines will be utilized in the lower reaches of the river.

All field facilities for fisheries studies will be temporary. Seasonal tent camps will be established for area-specific studies. These will most likely be at Lake Louise, Gold Creek, and Susitna station. The remainder of the field crews will be mobile throughout the sampling season and will be responsible for various areas within the drainage. Mobile crews will consist of two to four persons. Approximately seven crews are expected to operate within the study area.

Water for field camps will be obtained from clearwater streams. All solid wastes will be transported to Talkeetna or Anchorage, depending on locations of camps. Pits will be dug for sewage since most camps will be mobile and personnel will only be on site for 1 to 2 days.

Types of sampling equipment deployed may include weirs for counting adult and juvenile fish, fish wheels, and sonar counters and associated hardware. Weirs will be installed within the lower reaches of selected

clearwater tributaries. Exact locations will be dependent on the stream characteristics of each creek. All structures will be temporary and will consist of conduit inserted in 4 by 4 inch drill wooden stringers. Weirs will be supported upright by log tripod structures. Determining total escapement will require blocking the entire creek. Weirs will be monitored 24 hours a day and fish will be allowed to pass through the structures as they enter the creek.

The most recently developed sonar counters utilized in the Cook Inlet area consist of a 60-foot-long cylindrical aluminum substrate which is deployed along the river bottom perpendicular to the riverbank and cabled to the shore. A single transducer is mounted on the inshore end, and associated electronics are housed in a temporary 4- by 8-foot shack located on the riverbank. A variation of this design may be required for the Susitna River. Counters would not prevent boat navigation in the vicinity, although it would be desirable to channel boat traffic around the substrates. Locations of each substrate would be well marked with buoys and signs.

Fish wheels may be utilized for tag and recovery programs to determine salmon abundance. Suitable sites will be selected prior to the initial field season. A tag and recovery program would most likely include a lower tagging camp with four to five fish wheels and one or two recovery camps in the upper drainage. Fish wheels would be disassembled at the end of each season and stored on site until the program is discontinued.

Fisheries and related water quantity and quality monitoring equipment will be portable and will be transported to sampling sites by field crews working in each area.

Big game studies will be conducted almost exclusively from aircraft. Aerial surveys and radio tracking flights will be flown over the impoundment areas, drainages flowing into the impoundments and along the mainstem below the impoundments on an almost daily basis throughout the study period. These flights will involve one to four single engine fixed-wing aircraft and two to eight persons at any given time. Approximately 200 big game animals (moose, caribou, bears, wolves, and wolverines) will be captured and radio collared with the aid of a helicopter. The majority of these animals will be captured during the first two summers of the study period; however, smaller numbers will be captured after that period as required.

Aircraft operation will be staged from existing airstrips. Landings in the study area will be limited to the capture sites of animals, wolf and bear den sites, and occasional other places where detailed inspection is necessary such as location of dead study animals. Time on the ground will be limited to a few minutes or few hours at any one site. Tagging operations will involve one helicopter, one to four fixed-wing aircraft, and four to ten persons.

Occasionally it may be necessary to refuel aircraft in the study area. Whenever possible this will be done at existing airstrips or near

camps established for other activities. No camps or other temporary or permanent on-the-ground facilities will be established for biological activities related to large mammals, although facilities established for other activities might be occasionally used.

Moose habitat and small animal studies will involve ground work within the impoundment areas and along the mainstem Susitna below the impoundments. Timing, specific locations, and amount of ground work will depend on final biological study design; however, it is anticipated that it will be limited to small temporary camps with two to six persons. Access will probably be by helicopter, fixed-wing aircraft, and boat where possible. Disturbance to the area will be limited to that which normally occurs during browse studies and small animal trapping. Longterm effects will be minimal.

2. Existing Environmental Setting

2. EXISTING ENVIRONMENTAL SETTING

2.1 PHYSICAL CHARACTERISTICS

2.1.1 General

Three glaciers flow down the southern flanks of the Alaska Range near 13,832-foot Mount Hayes to form the three forks of the upper Susitna River. These forks join to flow southward for about 50 miles through a network of channels over a wide gravel floodplain composed of the coarse debris discharged by the retreating glaciers. The cold, swift, silt-laden river then curves toward the west where it winds through a single deep channel, some 130 miles through uninhabited country, until it reaches the Alaska Railroad at the small settlement of Gold Creek.

After the Susitna leaves the confinement of Devil Canyon, the river's gradient flattens. The river then turns south past Gold Creek, where it flows for about 120 miles through a broad silt and gravel filled valley into Cook Inlet near Anchorage, almost 300 miles from its source.

The upper Susitna River is a scenic, free-flowing river with very few signs of man's presence. The extreme upper and lower reaches of the Susitna occupy broad, glacially scoured valleys. However, the middle section of the river, between the Denali Highway and Gold Creek, occupies a stream cut valley with extremely violent rapids in Devil Canyon. The principal tributaries of the Susitna in the upper basin are the silt-laden Maclaren, the less turbid Oshetna, and the clear-flowing Tyone. Numerous other smaller tributaries generally run clear.

High summer discharges are caused by snowmelt, rainfall, and glacial melt. The main streams carry a load of glacial silt during the high runoff periods. During the winter when low temperatures retard water flows, streams run relatively silt free.

Much of the upper Susitna River basin is underlain by discontinuous permafrost. The area above and below the Maclaren River junction with the Susitna is generally underlain by thin to moderately thick permafrost. Maximum depth to the base of permafrost in this area is about 600 feet. Generally around the larger water bodies, such as lakes, and in some areas of the lower section of the upper Susitna basin, permafrost is not present.

Most of the Susitna basin above Devil Canyon is considered to be potentially favorable for deposits of copper or molybdenum and for contact or vein deposits of gold and silver, although much of the drainage basin has never been geologically mapped. The Alaska State Department of Natural Resources states that there are "active" and "nonactive" mining claims in the upper Susitna River drainage area between Devil Canyon and the Oshetna River.

The climate of the basin is characterized by severe winter temperatures and warm summers. Temperature extremes are estimated at minus 54^{o} and plus 89^{o} F. Normally, the first freeze occurs early in September, and the last freeze occurs in mid-May. Mean annual precipitation in lower elevations of the basin are estimated to range between 18 and 22 inches, while precipitation in higher elevations, because of orographic

effects, reaches 80 inches per year. Mean annual snowfall ranges from 60 inches in the lowlands to as much as 400 inches in the high mountains. Freezeup in the highest reaches of the Susitna River starts in early October, and by the end of November the lower regions of the river are icebound. The river breakup begins in early May, and within 2 weeks of breakup, the river tributaries are free of surface ice.

2.1.2 Geology/Topography/Soils

The geologic setting of the Susitna River basin includes unconsolidated sediments of late Wisconsin glaciation which cover most of the area. These late Wisconsin glacial sediments consist of unconsolidated tills, moraines, sand and gravel deposits, and eskers. The soil type most common to the area is a glacial till composed of silty, sandy gravel overlain by 0.5 to 2 feet of organic silts and vegetation. This soil is considered to be easily erodable especially when found on steep slopes and when underlain by permafrost. Discontinuous permafrost is found throughout the area especially on north facing slopes. Bedrock outcrops consist chiefly of tightly folded, metamorphosed and faulted volcanic and sedimentary rock. The glacial sediments which exist throughout the basin are fairly flat in areas adjacent to the Susitna River. The river valley is a V-shaped valley formed by fairly recent and continuing erosion of the Susitna River drainage system.

2.1.3 Existing Landscape Character

The proposed action would occur in three discrete physiographic provinces. The Broad Pass Depression (Appendix A-1, A-4) extends along

the Denali Highway toward the headwaters of the Susitna River; at the southern end, the trough opens to the Cook Inlet - Susitna lowland. Rising to the southeast of the Broad Pass Depression is the Fog Lakes Upland (Appendix A-1, A-3). This physiographic province cuts between the Chulitna Mountains and the central Talkeetna Mountains and provides a drainage for a large portion of the upper Susitna River. The Susitna River corridor (Appendix A-1, A-2) cuts through the Fog Lakes Upland, leaving steep timbered canyons incised by raging white water.

That portion of the project area contained within the upper Susitna River basin is a pristine landscape of high visual resource value which is almost devoid of signs of man's presence. Some minor cultural modifications can be observed such as cabins and trails; however, these are scarce. For the most part, this area could best be described as wilderness.

The visual and recreational resource amenities of the upper Susitna have long been realized. Using the Bureau of Land Management Visual Resource Management System, this area has been evaluated as displaying Class A scenic quality (Appendix A-1 to 4) and qualifies for Visual Resource Management Class II.

2.1.4 Wilderness Considerations

The Bureau of Land Management has been mandated by the Federal Land Policy and Management Act of 1976 Section 603 to review all public land roadless areas of 5,000 acres or more to determine their suitability for wilderness designation. Presently, no wilderness inventory has been

undertaken for the Susitna River valley; this fact, however, does not preclude the potential for this area to be designated a Wilderness Study Area. Recent policy direction has been stated in Interim Management Policy and Guidelines for Wilderness Study Areas (Draft), U.S. Department of Interior, Bureau of Land Management; January 12, 1979. That document states the following:

> If the decision (with respect to the proposed activity) has to be made before a special project inventory can be completed, then the affected lands must be considered a potential Wilderness Study Area (WSA) and the proposed action must be evaluated as though the land were in a WSA.

While the above policies provide necessary management direction, it is also important to point out that without completing an intensive inventory, it appears that the area being discussed displays wilderness characteristics based on the criteria described in the Wilderness Inventory Handbook; Policy, Direction, Procedures, and Guidance for Conductive Wilderness Inventory on the Public Lands, September 27, 1978. In that document, the following list of critieria from Section 2(c) of the Wilderness Act of 1964 are cited:

1. Size - Roadless areas with over 5,000 acres of contiguous public lands. State or private lands are not included in making acreage calculations.

2. Naturalness - Generally, the area appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable.

3. Solitude or a Primitive and Unconfined Type of Recreation - Determine if the area has outstanding opportunities for solitude or a primitive and unconfined type of recreation.

2.1.5 Wetlands and Floodplains

Section 404 of the Clean Water Act and Executive Orders 11988 and 11990 require special consideration of wetlands and floodplains in assessing the impacts of proposed activities which may alter or destroy wetlands. Wetlands are present on the proposed project area, but their extent and location are not fully known. At this point in time, a wetlands determination and inventory has not been accomplished.

2.1.6 Other

The portion of the proposed project area within the upper Susitna River basin is virtually unaffected by man. For this reason, water and air quality are high and background noise levels are low. In those portions of the proposed project area nearer man's activities water and air quality may be lower and background noise levels may be higher.

2.2 BIOLOGICAL CHARACTERISTICS

2.2.1 Fish

Both anadromous and resident fish inhabit the proposed project area. Baseline fisheries inventories were conducted by the Alaska Department of Fish and Game (ADF&G) in the upper Susitna River during the 1974-1977 field seasons; however, little information is available for the remainder of the project area.

The Susitna River basin is recognized as important habitat for five species of Pacific salmon (chinook, coho, chum, pink, and sockeye). Although total escapements have not yet been derived, according to ADF&G, a significant percentage of the Cook Inlet salmon run migrates into the Susitna River basin. No fish have been documented to migrate up through Devil Canyon.

Grayling, rainbow trout, Dolly Varden, burbot, lake trout, whitefish, sucker, and sculpins are some of the more common and important resident fish species present within the proposed project area. Past studies have provided some preliminary fisheries data; however, detailed population, distribution, and habitat data is not available.

Lakes in the area are small and shallow and generally devoid of fish, although they do support other aquatic plant and animal species.

2.2.2 Mammals

Mammals and birds found within the proposed project area are representative of wildlife species common to interior Alaska.

One of the most significant wildlife resources of the area is the Nelchina caribou herd. Segments of this herd range throughout much

of the upper Susitna River basin and along the northern transmission corridors. The major calving area for the herd is on the northeast slopes of the Talkeetna Mountains on the upper reaches of the Kosina Creek, Oshetna River, and Little Nelchina River drainages. The northernmost portion of this major calving area is approximately 5 to 10 miles south of the proposed Watana damsite. However, two other calving areas have been identified within the project area (1) between Butte Lake and Deadman Lake and, (2) an area two miles southeast of Stephan Lake. Calving areas constitute a sensitive and critical habitat area, essential to the caribou population. Calving generally takes place between mid-May and mid-June. A seasonal migration route (south to north during July) generally occurs between Tsusena and Watana Creeks. Caribou range throughout the project area in the summer in small bands. Caribou depend upon climax range, especially for winter forage; alteration of the vegetation, especially of sedges and lichens, has a detrimental impact upon their distribution and numbers. A trait of the Nelchina herd is an almost constant change of winter ranges, a phenomenon that has undoubtedly characterized Alaska's caribou populations for centuries. Generally, caribou winter approximately 5 to 10 miles north of the proposed Watana damsite. The Alaska Department of Fish and Game considers the Nelchina herd to be one of the State's most important caribou populations. Hunters from Anchorage and Fairbanks participate in the annual hunting of this species, and nonhunting recreationists view the migrations of caribou as they cross the State's major highways.

In addition, the herd provides sustenance to predators and scavengers such as wolves, grizzly bears, black bears, wolverines, lynx, and various species of birds.

Moose range throughout the proposed project area. Populations have been declining since the early 1960's because of loss of productive browse habitat, increasing predator populations and several severe winters. ADF&G estimates that the Susitna basin resident moose population consists of between 4,000 and 5,000 animals (1977). Winter areas are critical habitat for moose populations. During the winter months, moose will concentrate in these areas where forage is still available. However, forage availability is generally limited and moose are generally in a negative energy balance and under stress. Exact locations of wintering areas are unknown; however, in general these animals depend heavily upon the river bottoms and adjacent areas for winter habitat and calving areas. This is probably because the depth, density, and hardness of snow in coniferous and deciduous tree communities, are more favorable to moose movements. The lower, spruce-covered reaches of the Watana Creek valley, upper Tsusena Creek near Tsusena Butte, and in and around the junction of Fog Creek and the Susitna River, are suspected to be critical habitat for the majority of moose inhabiting this area during a severe winter. The Tsusena and Deadman Creek valleys are also suspected to be important wintering areas.

Grizzly or brown bears are common throughout the proposed project area and are fairly numerous in the upper Susitna basin. Alpine and

subalpine zones are the habitats most frequently used by grizzlies, although the more timbered areas are seasonally important. Grizzlies are adversely affected by contact with man and are sensitive to aircraft noise. Denning areas are critical habitat for grizzly bears; however, none have been identified to date in the project area. Any denning sites that would be present, however, would generally be on the upper alpine zones and away from the areas of primary disturbances.

Black bears are fairly common throughout the forested and semi-forested portions of the proposed project area. River bottoms, lake shores, and marshy lowlands are favored black bear habitat. Black bears are not as adversely affected by contact with man as are grizzlies.

Dall sheep are present in many areas of the Alaska Range, Talkeetna Mountains, and in the higher elevations of the Susitna River basin. The greatest concentrations of Dall sheep in the Susitna basin occur in the southern portions of the Talkeetnas; herds become scattered on the northern portion of the range, where parts of the mountains are uninhabited by sheep. Dall sheep are also found in the Watana Hills. Because of the relatively gentle nature of much of the Talkeetna Mountains and Watana Hills, predation in this area has more effect on sheep numbers than in more rugged habitats. Sheep have always furnished some of the diet of wolves and other carnivores in this area. Hunting pressure for rams is fairly heavy due to relatively good access from highways, by air, and by ATV's (all-terrain vehicles). Sheep populations are almost entirely controlled by natural factors such as habitat,

weather conditions, predation, and disease. Conflicts between man's activities and critical sheep habitat, such as lambing or wintering areas, can adversely impact Dall sheep populations, in that sheep are extremely sensitive to noise.

Mountain goats occur in low numbers in various areas of the Talkeetna Mountains and in the Watana Hills area. Goats generally inhabit rougher terrain than do Dall sheep, and are thus less susceptible to man's activities.

Wolves occur throughout the proposed project area. Populations are subject to rapid fluctuations because of prey abundance fluctuations. In 1976, ADF&G estimates of wolf density in the Nelchina basin were approximately 1 wolf per 70 square miles. Hooved mammals such as moose, caribou, and sheep are the major source of food for wolves, although small mammals are occasionally important. Wolves are closely tied to large mammals. Small changes in the distribution and abundance of large mammals may have long-range impacts on wolf predation patterns, and small changes in predation patterns may have long-range impacts on the distribution and abundance of large mammals. Denning areas are critical habitat for wolf packs and are highly sensitive to human disturbance. Wolves use a complex of denning areas from which they conduct their hunting activities, and switch between these denning areas depending on the availability of prey. Elimination of a denning site from use can have a long-range impact on the wolf pack and prey species.

Almost all species of fur bearers common to Alaska occur in the proposed project area. Beaver, otter, mink, and muskrat are the most prominent species in riparian and aquatic habitats. Wolverine, lynx, coyote, red fox, marten, weasels, squirrels, and marmots are common in upland forest and alpine habitats. Population levels and trends of carnivorous furbearers are closely tied to prey species.

2.2.3 Birds

The east-west stretch of the Susitna River between the Tyone River and Gold Creek is a flyway for waterfowl. The majority of the waterfowl nesting areas in the upper Susitna River basin are on the nearby lakes of the Copper River lowland region, on the Tyone River and surrounding drainage areas, and on the ponds and lakes of the wide flood plain in the Denali area. The upper Susitna River basin has a moderate amount of use by waterfowl when compared with the lower Susitna River basin. The lower basin has a substantially greater amount of waterfowl habitat, and a greater number and variety of waterfowl seasonally use the thousands of lakes and ponds in this area to nest and to raise their young. Large numbers of migrant birds also use the lower Susitna River basin for feeding and resting during spring and fall flights to and from Alaska's interior and north slope.

Raptors which occur within the proposed project area include the bald and golden eagles, osprey, red-tailed, Harlan's, rough-legged and Swainson's hawks, marsh hawk, goshawk, sharp-shinned hawk, gyrfalcon, and the great-horned, great-gray, snowy, hawk, boreal and short-eared

owls. Peregrine falcons have occasionally been sighted within the area an along migration routes through the Broad Pass area of the upper Chulitna River, although no nests have been found. Nests are critical to raptor populations and sensitive to human disturbance. Nests are susceptible to abandonment if the disturbance occurs during the nesting period.

2.2.4 Vegetation

Within the proposed project area are found six of the major vegetation ecosystems of Alaska. The lowland-spruce hardwood forest type is found along the upper Susitna River and along the southern portion of the Nenana River. The bottomland spruce-popular forest type occurs adjacent to the lower Susitna River, and along the northern portion of the Nenana River. The low brush, muskeg-bog type is found in isolated locations in the extreme northern portion of the transmission corridor near Fairbanks and in the southern portion of the transmission corridor near Big Lake. The moist and alpine tundra types are found in the upper Susitna River basin.

The exact location or extent of wetlands within the Watana project area is unknown; however, wetlands present are generally of the sedge fen and dwarf shrub peatland type. An evaluation of wetlands (and permit authority for the discharge of fill material into wetlands) under Section 404(b)(1) of the Federal Water Pollution Control Act as amended will be conducted by the Alaska District, Corps of Engineers.

Threatened or Endangered Species

The only animal species classified as threatened or endangered which may migrate through or reside in the project area are the two subspecies of the peregrine falcon: Falco peregrines anatum (American) and Falco peregrines tundrius (arctic). No inventory for threatened or endangered plants is known to have been done in the project area; consequently, no threatened or endangered plants are listed for this area.

2.3 CULTURAL CHARACTERISTICS

2.3.1 Access

The Alaska Railroad runs from Seward through Anchorage and up the lower Susitna valley. It crosses the Susitna River near Gold Creek, and then runs past Mount McKinley National Park and on to Fairbanks.

Paved roads in this region include the 358-mile Parks Highway between Anchorage and Fairbanks, the 328-mile Glenn Highway connecting Anchorage with Tok Junction, and the 266-mile Richardson Highway that runs from Valdez to Delta Junction, 97 miles southeast of Fairbanks.

The only road access through the upper Susitna basin is the 135-mile gravel Denali Highway between Paxson on the Richardson Highway and Cantwell on the Parks Highway, and the 20-mile gravel road from the Glenn Highway to Lake Louise. The Denali Highway is normally not open for use during the winter months.

Several small, remote landing strips are scattered throughout the basin, and float planes utilize many lakes and streams to ferry freight and passengers to the remote backcountry areas.

ATV's and other types of off road vehicles provide transportation into areas in the upper Susitna basin where there are no developed roads. Several trails exist which are utilized by ATV's, trail bikes, hikers, horseback riders, and winter travelers. Of special note are two trails proposed for possible use in this action. One is the trail built by the Bureau of Reclamation in the 1950's. Constructed to support an exploration program at the Devil Canyon damsite, it extends from the Alaska Railroad at Gold Creek to Devil Canyon. The trail is currently used over its western two-thirds to support mining activity. There also exists a less well developed ATV trail that begins at the Denali Highway near Butte Lake and heads southwest for about 12 miles before it fans out into several barely distinguishable branches. This trail was used in March 1978 to transport equipment to the Watana site. Two cat trains were passed over the trail with some minor impacts, such as vegetation damage. The trail was reseeded and fertilized at the end of the field activities.

Shallow draft river boats, air boats, small boats, canoes, rubber rafts, and kayaks utilize sections of the upper Susitna River, as well as a few tributary streams, mostly above the confluence of the Tyone River.

2.3.2 Public Use

The greatest constraint to public use of the upper Susitna River basin is the shortage of road access. As a result, float planes are used to fly in hunters, fishermen, and other recreationists to various

areas within the basin, but, except for a few larger isolated lakes, this form of access is relatively minor. All-terrain vehicles and snowmobiles also provide off-road access to areas within the upper Susitna basin. Boats are used to some extent to provide access on the Tyone River drainage and to areas of the Susitna River between the Denali Highway and Devil Canyon. Much of the upper Susitna River basin has very little recreational activity at the present time. Great distances, rough or wet terrain, and lack of roads limit use of most of this area to relatively few people.

Though limited, the major recreational use of the upper Susitna area is big-game hunting and associated recreational activities. The greatest hunting pressures are exerted from a few fly-in camps, and from areas along the Denali Highway. Most wolves and bears harvested are taken during caribou or moose hunts. The increased use of ATV's to provide access and to haul big game is a significant factor in improved hunting success, even in the face of declining game populations. The mechanized ATV can penetrate deeply into previously inaccessible country, leaving few areas that provide havens for the reduced numbers of caribou and moose. The hunting of Dall sheep, mountain goats, and waterfowl is minimal in the upper basin even in areas of road access such as the Denali Highway.

Access is again the major factor in determining areas that are utilized in fishing for grayling, rainbow trout, whitefish, and lake trout. The Susitna and Maclaren Rivers are silt laden throughout

their entire courses during the warmer months of the year. Sport fishing is limited to lakes, clear water tributaries, and to areas in the main Susitna near the mouths of these tributaries. Sport fishing pressure in the upper Susitna basin is light. Many lakes and some areas of the river afford landing sites for float equipped aircraft. A few areas along the main Susitna and some tributaries, such as the Tyone River and Lake Louise, have some pressure from boat fishermen. An increasing number of hunters use ATV's to get into and out of the backcountry, exerting incidental fishing pressure in some areas. Salmon have not been documented to migrate into the upper Susitna River above Devil Canyon, so they are not considered a factor in the sport fishery of this area.

A minor amount of recreational boating occurs in the waters of the upper Susitna basin. Some lakes, such as Lake Louise, have a heavier amount of boating activity, and some rivers, such as the Tyone and the Susitna, have a lighter amount of boating activity. Some kayakers utilize portions of the main Susitna River, but very few have braved the difficult waters of the Susitna through Devil Canyon.

Most camping use in this area is incidental to other recreational activities such as hunting, fishing, boating, and highway travel. Most other recreational activities in the upper Susitna River basin exert varying environmental impacts on the area. Many activities such as hiking, backpacking, and photography take place incidentally to other recreational pursuits such as hunting, fishing, boating, camping, and driving for pleasure.

At the present time, recreation is one of the major uses of the upper Susitna River drainage area, but the overall utilization of this area by humans remains comparatively light.

Public use of the remainder of the project area (those portions of the proposed transmission corridors outside of the upper Susitna River basin) is somewhat heavier because access is made easier by the presence of roads and the Alaska Railroad.

2.3.3 Historic Resources

The current National Register of Historic Places lists no historic properties that would be affected by the exploration and survey program. A historical-archeological literature review completed for the Corps of Engineers by the Alaska Division of Parks (Heritage Resources Along the Upper Susitna River, August 1975) indicates 11 historic sites within the study portion of the upper Susitna basin. These are all essentially related to the discovery of gold. Most of the early mining activity occurred on Valdez Creek, where the town of Denali was established. Nine of the sites are located in that general area. Two sites, both designated as cabins, are located on Kosina Creek, one near its mouth, and one about 6 miles upstream.

The Alaska Heritage Resource Survey (AHRS) lists several known sites in addition to those identified in the 1975 study. A historic inscription site with 4 names and the date July 2, 1897, was reported at the mouth of Portage Creek in 1976. The exact location of the site has not been determined, nor has the site been fully documented. One of the names is W.A. Dickey, who named Mt. McKinley in 1897.

Other archeological sites (AHRS #TLM-007) were reported on Stephan Lake in 1976. The area was only briefly examined, but evidenced a number of occupation sites. A cabin shown on USGS Maps at the south end of Stephan Lake may also be historical in age. An aboriginal occupation site with housepits has also been reported on Clarence Lake, east of Kosina Creek.

The apparent lack of historical locations between Devil Canyon and the Maclaren River is explained by the following excerpt from the Alaska Division of Parks' report (in discussing the first mapping of the area in 1912): "Except for a few prospects on the Oshetna River, the USGS never received any reports of gold being found on the Susitna between Devil Canyon and the Maclaren River in significant quantities. Though the Tanaina and Ahtna Indians did a great deal of hunting and fishing on the river in this area, the white man found little gold, an almost unnavigable river, and no reason to settle anywhere near the 'Devil's Canyon.'" Tanaina informants have reported a historic village site on Stephan Lake called Titik'niłtunt, meaning "animal trail goes out lake." Their name for Stephan Lake is similarly rendered as Titik'niłtun Bena. In 1898 Lt. Learnard, attached to the Abercrombie-Glenn Army exploration expedition, encountered a Native caribou-hunting camp on what was probably Prairie Creek, near Daneka or Stephan Lakes. About 1 mile away was a winter village. Prospectors were also camped at the mouth of Portage Creek.

A 1978 archeological survey conducted by the Corps of Engineers resulted in the finding of one historic site. A log crib of unknown significance was discovered at the Watana site. Archeologist Glenn Bacon in his report "Archeology in the Upper Susitna River Basin 1978," states, "Recent historic utilization of the area appears to be very limited and probably insignificant."

2.3.4 Archeological Resources

Archeological surveys conducted by archeologist Glenn Bacon for the Corps of Engineers during 1978 in the Watana and Devil Canyon areas resulted in the discovery of several previously unknown archeological sites. These prehistoric sites are generally located on tops of small hills and knolls and are probably associated with hunting activity. The sites discovered have not been fully evaluated for nomination to the National Register.

Although the extent of information obtained at the sites discovered does little to improve the local archeological data base, the sites do indicate that prehistoric use of the area "appears to have been considerable." Prehistoric use also appears to span a long time range in this region, and a C-14 date from one of the sites tested on Stephan Lake yielded a date of 6000 years before present.

The National Register was consulted for sites within the proposed transmission corridors. One site, the Dry Creek archeological site, in the vicinity of Lignite, is near the northern portion of the proposed corridor.

2.3.5 Land Use/Status

Lands within the upper Susitna River basin (Map 7) are essentially in large block ownership with the majority under the control of the Department of the Interior, Bureau of Land Management (BLM). These lands are generally in their natural state and undeveloped with improvements or land access routes. Air transportation is the primary means of access to and within the area. There are some scattered small parcels of land in private ownership as home sites or mining claims. Many of these private parcels have no developed overland access. For the most part, development in the area is concentrated along the established transportation routes such as the Parks Highway and the Alaska Railroad on the west and the Denali Highway on the north.

Because of the absence of roads and other development in the basin, the area has high wilderness value potential. The area includes approximately 5 million acres of lands that show little or no sign of man's presence except for fringe areas along established transporation routes and isolated mining or recreational development. The area is geographically located north of the most highly developed and populated portion of the State. The transportation links between Anchorage and Fairbanks are the Parks Highway and the Alaska Railroad to the west and the Richardson and Glenn Highways to the east and south. The Alaska Range is a natural barrier on the north and the Denali Highway parallels the range connecting the Parks Highway and the Richardson Highway to form an access system on the northerly side of the subject area. These

transportation systems surround the area and make it potentially one of the accessible wilderness areas in the State.

The wilderness characteristics of the area also inhibit use because of the lack of transportation facilities. Given man's dependence on motorized transporation and the severity of the Alaskan climate, the area is simply too large to attempt entry without mechanization of some sort. Since there are relatively few people who have access to air transportation or long-range ATV's, the area's use by man is extremely limited, and then primarily restricted to the fringes. Transportation by water, that might otherwise be provided by the Susitna River, is limited because of the natural barrier created by the extremely rough water through Devil Canyon. Another factor that tends to limit the use of the area as a wilderness is the wilderness characteristic of the State as a whole. Wilderness conditions can be encountered within a few miles of almost any development in the State, including metropolitan Anchorage.

Much of the public land in the basin has been selected by Native corporations under the Alaska Native Claims Settlement Act (ANCSA), P.L. 92-203, 18 December 1971. These selected lands remain under the jurisdiction of BLM pending final conveyance of fee simple title to the various Native corporations. Any use of these lands prior to conveyance of title is subject to specific permission from BLM and the selecting Native corporations.

The gross land area required for containment of the proposed Devil Canyon and Watana reservoirs is approximately 157,440 acres. Of this land, some 67,200 acres are to be conveyed to the Cook Inlet Region, Incorporated (CIRI) for later reconveyance to various village corporations. This transfer of lands is directed by a 1976 amendment to ANCSA, P.L. 94-456 and will include both the surface and subsurface interests. This transfer also includes lands within Power Site Classification No. 443 which was established in 1958 for potential future development of the Susitna River for hydroelectric power production.

In addition to the lands discussed above, as many as 53,760 acres have been selected for conveyance to satisfy any deficiencies that may exist in total acreage entitlements under ANCSA. These "deficiency" selections in the area have a low selection priority and, in all probability, will not be conveyed to CIRI on behalf of the village corporations. These lands have, however, been overselected by CIRI for its own benefit and could conceivably be conveyed to CIRI. All Native and State selected areas are subject to the wilderness provisions (Section 603) of P.L. 94-579, the Federal Land Policy and Management Act.

A portion of these lands south of the Susitna River (24,686 acres) has been made available for selection by the State of Alaska pursuant to the agreement titled "Terms and Conditions for Land Consolidation and Management in the Cook Inlet Area" (Cook Inlet Land Swap Agreement). A recent PLO draft indicates that the land north of the Susitna is also selectable by the State upon final settlement of the Native claims within the area.

Lands remaining after conveyance (of selected lands) to the State would revert to a study classification wherein BLM could apply its normal procedures to study the alternatives available for use of uncommitted public land under Federal management.

Pursuant to P.L.O. 5654, November 17, 1978, lands along the Susitna River upstream from Gold Creek near the Alaska Railroad were withdrawn from all forms of appropriation and entry for protection of potential wild and scenic river values. This withdrawal included all lands within 2 miles of the ordinary high water mark on each bank of the river. This withdrawal was made subject to valid, existing rights and interests in land within the boundaries of the included area. Much of the land along the river is selected by CIRI corporation; therefore, there is a valid, existing right to CIRI.

The above discussion of land relates to the proposed reservoir area and does not account for lands necessary for access roads and transmission line corridors. There are various alternatives available for the location of these facilities and a discussion of land use and status must be of a general nature. Generally, the lands immediately surrounding the proposed reservoir are as discussed above, i.e., to be conveyed to Native corporations. Lands to the west of the proposed project are predominantly State and privately owned and are not subject to Federal land management regulations.

2.3.6 Demography

The southcentral railbelt area of Alaska contains the State's two largest population centers, Anchorage and Fairbanks, and 73 percent of

the State's total population. Population figures for 1976 show that 413,289 people live in Alaska, with 301,250 of these living in the railbelt area. The rapid population growth of the past in Alaska is expected to continue, especially in the railbelt area. With the possible relocation of Alaska's capital from Juneau to Willow, an additional population impact will be exerted on this area of the State. At the present time, only a few small settlements are located along the Parks Highway between Anchorage and Fairbanks and along the Alaska Railroad in the Susitna River valley. Talkeetna, with a population of about 300, is located at the confluence of the Talkeetna and Susitna Rivers, and is an important tourist and recreation center. Except for the small settlement at Denali, there are few permanent full-time residents in the upper Susitna River basin above Devil Canyon.

2.3.7 Economics

The southcentral region of Alaska includes the Kodiak-Shelikof area, the Cook Inlet area, and the Copper River-Gulf of Alaska area. The southcentral railbelt area is that portion of the southcentral and Yukon subregions that is served by the Alaska Railroad. Both Anchorage and Fairbanks are regional economic centers for the southcentral railbelt area. Government, trade, and services comprise the major portion of the area's total employment. Construction and transportation are also important. Making relatively less significant contributions are the financing, mining, and manufacturing industries, while agriculture, forestry, and fisheries contribute less than 1 percent of the employment dollar to the economy of the railbelt area.

3. Probable Environmental Impacts

3. PROBABLE ENVIRONMENTAL IMPACTS

3.1 ACTIVITY IMPACTS

The impacts discussed below are organized by the activities that will be impacting the resource. Under each activity are listed the physical, biological, and cultural resources which could potentially be impacted.

3.1.1 Support Facilities - Watana

3.1.1.1 Field Camp

Physical Resources Impacts. Impacts would be made by gravel pads contained within a 10-acre area causing local erosion and sedimentation of pad debris, interruption of natural surface flow patterns, reduction in soil productivity, impact on permafrost stability of pad and adjacent areas, reduction in scenic quality, and change in natural soil infiltration rate. The pad could fill in wetlands, causing loss of production, and would reduce the wilderness character of the landscape.

Field Camp solid waste incineration could cause air quality degradation, and solid waste burial could cause ground water contamination.

The proposed 5000-gallon treatment plant could potentially cause thermal and chemical surface water contamination, chemical subsurface water contamination, and soil/waterbody nutrient level change.

The fuel storage pit would lower visual resource quality and could potentially cause chemical surface and subsurface soil and water contamination in the event of a spill.

Structures on the pad would have a negative short-term effect on wilderness.

Power generation would adversely affect the wilderness solitude and degrade the air quality during the period of operation.

The camp in general with all its associated activities, would have a significant negative effect on wilderness quality.

Biological Resources Impacts. The gravel pads would destroy all the vegetation beneath them, and would decrease wildlife habitat proportionately. Small mammals and possibly some nesting birds would be displaced.

Operation of the field camp would adversely affect some wildlife and possibly increase hunting pressure on game species and fishing pressure on fish populations.

Sewage discharge in local lakes or ponds could adversely affect resident fish and amphibians if present.

Cultural Resources Impacts. Pad construction could destroy unidentified archeological sites.

Positive economic benefits would result in that money would be infused into the economy of Talkeetna in the form of lodging receipts, local labor wages, and other increased expenditures in the community during camp construction.

3.1.1.2 Alternate Field Camp

This action would have all the impacts of the proposed field camp on physical, biological, and cultural resources, but the degree of impact might vary slightly depending on its precise siting.

3.1.1.3 Interim Field Camp

Since this field camp would be an interim measure, the impacts discussed under "Field Camp" (3.1.1.1.) would still occur, but only

during the second through fourth years.

Physical Resources Impacts. Soil surface disturbance leading to soil temperature disruption and localized erosion and sedimentation could result. Trailers and facilities would have a negative short-term impact on the pristine scenic quality.

Wilderness impact should be minimal in the long-term, but would be dependent on the extent of revegetation required.

Impacts caused by fuel storage, power generation, and sewage disposal would be similar to, but of less extent, than that discussed under the field camp section.

Biological Resources Impacts. Some loss of vegetation would result from shoring, foot traffic and vehicle activity. Operating the field camp would have the same general effects on wildlife as described in the field camp section, but to a lesser extent. This site has better drainage than the proposed field camp location and thus is less likely to impact wetlands or permafrost.

Cultural Resources Impacts. Unidentified archeological resources are less likely to be destroyed under the interim field camp than under the proposed field camp.

A positive economic impact could affect Talkeetna if this camp were serviced from there.

3.1.1.4 Airstrip

Impacts are essentially the same for either the 5000 foot or 2000 foot airstrip; however, the magnitude of impact varies greatly.

Physical Resources Impacts. Impacts would include increased dust (decline of air quality), localized surface water flow alteration, erosion and sedimentation, major topography alteration, and soil surface impact leading to permafrost degradation.

Scenic quality would be reduced.

Wetlands may be filled in depending on extent of wetlands and exact placement of airstrip.

Wilderness would be significantly impacted, and is incompatible with this activity.

Fixed and rotary wing air traffic would cause an increase in noise.

Biological Resources Impacts. Vegetation would be destroyed where covered by gravel; a corresponding loss of wildlife habitat and displacement of wildlife would occur.

Fixed and rotary wing air traffic would disturb wildlife in the area.

The development of this airstrip could increase access into these areas and increase hunting pressure on game species. This could probably have a long term impact on wildlife.

Cultural Resources Impacts. Access to the surrounding area would be enhanced by creation of the landing strip for light aircraft, causing a beneficial impact to recreationists. This same enhanced access could lead to a negative impact on the surrounding physical and biological resources.

Unidentified archeological resources could be lost by construction of the pad.

Land use could increase because of enhanced access by aircraft.

A positive economic impact would occur at Talkeetna or other port of departure for aircraft.

3.1.1.5 Intrasite Trails

Physical Resources Impacts. Impacts would be change in surface runoff pattern, increase in sedimentation and erosion, modification of topography, surface disturbance, and soil temperature change leading to permafrost degradation.

Scenic quality would be impacted adversely.

Wetlands may be filled in, depending on their location and the exact placement of trails.

Wilderness would be adversely impacted by permanent landscape scars not consistent with wilderness characteristics.

A possible positive impact would be lessening of the impact of vehicular traffic over the landscape.

Biological Resources Impacts. Vegetation would be destroyed, resulting in loss of wildlife habitat and a subsequent displacement of wildlife.

Vehicular traffic would harass wildlife in the area.

Cultural Resources Impacts. Unidentified archeological resources could be lost because of pad construction.

3.1.1.6 Borrow Source (Upper Tsusena Creek)

Physical Resources Impacts. Surface flow pattern would change, localized sedimentation and erosion would occur and landslides might

possibly occur. There would be major modifications of topography, soil removal, soil temperature change leading to permafrost degradation, and soil nutrient change.

Borrow site operations would increase particulate air pollution and noise levels.

Scenic quality would be significantly reduced.

Wetlands could possibly be drained in the surrounding area.

Wilderness values would be adversely impacted by surface scarring.

Biological Resources Impacts. Vegetation would be removed, with subsequent loss of wildlife habitat and displacement of wildlife.

Increased erosion could negatively impact the fishery resource in Tsusena Creek.

Cultural Resources Impacts. Unidentified archeological resources could be destroyed.

3.1.1.7 Alternate Borrow Source (Lower Tsusena Creek)

Physical Resources Impacts. Surface impacts would be similar to those discussed under "Borrow Source" (3.1.1.6).

Impacts on visual resources would be greater than at the "Borrow Source" because of visibility from the Susitna River.

Floodplains could possibly be impacted, depending on extent and location of gravel removal.

Impacts on wilderness would be the same as discussed under "Borrow Source."

Biological Resources Impacts. Impacts to vegetation and wildlife would generally be the same as those discussed under "Borrow Source." There may be greater negative impacts to moose in the short term (5 years) at this site because of loss of winter range. This impact may become positive in the long term as vegetation favored for moose browse comes in.

Fish may be impacted to a lesser extent here than at the "Borrow Source" (3.1.1.6) because of the nature of the already silty Susitna.

Cultural Resources Impacts. Impact on archeological sites may be more apt to occur here because of the greater chance of sites occurring here than in the proposed "Borrow Source."

3.1.1.8 Haul Trails

Physical Resources Impacts. Impacts would be similar in nature to those discussed under "Intrasite Trails" (3.1.1.5). Each of the three routes, however, would have its own unique impacts. Alternative A, up the side of the Susitna Canyon, would have the greatest visual impact from the Susitna River and probably the greatest susceptibility to erosion. Alternative B would cause a greater impact at the "Alternative Borrow Source" (3.1.1.7) because of the need for gravel. The trail to the proposed "Borrow Source" (3.1.1.6) would probably have the greatest chance of impacting wetlands.

Essentially, all three trails would have the same impact on wilderness, that of permanent scarring of the landscape. Again, alternative A has probably the greatest potential for detrimental impact.

Biological Resources Impacts. Again the impacts are essentially the same on all three trails and the same as those discussed under "Intrasite Trails" (3.1.1.5).

Cultural Resources Impact. Impacts would be the same as under "Intrasite Trails" (3.1.1.5).

3.1.2 SITE ACCESS - WATANA

3.1.2.1 Winter Trail

Physical Resources Impacts. Impacts may consist of a change in surface runoff pattern, change in soil temperature, change in soil infiltration and acceleration of erosion, especially at stream crossings.

A minor impact on wilderness would probably occur during the first winter of use, based on observations of last winter's effects. In the second and succeeding years, however, that impact would probably increase.

Biological Resources Impacts. Possible loss of vegetation and changes in species composition may result.

Possible stress on wildlife could be induced during mobilization.

Cultural Resources Impacts. A new trail would be identified. The effect of this identification to the general public could be to increase visitor use and open up the backcountry to recreationists.

Use of the winter trail would require roughly 50 miles of the Denali Highway to be opened to vehicular traffic during the winter. This could have a positive economic impact for the local lodge owner between Cantwell and Butte Lake.

3.1.2.2. Pioneer Road

Physical Resources Impacts. Impacts anticipated are erosion and sedimentation, interruption of natural surface flow patterns, change in soil productivity, permafrost degradation, and widespread diffusion of dust.

Landscape quality would be significantly reduced.

Wetlands could possibly be filled, depending on their extent and the placement of the road.

The landscape would receive permanent scarring not consistant with wilderness characteristics.

Biological Resources Impacts. Impacts would be the same as described under "Intrasite Trails" (1.3.1.5) but would be of much greater extent.

The development of this road would increase access into these areas; it would increase hunting pressure on game species and therefore probably have a long term impact on wildlife.

Positive impacts would result from the reduction of air traffic and subsequent reduction of wildlife harassment from aircraft.

Cultural Resources Impacts. Access would be provided to the general public. This would positively impact the recreation potential of the area. Other positive impacts are identified under "Pioneer Road" in the "Proposed Action and Alternatives" section (1.3).

3.1.2.3 Erosion Control and Maintenance

No impacts identified.

3.1.3 SUPPORT FACILITIES - DEVIL CANYON

3.1.3.1. Field Camp

Physical Resources Impacts. Impacts would consist of modification of the topography and soil removal, to a minor extent.

Scenic quality would be moderately changed, as at the Watana Field Camp, but to a lesser extent.

Wilderness would be impacted here the same as at Watana but to a lesser extent. Facilities and structures would have virtually the same impact here as described under the "Watana Interim Field Camp" (3.1.1.3).

Biological Resources Impacts. Impacts would consist of vegetation removal and disturbance, wildlife habitat alteration, and a subsequent displacement of wildlife.

Camp operations would have the same impact as that discussed under the "Watana Interim Camp."

Cultural Resources Impacts. Unidentified archeological sites could be destroyed.

3.1.3.2 Alternate Field Camp

Physical Resources Impacts. Impacts would generally be of the same type as with the "Field Camp" (3.1.3.1.), but to a much lesser extent, with physical surface disturbance being greatly reduced.

Biological Resources Impacts. Impacts would be the same as described in "Field Camp," but again greatly reduced.

The increase of air traffic would also increase disturbance to wildlife.

Cultural Resources Impacts. Positive economic impacts could affect private lodge owners if they were used as the source of lodging.

3.1.3.3. Roads and Trails

Physical Resources Impacts. Sedimentation and erosion can be expected.

Scenic quality would be altered slightly.

Impacts to wilderness are unknown.

Impacts to wetlands are unknown.

Biological Resources Impacts. Some vegetation would be removed, and therefore some degradation of wildlife habitat could occur.

Cultural Resources Impacts. Access to the site would be enhanced, and recreation potential could be increased.

3.1.4 SURVEY

Physical Resources Impacts. Vegetation modification could cause short-term impact on wilderness. Brushed survey lines could reduce scenic quality by forming straight lines.

Biological Resources Impacts. Minor amounts of vegetation removal and temporary localized displacement of wildlife would occur.

Cultural Resources Impacts. No impacts have been identified.

3.1.5 HYDROLOGY

Physical Resource Impacts. Installation and use of stream gaging stations and anemometers would cause a slight impact on soils and visual quality because of disturbance of vegetation.

A minor short-term impact of noise pollution would affect the wilderness character of the area.

Structures would have a minor impact on scenic quality.

Biological Resources Impacts. Construction and maintenance of stations could disturb Dall sheep and caribou dropping and rearing areas, with a consequent impact on wildlife.

Cultural Resources Impacts. No impacts have been identified.

3.1.6 ENVIRONMENTAL WATER QUALITY MONITORING

(See HYDROLOGY, 3.1.5).

3.1.7. RECREATION

Physical Resources Impacts. Helicopter overflights and landings would have a minimal short-term impact on wilderness.

Biological Resources Impacts. Air traffic could temporarily disturb wildlife.

Cultural Resources Impacts. Recreationists could temporarily be disturbed.

3.1.8 FOUNDATIONS AND MATERIALS

3.1.8.1. Seismic Monitoring

Physical Resources Impacts. Scenic quality would be impaired in the short-term, as would wilderness.

Biological Resources Impacts. Biological impacts would be as discussed under "Hydrology" (3.1.5).

Cultural Resources Impacts. No impacts were identified.

3.1.8.2. Access Road Studies

Physical Resources Impacts. Localized soil removal would result from drilling. Possible degradation of permafrost, and surface drainage

disruption may occur from Nodwell traffic destroying vegetation. Erosion may occur at stream crossings. A slight alteration of scenic quality would take place, depending on the amount of erosion and destruction of vegetation.

Wilderness impact would depend on visual impact.

Wetlands might be impacted, if it were not possible to travel around them.

Biological Resources Impacts. Localized disturbance to wildlife could occur temporarily. Some vegetation would be destroyed.

Cultural Resources Impacts. Public use by ATV operators could be increased.

3.1.8.3 Transmission Corridor Studies

Physical Resources Impacts. Soil disturbance would result at drilling locations.

Floodplains and wetlands could be impacted, depending on their extent and the placement of drills.

Wilderness would be impacted for a short term, depending on visual impact.

Biological Resources Impacts. Some vegetation would be destroyed.

Local wildlife could be harassed by helicopter traffic.

Cultural Resources Impacts. No impacts have been identified.

3.1.8.4 Watana Site Geology

Physical Resources Impacts. Soils wouldreceive a minor impact.

Flagging would cause an adverse visual and wilderness impact for a short term.

Biological Resources Impacts. Wildlife may be disturbed by ground activity and helicopter traffic.

Cultural Resources Impacts. No cultural resource impacts were identified.

3.1.8.5 Watana Borrow Site Exploration and Testing

Physical Resources Impacts. Quarry Site A would sustain limited soil disturbance from blasting and drilling, and a significant alteration of scenic quality would result. Impacts would probably be visible from the river and might significantly affect wilderness characteristics.

Quarry Site B would have limited soil disturbance from drilling operations. Accelerated soil erosion, gully formation, and possible permafrost degradation may occur. Scenic quality and wilderness may be impacted.

Borrow Site C impacts are unknown at this time as plans to work in this area are not identified.

Borrow Site D would have limited soil disturbance, ground water mixing, soil profile mixing and an alteration of scenic quality.

Borrow Site E would have impacts similar to those on Site D.

Equipment operation and movement on and between sites would probably cause the greatest impact to the surface.

Blasting in Quarry Site A may leave the site in a condition incompatible with wilderness.

Vehicular movement, drilling and test pit excavation may impact wetlands, depending on their extent and site location.

Floodplains could possibly be impacted at Borrow Site E because of its proximity to the Susitna River. Erosion is more likely in the case of Borrow Site E because of terrain and access problems.

Biological Resources Impacts. These impacts would be virtually the same for all sites. Localized vegetation removal would occur. Ground and air operations would have a moderate harassing effect on wildlife.

Cultural Resources Impacts. Ground disturbance could cause unidentified archeological sites to be lost.

3.1.8.6 Watana Damsite Drilling and Trenching

Physical Resources Impacts. Localized erosion and soil disturbance would result from drilling, drill movement by skidding, test pit excavation, and trenching.

Scenic quality would be altered by vegetation removal and soil disturbance. Scenic impact would be observable from the Susitna River.

Wilderness would be impacted by the same operations that affect scenic quality. Trenching may have a significant adverse effect on wilderness.

Wetlands and floodplains may be impacted, depending on their extent and the precise location of surface-disturbing operations.

Biological Resources Impacts. Vegetation would be destroyed. Placement of equipment by helicopter would increase the amount of timber cut.

Wildlife habitat would be modified. Timber cutting would possibly benefit browse species. Wildlife populations would be displaced while operations were occurring.

Cultural Resources Impacts. Unidentified archeological resources could be lost.

3.1.8.7 Watana Geophysical Investigation

Physical Resources Impacts. Localized erosion and soil disturbance would occur from explosives and vehicle movement. A minor impact would occur to visual quality and wilderness character. Wetland may be impacted to an unknown extent depending on exact placement of equipment and charges and the extent of wetlands.

Biological Resources Impacts. Vegetation would be destroyed and wildlife would be disturbed locally.

Explosions may impact fish if they occur close to fish-bearing waters.

3.1.8.8 Watana Features Design

Physical Resources Impacts. No impacts have been identified.

Biological Resources Impacts. Helicopter traffic may disturb wildlife.

Cultural Resources Impacts. No impacts have been identified.

3.1.8.9 Devil Canyon Geology

Impacts would be the same as those identified under "Watana Damsite Drilling and Trenching" (3.1.8.6) except that impacts from trenches and test pits would not occur. Rock from the tunnel and shaft could impact

floodplains by being placed on them after excavation. Additionally, wetlands, if present, could be impacted by rock fill.

3.1.8.10 Devil Canyon Damsite Drilling

(See "Watana Damsite Drilling and Trenching" (3.1.8.6)).

3.1.8.11 Devil Canyon Aggregate Studies

Impacts on resources will be similar to those described for "Watana Borrow Site Exploration and Testing" (3.1.8.5). Impacts will probably be less severe in nature, however, because they will be in previously disturbed areas.

3.1.9 Design

No impact is expected from this specific activity.

3.1.10 Real Estate

No impact is expected from this specific activitiy.

3.1.11 Cultural Resources Studies

Physical Resources Impacts. Some soil disturbance could occur.

Biological Resources Impacts. Some vegetation could be destroyed.

Cultural Resources Impacts. Archeological sites identified could be saved or salvaged prior to any potential surface disturbance.

3.1.12 Biological Resources Studies

Physical Resources Impacts. Camps could have some impact on soils.

Aircraft could impact wilderness quality for a short term. Temporary structures will be built in floodplains.

Biological Resources Impacts. Wildlife would be disturbed by aircraft and biologists. Some loss of game animals can be expected during big game studies.

Cultural Resources Impacts. Hunters could possibly be disturbed if studies were occurring during season.

3.2 SUMMARY OF CUMULATIVE IMPACTS

This section summarizes the potential impacts on each resource that would be affected, and identifies the cumulative impacts of all proposed activities on that resource.

3.2.1 Physical Characteristics Impacts

3.2.1.1 Visual Resources Impacts

One of the most significant impacts of the proposed activity will be related to visual quality, in that the activities will degrade local areas within the upper Susitna River basin which presently show little sign of man's presence. Areas along the proposed transmission corridor will be less impacted because of the more numerous signs of man's presence.

The foundations and materials and the field camp activities will result in both short-term and long-term visual imapcts. Many of these impacts can be minimized by redesigning, recontouring and reseeding disturbed areas; however, the impacts cannot be entirely rehabilitated. Signs of man's presence will be reflected in the fragile tundra vegetation for many years to come. Activities of less scope, such as hydrology and survey, will cause visual impacts of a local and temporary nature.

Major long-term impacts would result from the following activities:

1. Pioneer Trail
2. Airstrips
3. Field camp gravel pads
4. Intrasite trails and haul trails
5. Borrow sources
6. Borrow site exploration - blasting
7. Damsite drilling - trenches

In most cases, these impacts probably cannot be rehabilititated to meet VRM Class II objectives. With proper mitigation, some degree of rehabilitation is possible (see page A5-18). The remainder of the activities proposed will generally be mitigated, provided careful management techniques are used.

3.2.1.2 Wilderness Impacts

Those impacts identified above as major long-term impacts in the "Visual Resource Impacts" (3.2.1.1) section are essentially the same impacts that would prevent this area from meeting the wilderness character requirements outlined in the BLM Wilderness Manual.

3.2.1.3 Air Quality

Aircraft and ground vehicles will cause minor temporary degradation of air quality in the immediate vicinity of the field camp and drilling sites within the project area. In addition, there will be some local degradation attributable to portable powerplants, petroleum fuels utilized for camp heating and cooking purposes, and particulate matter.

Air pollutants are expected to be minor and localized and will cease with termination of activities and withdrawal of camps and equipment.

3.2.1.4 Water Quality

Wintertime activities will have essentially no impact on water quality while soils and water surfaces are frozen. Water pollution will increase during the frost-free months, although care will be taken in field camp, airstrip, and trail construction to minimize this possibility. Threats to water quality will be almost wholly attributable to introduction of mineral or organic soil particles caused by construction activities and disposal of human waste. No other organic pollution should occur. Fuels and chemicals will be stored and handled in a manner designed to prevent entry into water courses. Solid wastes will be disposed of by burning and/or removal from the area. Domestic liquid waste will be disposed of in compliance with Federal and State effluent discharge standards.

3.2.1.5 Noise

Unavoidable noise will be caused by aircraft and ground vehicles required to move personnel and equipment to and from the field camp and exploration sites. This will be a source of periodically recurring noise as these particular activities are engaged in. A more constant source of noise will be related to equipment utilized in daily exploratory activities. However, this will be very localized, occurring only in the immediate vicinity of the dam and camp sites. Disturbance to humans will be limited primarily to workers associated with the project.

Additional disturbance will occur to the relatively few people expected to frequent the area for other purposes, such as hunting, fishing, or white-water boating. Impacts may be substantially more disturbing to wildlife in the area. This is more specifically addressed in the Biological Section.

3.2.2 BIOLOGICAL IMPACTS

3.2.2.1 Fish

Some unavoidable minor introduction of mineral or organic soil materials may occur to streams as a result of gravel borrow, drilling activities, and other actions which displace vegetation or disturb soil surface. However, the proposed borrow source on upper Tsusena Creek is the primary identified potential source of erosion that could affect the fishery resource. No other sources of pollution are likely to occur, with implementation of the provisions envisioned for waste disposal, effluent discharge and accidental spillage contingencies. The fishing pressure exerted by workers on their off hours could adversely affect the limited fishery resource.

3.2.2.2 Mammals

Disturbances associated with construction and use of the winter trail and field camp, and exploration activities will have adverse impacts on large mammals inhabiting the project area. These disturbances will result from increased human activity, the operation of heavy equipment, and low-flying helicopters. The disturbances will be greatest in the Watana damsite area but will also occur to a lesser extent at

the Devil Canyon damsite, along the access road corridors and along the transmission corridor.

Disturbances to wildlife will disrupt normal behavior patterns, will generate increased physiological stress and will force some species to vacate areas of activity. Studies have shown that disturbances during and immediately following birth can result in decreases in survival of the newborn young in moose, caribou, and mountain sheep. During winter periods disturbances of large animals can cause increased mortality because animals are forced to expend more energy than they can consume.

Direct disturbances as well as physical disruption of habitat may result in the displacement of large mammals from the areas of concentrated activity. Animals displaced from existing habitat may not find suitable new habitat to support them in surrounding areas. It can be presumed that mammal populations in adjacent areas are in relative balance with their food and other habitat requirements and that no suitable unoccupied habitat exists to absorb displaced animals. If this balance does exist, displaced animals would be expected to succumb to natural mortality or to displace other resident animals. This would be of particular importance for moose populations.

Displacement of wolves from traditional hunting areas would place increased pressure on other prey populations in adjacent areas. This could have long-term impacts, but to what extent is unknown. Local populations of large mammals will be most impacted.

The reestablishment of large mammal populations within activity areas following the activity will be dependent upon the level and type of disturbances which will remain. It is expected that large mammals will eventually reoccupy activity areas; however, depending on the rate of revegetation, their use of the areas may be diminished. This diminished use is not expected to be significant, because of the small size of the areas.

Because of the limited research that has been done to date on the behavior of wild animals, the significance of the disruption of behavior patterns on the well-being of wildlife cannot be fully evaluated. Many of the potential impacts will be temporary and will affect individual animals or small segments of the populations. Some of the impacts, however, may be far more significant, affecting basin animal populations over long-term periods. The exact nature and degree of long-term impact is unknown.

Small mammals will also be adversely impacted by disturbances produced by the proposed activity; however, these impacts are not expected to be significant.

3.2.2.3 Birds

Impacts to birds are expected to be minor. Noise and human activities may temporarily displace local populations of resident birds such as ptarmigan and grouse and some species of summer residents, mostly song birds. On the basis of presently known raptor use and populations, these species should be minimally affected since population densities

appear to be low within the river canyon area. Waterfowl, whose use of the canyon area is essentially limited to a flyway between the upper and lower Susitna basins, should not be impacted. Direct habitat loss to any bird species will be minor.

3.2.2.4 Vegetation

Plant life potentially impacted by the proposed action is characteristic of six of the major vegetative ecosystems of Alaska.

Vegetation along the proposed winter trail is generally moist or alpine tundra. Depending on snow depth, utilization of the 41-mile winter trail could potentially destroy or damage vegetation along it. Moist or alpine tundra would also be destroyed or damaged as a result of the field camp and foundations and materials activities at the Watana damsite. Some spruce and brush will also be cleared in the Watana area as well as at Devil Canyon.

In general, the majority of vegetation clearing required will be to facilitate access via helicopters. The dimensions listed below are a guide to clearing required; however, site specific requirements may alter the amount of clearing needed.

Class	Rotor Diameter	Clearing Diameter
I (Bell 206B)	40 feet or less	75 feet
II (Bell 205A1)	41 feet to 55 feet	90 feet
III	56 feet to 75 feet	110 feet

Additional clearing may be required at some sites to provide approach paths for helicopters sling-loading equipment.

Limited clearing of vegetation will be required along the proposed transmission corridor.

After individual activities are completed or at least after the cessation of the proposed activites, all disturbed areas will be re-contoured, reseeded, and fertilized as needed.

3.2.2.5 Threatened or Endangered Species

Threatened or Endangered Species

The only presently known threatened or endangered animal species which might be found in the area are the American and arctic subspecies of the peregrine falcon. These birds have been observed migrating through the basin, although no known nesting occurs within the proposed hydropower project area. Unless nesting is discovered to occur within areas of immediate impact of proposed activities, there should be no adverse effect on these birds. Should nesting be found to occur, extreme care should be exercised in avoiding these sites. There are no known threatened or endangered plant species occurring within the project area.

3.2.3 CULTURAL IMPACTS

3.2.3.1 Access and Public Use

Existing access to the project area will not be significantly affected by the proposed activities. Construction of an airstrip at Watana may result in some increased attraction to aircraft. This might create some increased use by hunters, fisherman, and boaters, although the effect on surrounding areas would be negligible due to lack of other

forms of transportation. The proposed activities will have no significant impact on recreational use of the project area.

3.2.3.2 Historic Resources

On the basis of the historical record of man's recent activity in the canyon area of the Susitna River, there is no evidence of existing historic sites which would potentially be affected by the proposed activity.

3.2.3.3 Archeological Resources

The proposed activities are not expected to significantly impact archeological resources which may be found within the project area. Archeological surveys will be conducted before any activity which may potentially impact archeological resources is allowed to proceed. If archeological sites are found, exploration activities will be conducted so as to avoid the sites.

Some preliminary studies were conducted by the Corps of Engineers during the fall of 1978 at the Watana damsite to clear areas which would be required for the proposed field camp, airstrip, and borrow area. No archeological resources were discovered.

3.2.3.4 Land Use/Status

Most of the proposed activities are temporary in nature and minimal in scope with respect to land use and status; however, the airstrip and pioneer road would improve access in the long term. There is anticipated to be no impact on land status. The proposed activities will increase the presence of man in the work area with a corresponding degree of

temporary pollution associated with his presence. Similarly, the proposed activities are considered to be neither an attractant nor a deterrent to customary use of the area.

3.2.3.5 Demography and Economics

Positive economic benefits may result, in that money would be infused into Talkeetna in the form of lodging receipts, local labor wages, and other increased expenditures in the community. However, if a large number of workers from outside the area operate from Talkeetna, friction between them and the local population could develop.

4. Recommended Mitigating Measures

4. RECOMMENDED MITIGATING MEASURES

These are measures not included in the description of the proposed action but recommended to lessen the project's impact on the environment. These measures are aimed at mitigating the impact of the discrete activities on the environment beyond that described in the proposed action.

These mitigating measures are listed under a heading of "General" (4.1) when they are applicable to several proposed activities. Specific mitigating measures are listed under the heading "Specific" (4.2) and a subheading naming that activity which contains the action to be mitigated.

4.1 GENERAL MITIGATING MEASURES

4.1.1 Physical Resources

(1) Compliance with Section 404 of the Clean Water Act and Executive Orders 11988 and 11990 will require a wetlands inventory for the project area and public notice of intent in advance of activities which may alter or impact wetlands. Compliance with these requirements will identify practicable alternatives, and specific mitigation measures, including means for rehabilitation of disturbed wetlands. Prior to satisfying the above requirements, all activities having the potential of affecting wetlands should be confined to periods when the ground is frozen and snow cover is adequate to protect vegetation cover.

(2) In areas where fill is required, fill should be placed over existing vegetation and be sufficient in depth to insulate the permafrost layer from thawing. Rehabilitation should proceed immediately upon completion of construction.

(3) All access roads, trails, and skidding paths should have water management as an integral part of the engineering design. All activities should be performed to minimize erosion. Water bars could be utilized to prevent rill and gully erosion. Upgrading of the water bars should occur each fall to prevent erosion caused by water flowing beneath the snowpack.

(4) All access road drilling should be done during the winter. There should exist a minimum of 12 inches of snow on the ground with the ground frozen to a 6 inch depth.

(5) Cut banks and exposed soils should be rehabilitated as soon after disturbance as possible to prevent soil erosion. Rehabilitation should consist of grading to contour, seeding, fertilizing and mulching where necessary.

(6) A soil surface description and permafrost core should be required for each proposed acre impacted by housing, trail or the airstrip. This data would be used by the contractor to ensure that insulation pad construction design prevents permafrost degradation. Design plans for pads, trails, and the airstrip should be approved by BLM.

(7) The BLM Landscape Architect should be consulted at the planning stage for all surface and vegetation-disturbing activities so

specific visual resource mitigating measures described in "appendix A" can be implemented.

4.1.2 Biological Resources

(1) Sites where vegetation will be destroyed should receive clearance for Federally proposed threatened and endangered plant species. This clearance should be made by a botanist who is qualified.

(2) Sites where vegetation is destroyed should be rehabilitated as soon as possible after impact. This should include grading to natural contours, and establishing a permanent native vegetative cover.

(3) Daily access to work sites from camp area should be made by foot or helicopter.

(4) Aircraft should stay a minimum of 1000 feet above ground level when traveling between sites, when practical.

(5) All raptor nests must be protected.

A. No vegetation should be disturbed within 660 feet of any raptor nests.

B. No disturbance should take place within 1/4 mile of any nest during the nesting season (May to June). This includes ground and air activities.

(6) If Peregrine Falcon nests are discovered, all activities within one mile of the nest should cease and BLM should be notified immediately.

(7) All camp sites should be kept clean of food and garbage to avoid attracting bears.

4.1.3 Cultural Resources

To prevent impacts to cultural resources from surface disturbing activities, the following procedure is recommended:

(1) The Alaska Power Authority (APA) should engage the services of a qualified archeologist, acceptable to BLM. BLM should be provided a copy of the APA scope of work for their review and comment. BLM should provide a voting member to the preselection and selection boards.

(2) Prior to undertaking exploration activities, except the proposed explorations in the river channel, the archeologist should examine all areas where surface-disturbing exploration activities are planned, as far in advance of those activities as possible. Where deemed necessary, the archeologist should also be present on site to monitor surface-disturbing activities that may reveal cultural materials. If any evidence is found of cultural resources of prehistoric, historic, or contemporary nature that may be directly or indirectly affected by operations, the APA should be notified immediately and such discoveries should be left intact. All activities in the vicinity of such discoveries should cease until avoidance or mitigation procedures acceptable to the BLM Authorized Officer are undertaken and notice is given to proceed.

(3) The grantee or any contractor may not injure, alter, destroy, or collect any site, structure, object, or other value of historical, archeological, paleontological, or other cultural importance,

excepting the limited testing and/or collecting required by the qualified archeologist for evaluative purposes.

(4) Any personnel who discover any materials that may be of cultural significance on these lands must report their discovery immediately to the APA. The APA would insure that such areas will be protected, and notify the BLM Authorized Officer. All activities in the vicinity of such discoveries should cease until avoidance or mitigation procedures acceptable to the BLM Authorized Officer are undertaken and notice is given to proceed.

(5) If cultural resources which might be eligible for the National Register of Historic Places are identified within the area of potential environmental impact, notice to proceed would not be given until compliance with Section 106 of the National Historic Preservation Act is assured, as outlined in 36 CFR 800.

(6) A preliminary archeological report should be submitted annually by January 1 to the APA Contracting Officer and BLM Authorized Officer. After allowing 60 days for comments, an acceptable final report should be submitted to the APA Contracting Officer and BLM Authorized Officer within 30 days. An acceptable field report contains, at a minimum the following items:

   (a) Identification of the Federal Antiquities Permit under which the work was performed.

   (b) Description of data review and field inventory methods used, intensity of field inventories, the names of individuals

employed in the work, and the commencement and termination dates of field inventory.

(c) Identification of the project, and the BLM serial casefile number, for which the report is being written.

(d) A general background discussion of cultural resources of the area, as well as a brief summary of prehistoric and historic use of the area, including sources of information utilized.

(e) Description of what work was done, including sources consulted, areas examined, locations tested, photographs and other records made.

(f) Identification and description, including drawings and photographs, of findings and an evaluation of their signifcance; and whether such sites might be eligible for placement in the National Register of Historic Places with specific citation to qualifying criteria under 36 CFR 800.10.

(g) Site inventory records (BLM Form 8110 or other acceptable form) completed for each cultural property inventory with appropriate sketch maps of the site and base maps indicating the location of each site.

(h) Suitable maps that clearly show all areas surveyed and all locations tested and the intensity of survey and relationship of cultural resources identified to the project. Minimum acceptable base maps would be USGS 15-minute series quadran-

gles or best available substitute. Project blue prints showing the relationship of the cultural resources to the proposed activities are desirable.

(i) Catalog and descriptions of all cultural resource objects collected and indication of where they are stored including catalog and accession numbers.

(j) Identification of the probability of finding additional sites in the project area and their probable significance.

(k) Identification of the probable direct and indirect effects of the project upon known and unknown cultural resources.

(l) Professional recommendations to realistically mitigate the direct and indirect adverse effects upon cultural resources which may result from the project.

4.2 SPECIFIC MITIGATING MEASURES

4.2.1 Support Facilities - Watana

4.2.1.1 Field Camps

(1) During the design phase, BLM should assist in minimizing visual impact through facility siting. ADO Landscape Architect's approval should be required previous to construction. Facility siting includes location of camp, pad design and structure location.

(2) Solid waste incineration should be in a low, smoke-type incinerator, and accomplished so as not to degrade permafrost.

(3) All non-burnables and residue from incineration should be removed to a state-certified sanitary landfill or buried in a well-drained

site with sufficient well-drained, fine-textured subsoils to allow for complete decomposition of waste leachate before it enters the ground water table. Such sites must meet State requirements for sanitary landfills and be approved by BLM. Sanitary landfill procedures must be followed.

(4) Secondary treatment should be required for all septic waste. Every attempt should be made to locate camp facilities on a site suitable for an underground leech field. The site for such a leech field and septic system must meet applicable Federal and State requirements. Pertinent certification would have to be obtained within 60 days of operation commencement.

As an alternative, incineration of "black wastes" can be allowed. Gray wastes should be deposited in a subsoil leech field.

(5) No direct discharge of waste water into open waters or onto the soil surface for any permanent or semi-permanent camp should be allowed.

(6) Burial of incineration wastes must meet State and Federal requirements and the mitigating measurements listed above.

(7) Around the fuel storage areas a fire break should be maintained consisting of a bare mineral strip (top of dike) for a width of approximately 3 feet. Fire fighting equipment should be maintained on site, and an organized fire control plan should be developed.

4.2.1.2 Alternate Field Camp

See Mitigating Measures under "Field Camp" (4.2.1.1).

4.2.1.3 Interim Field Camp

See Mitigating Measures under "Field Camp" (4.2.1.1) in addition to the following:

Interim Watana and Devil Canyon field camp trailer and module facilities should be limited to well-drained, permafrost-free sites. No heavy equipment use should be allowed during breakup.

4.2.1.4 Airstrip

See Measures in "General" section (4.1).

4.2.1.5 Intrasite Trails

See Measures in "General" section (4.1).

4.2.1.6 Borrow Source

Contractor should be required to submit a mining plan of operation as per CFR Title 43, Part 23 Surface Exploration, Mining and Reclamation of Lands. Sections of this plan may be adapted from presented EAR with detailed information as required and with approval from BLM prior to disturbance on site.

4.2.1.7 Alternate Borrow Source

See Mitigating Measures under "Borrow Source" (4.2.1.6).

4.2.1.8 Haul Trail

See Mitigating Measures under "General" section (4.1).

4.2.2 Watana Site Access

4.2.2.1 Winter Access Trail

(1) Route selection should be such that it generally follows the natural land contours and follows as close as possible to to 'Winter '78 cat trail.

(2) Minimum snow depth requirement should be 12 inches of fresh snow over the vegetation. Passes over a single track should be restricted when less than 4 inches of compacted snow protects the vegetation and soil surface. Route selection should attempt to avoid shrubs and trees. Soil should be frozen to a 6 inch depth.

(3) The routes should be flagged at quarter mile intervals in such a manner as to be visible from a helicopter making low flights the following summer. Snow depth and relative density should be measured and recorded at each quarter mile (refer to U.S.D.A. Snow Survey procedures). Flags should be numbered, and measurements of snow depths shall be referenced to these numbers. Biodegradable flagging will be required and must be removed after use.

(4) No wheeled vehicles or tractors with blades down should be allowed. A maximum of 10 psi tread pressure will be allowed for access vehicles.

(5) Vegetation impact; i.e., tree removal and so forth, should be held to a minimum.

(6) APA is required to follow all stipulations presented for Winter 78 cat train.

(7) Complete rehabilitation of any disturbed areas should be required.

4.2.2.2 Pioneer Road

(1) During design phase, BLM will assist in minimizing visual impacts through trail siting.

(2) Design should include surface runoff/flow management design:

culverts, settling basins, and diversions should be placed as required, subject to approval by APA.

(3) Gravel should be placed directly over vegetation cover in permafrost areas whenever possible.

(4) Site selection should utilize the most favorable, well-drained, permafrost-free site available. A submission would be required to AOFR of transportation routes and alternatives previous to AOFR notice to proceed.

(5) Water bars are required adjacent to road construction to facilitate drainage and retention.

(6) Dust free materials should be utilized to the maximum extent possible.

(7) BLM Hydrologist approval should be required for design and placement of all water management structures. Minor channel crossing should attempt to avoid any extensive impacts. Settling basins should be required to prevent sedimentation and transport of materials.

(8) Routing should follow general contours of the natural landscape. Cuts and fills should be held to a minimum.

4.2.3 Support Facilities - Devil Canyon

4.2.3.1 Field Camp

See Mitigating Measures under "Interim Field Camp" (4.2.1.3).

4.2.3.2 Alternate Field Camp

See Mitigating Measures under "Interim Field Camp" (4.2.1.3).

4.2.3.3 Roads and Trails

See Mitigating Measures under "General" section (4.2).

4.2.4 Survey

See Mitigating Measures under "General" section (4.2).

4.2.5 Hydrology

See Mitigating Measures under "General" section (4.2).

4.2.6 Environmental Water Quality Monitoring

See Mitigating Measures under "General" section (4.1).

4.2.7 Recreation

See Mitigating Measures under "General" section (4.1).

4.2.8 Foundations and Materials

4.2.8.1 Seismic Monitoring

All vegetation and soil removal should be held to a minimum. Time spent on each site should be held to a minimum and there should be a minimum amount of helicopter bypass over each site. Daily access should be limited to helicopter and foot traffic only.

4.2.8.2 Access Road Studies

(1) The possibility of running access road studies only during winter with a minimum of 12 inches of snow cover and ground frozen to a depth of 6 inches should be examined.

(2) All activities should be carried out in such a way as to minimize soil and vegetation impacts.

(3) No major river crossings should be allowed without approval by BLM.

(4) Traffic should be limited to a single direction and one pass only.

(5) A detailed plan of operation should be approved by BLM previous to commencing operations. We should require the soil profile des-

criptions from their access road studies. In addition, all holes excavated should be backfilled.

(6) Vehicle ground pressure should be limited to 3.5 psi maximum for summer operations. All vehicles that will be utilized in this access study should be approved by BLM previous to operational commencement.

4.2.8.3 Transmission Corridor Studies

See Mitigating Measures under "General" section (4.1).

4.2.8.4 Watana Site Geology

All flagging should be removed after operations are completed.

4.2.8.5 Watana Borrow Site Exploration and Testing

Quarry Site A

(1) Major explosive rip test sites may require rehabilitation if unconsolidated debris is removed or exploded from site. If so, unconsolidated material should be stabilized immediately after opening to prevent soil transport, erosion, and sedimentation in the adjacent areas.

(2) Mobilization of drill rigs should be accomplished by helicopter with minimal disturbance to vegetation. If helicopters cannot be used, there should be no skidding of equipment parallel to the slope. This will reduce the possibilities of initiating rill and gully erosion.

Quarry Site B

Refer to "Quarry Site A" (4.2.8.5).

Borrow Site C

It is the recommendation of the Resource Staff at this time that no activities take place at Borrow Site C. If it becomes evident that investigations must take place there in a future time, then a plan should be developed by the contractor and submitted to the Bureau for review previous to permission to commence operations. Included in the plan of operations must be access route identification and information pertaining to that access route. This information is now lacking from the EAR.

Borrow Sites D and E

(1) All drilling operations except for the test pit should be done in the winter time on a snow depth of 12 inches and on ground that is frozen for a depth of 6 inches. Test pit operations should be allowed in the summer but utilizing only vehicles designed for over-tundra traffic. These vehicles should be approved by BLM before operations.

(2) All surface soils from test pits should be removed and stockpiled for replacement. Rehabilitation procedures should meet criteria listed under "General" subheading.

4.2.8.6 Watana Damsite Drilling and Trenching

Design the operations so that minimum erosion occurs, especially with drilling waste. Prevent drilling waste from entering into adjacent waterways. All vehicle transport, especially to the south abutment, should take place during periods of snow cover or by helicopter.

Skidding of equipment should be held to a minimum, especially perpendicular to the slope. Any evident tracks, which may become water gullies, should have water bars constructed immediately after transport. Minimize soil and vegetation removal. Minimize surface transport of equipment. Vegetation should not be cleared to the soil surface; brushing will be allowed and should be held to a minimum.

4.2.8.7 Watana Geophysical Investigations

Rehabilitation for all explosive holes must include grading to natural contour, fertilizing, and seeding. All operations should be designed to minimize disruption of soil and vegetation. No linear clearing should be allowed. There should be no vegetation clearing in long lines leading to checkerboard pattern.

4.2.8.8 Watana Features Design

See Mitigating Measures under "General" section (4.1).

4.2.8.9 Devil Canyon Geology

See Mitigating Measures under "General" section (4.1).

4.2.8.10 Devil Canyon Damsite Drilling

See Mitigating Measures under "Watana Damsite Drilling and Trenching" (4.2.8.6).

4.2.8.11 Devil Canyon Aggregate Studies

See Mitigating Measures under "Watana Borrow Site Exploration and Testing" (4.2.8.5).

4.2.9 Design

See Mitigating Measures under "General" section (4.1).

4.2.10 Real Estate

See Mitigating Measures under "General" section (4.1).

4.2.11 Cultural Resources Studies

See Mitigating Measures under "General" section (4.1).

4.2.12 Biological Resources Studies

See Mitigating Measures under "General" section (4.1).

5. Residual Impacts

5. RESIDUAL IMPACTS

Residual impacts are the impacts remaining after recommended mitigation measures are applied to probable environmental impacts. The following descriptions assume full application of recommended mitigating measures.

5.1 RESIDUAL IMPACTS BY ACTIVITY

5.1.1 Support Facilities - Watana

5.1.1.1 Field Camp

(1) Visual impacts could be only partially mitigated. The field camp while in place, would be a discordant feature in sharp contrast with the natural landscape.

(2) Some local erosion, sedimentation and interruption of natural flow patterns would remain.

(3) Waste incineration and power generation would result in a minor and short term reduction of air quality and noise pollution, respectively.

(4) The potential for fuel spills and subsequent soil and water contamination remains.

(5) The negative effect of the presence of the field camp on the wilderness character of the area could not be totally mitigated.

(6) Vegetative cover and wildlife habitat covered by gravel pads would be lost while the pads remained in place.

(7) Disturbance of wildlife as a result of field camp operations could not be totally mitigated.

5.1.1.2 Alternate Field Camp

Residual impacts would be the same as for "Field Camp" (5.1.1.1).

5.1.1.3 Interim Field Camp

(1) See residual impacts 1, 3, 4, 5 and 7 for "Field Camp" (5.1.1.1).

(2) Human and vehicular activity in the vicinity of the field camp would cause minor soil compaction and trampling of vegetation.

5.1.1.4 Airstrip

(1) Residual impacts 1, 2, 5 and 6 for "Field Camp" (5.1.1.1) would also apply to the airstrip but would be greater because of the larger land area involved.

(2) Noise, dust and activity associated with airstrip operation resulting in wildlife disturbance and a reduction in wilderness qualities could not be mitigated.

5.1.1.5 Intrasite Trails

Residual impacts 1, 2, 5 and 6 for "Field Camp," (5.1.1.1) are applicable.

5.1.1.6 Borrow Source

(1) Prior to reclamation, vegetation removal and surface disturbance would result in a contrasting and discordant feature on the landscape, causing significant reductions in visual and wilderness qualities.

(2) Particulate air pollution associated with operations could not be totally mitigated.

(3) Changes in surface flow patterns and topography, some localized erosion, and possibly permafrost degradation would occur prior to reclamation.

(4) Increased erosion could negatively impact Tsusena Creek fisheries.

(5) Vegetation removal would result in loss of wildlife habitat and displacement of wildlife. Displacement would continue until the site was rehabilitated and native vegetation re-established.

(6) Noise and activity associated with operations would disturb wildlife.

5.1.1.7 Alternative Borrow Source

(1) Residual impacts 1, 2, 3, 5 and 6 for "Borrow Source" (5.1.1.6) are applicable.

(2) Because of location, visual impacts could be greater for the alternate borrow source than for the borrow source. The possiblity of negative impacts to fishery resources would be reduced.

5.1.1.8 Haul Trails

(1) Residual impacts 1, 2, 3, 5 and 6 for "Borrow Source" (5.1.1.6) are applicable to the proposed haul trail and alternatives.

(2) The type of residual impacts would be essentially the same for the proposed haul trail and alternative. Because of the lengths and locations, however, the level of impacts would be lowest for the proposed trail and greatest for alternative A.

5.1.2 Watana Site Access

5.1.2.1 Winter Trail

(1) Some crushing and compaction of vegetation will occur.

(2) To the extent that the trail is visible after snow melt, a minor reduction in visual quality will occur.

(3) A visible trail, left after snow melt, could attract ORV use during periods of the year when surface damage would be much more severe.

(4) Minor disturbance of wildlife may occur while the trail is in use.

(5) Snow compaction by vehicles may cause temporary changes in surface runoff patterns, changes in soil infiltration rates and accelerated erosion, especially at stream crossings.

5.1.2.2 Pioneer Road

(1) The types of residual impacts would be essentially the same as for the "Haul Trails" (5.1.1.8). The level of impacts would be greatly increased due to the length of the proposed pioneer road.

(2) If open to the public, the pioneer trail would provide access to areas that are now essentially inaccessible.

(3) Positive residual impacts would result from a reduction in air traffic and subsequent reduction in wildlife disturbance.

5.1.2.3 Erosion Control and Maintenance

(1) The general effect of this activity is mitigation of negative impacts associated with other activities.

(2) Negative residual impacts would include some wildlife disturbance and reductions in air and wilderness qualities associated with use of construction and maintenance equipment.

5.1.3 Support Facilities - Devil Canyon

5.1.3.1 Field Camp

Residual impacts would be similar to those listed for the Watana "Field Camp" (5.1.1.1) with these exceptions:

(1) Old, existing improvements (airstrip, road and other surface disturbance) on this site would greatly reduce the significance of the proposed activities on visual and wilderness qualities.

(2) The nature of the ground surface (sand and gravel) would significantly reduce the impacts, associated with camp activities, on soils and vegetation.

(3) Clearing of vegetation from the existing airstrip would improve access to the site.

5.1.3.2 Alternate Field Camp

(1) A minor reduction in visual and wilderness qualities would occur while the camp was on site.

(2) Helicopter movement of personnel and camp activities would cause some wildlife disturbance.

(3) The potential for fuel spills and subsequent soil and water contamination would exist.

5.1.3.3 Roads and Trails

(1) Scenic qualities and wildlife habitat would be altered as a result of brush removal from existing roads.

(2) Vehicle movement would result in higher noise levels, slight reduction in air quality and some disturbances of wildlife.

5.1.4 Survey

(1) Vegetation modification would cause short term residual impacts to wilderness and scenic qualities.

(2) Helicopter movement would result in increased noise levels, some wildlife disturbance and minor reductions in air quality.

5.1.5 Hydrology

(1) Structures would have a minor impact on scenic quality.

(2) Placement of structures would result in very minor ground surface disturbance.

(3) Residual impacts associated with helicopter movement are the same as 3 under "Survey" (5.1.4).

5.1.6 Environmental (Water Quality)

No residual impacts identified.

5.1.7 Recreation

Residual impact 3 for "Survey" (5.1.4) is applicable.

5.1.8 Foundation and Material

5.1.8.1 Seismic Monitoring

Residual impacts are essentially the same as those listed under "Survey" (5.1.4).

5.1.8.2 Access Road Studies

(1) Helicopter and surface vehicle movement and drilling activities would increase noise levels, cause slight reductions in air quality and disturb wildlife.

(2) Localized soil removal from drilling, compaction of vegetation and possible permafrost degradation from ground vehicle movement would reduce wilderness and scenic qualities.

(3) Creation of visible trails could attract other ORV users.

5.1.8.3 Transmission Corridor Studies

Residual impacts are essentially the same as those listed under "Access Road Studies" (5.1.8.2) except ground vehicles would not be used.

5.1.8.4 Watana Site Geology

See residual impact (2) for "Survey" (5.1.4).

5.1.8.5 Watana Borrow Site Exploration and Testing

Quarry Site A

(1) Residual impacts are essentially the same as probable environmental impacts identified for Quarry Site A (3.1.8.5).

(2) Skidding of core drills could result in significant surface disturbance.

(3) Helicopter placement of core drills would require tree removal and alteration of scenic qualities.

(4) Loss of scenic and wilderness qualities from holes blasted in the ground surface could not be totally mitigated.

Quarry Site B

(1) Residual impacts (2) and (3) for "Quarry Site A" are applicable.

(2) Some soil displacement, vegetation removal and wildlife disturbance would occur.

Borrow Site C

Refer to "Borrow Site C" under "Recommended Mitigating Measures" (4.2.8.5).

Borrow Sites D and E

(1) Residual impacts would be caused primarily by movement and operation of equipment used to dig test pits.

(2) Some soil displacement, vegetation removal and wildlife disturbance would occur.

5.1.8.6 Watana Damsite Drilling

Residual impacts are essentially the same as "Probable Environmental Impacts" identified for the "Watana Damsite Drilling" (3.1.8.6).

5.1.8.7 Geophysical Investigations

(1) Prior to rehabilitation, blasted holes would cause a minor reduction in scenic and wilderness qualities.

(2) Clearing of vegetation would slightly reduce scenic values.

(3) Blasting and helicopter movement would result in wildlife disturbance and minor reductions in air quality.

5.1.8.8 Watana Features Design

Residual impacts would be limited primarily to those associated with helicopter operation.

5.1.8.9 Devil Canyon Geology

No residual impacts are identified.

5.1.8.10 Devil Canyon Damsite Drilling

Residual impacts are essentially the same as "Probable Environmental Impacts" for "Devil Canyon Damsite Drilling" (3.1.8.10).

5.1.8.11 Devil Canyon Aggregate Studies

Residual impacts would be similar to those described for "Watana Borrow Site Exploration and Testing" (3.1.8.5), except these studies would be in previously disturbed areas.

5.1.9 Design

No residual impacts are anticipated.

5.1.10 Real Estate

No residual impacts are anticipated.

5.1.11 Cultural Resources Studies

Minor soil disturbance and vegetation removal would occur.

5.1.12 Biological Resources Studies

Residual impacts are essentially the same as those identified for "Biological Studies" under "Probable Environmental Impacts" (3.1.12).

6. Relationship Between Short-Term Use and Long-Term Productivity

6. Relationship Between Short-Term Use And Long-Term Productivity

For the purpose of this environmental assessment, the short-term is defined as being that period of time in which the proposed activities will occur. The long-term is that period of time in excess of the short-term.

The potential for long-term environmental impacts as a result of short-term activities does exist and is recognized. These long-term impacts may reduce the biological productivity within the project area over the long-term; however, the exact nature or extent of such reductions is unknown. For example, increased human activity and improved access may disturb wildlife, particularly large mammals such as wolves, caribou, and moose. It may be that these disturbances will cause short-term changes in distribution; however, the relationship of these changes to long-term productivity is unknown.

While the biological productivity of the area may be reduced over the long-term as a result of short-term project activities, other types of productivity may be increased. The proposed activities will increase scientific knowledge of the area, which will aid in making future use decisions about the area. Improved access to the area may increase the recreational use of the area as well.

Additionally, this area has a high wilderness potential. Those particular activities identified under "Wilderness Impacts" (3.2.1.2) would adversely affect this potential in local activity areas.

7. Irreversible And Irretrievable Commitments Of Resources

7. Irreversible And Irretrievable Commitments Of Resources

Perhaps the greatest potential irreversible or irretrievable commitment of a natural resource is related to land use. If not conducted in such a manner as to substantially reduce or minimize environmental impacts, the proposed activity may commit the lands within the project area to a use which may not have been in the public interest. For example, construction of roads or gravel pads or other wilderness-degrading activities may exclude the area from wilderness consideration. If the Susitna Hydropower Project is considered unfeasible, the lands within the project area will be returned to as near a natural state as possible.

Those irreversible or irretrievable commitments of resources which would result from the proposed project include the expenditure of fossil fuels and labor.

8. Consultation and Coordination

8. CONSULTATION AND COORDINATION

8.1 PUBLIC REVIEW AND COMMENT ANALYSIS

To identify the level of interest in the proposed action and allow public review of the draft Environmental Assessment of the proposed action, public meetings were held in Talkeetna (January 17) and Anchorage (January 18). In addition to the public meetings, written comments were solicited.

At the Talkeetna meeting, 34 people registered, with 11 giving verbal comment or asking questions. Some 50 people registered at the Anchorage meeting, with 23 giving verbal comment or asking questions.

A total of 93 written responses to BLM's request for public comment were received as of February 12, 1979.

Fifty-one responses from individual citizens and twenty-five from representatives of organizations or agencies favored the proposed actions as described.

Eighteen of the 93 written responses gave specific comments or recommendations, or expressed concerns about the proposed actions and Environmental Assessment document. Many of these comments deal with similar or common concerns. The final Environmental Assessment has been revised to address these comments. The following paragraphs summarize the primary comments or concerns and indicate where they have been discussed in the text.

Impacts

Several of the comments received identified additional impacts that should be considered. It was also stated that the draft assessment fell short in identifying impacts.

The section on impacts (section 3.) has been expanded to include the additional impacts identified. Some of these are: increased aircraft harassment of wildlife (section 3.2.2), and wildlife habitat alteration (section 3.2.2).

Alternatives

A comment made by several people was that a larger array of alternatives for carrying out the proposed actions should be identified. Therefore, several additional alternatives have been identified (section 1.). These deal primarily with alternative locations for various surface disturbing actions and alternative ways they can be carried out.

Formal Environmental Impact Statement

Eight responses specifically asked, for one reason or another, that a Formal Environmental Impact Statement be prepared. Their reasons are: the proposed action is a major Federal action; it will cause irreversible and irretrievable impacts. The actions are a segment of the larger Susitna Dam projects.

BLM Comments:

The decision to prepare or not to prepare a Formal Environmental Statement is not addressed in this final Environmental Assessment document. This document identifies impacts, alternatives, environmental

consequences, and mitigation measures. It will be used to help decide on the final actions to be allowed and whether those actions require a Formal Environmental Statement. At this time a decision has not been made to prepare or not to prepare an Environmental Statement. The comments received requesting that one be prepared will be considered when that decision is made.

Inadequate Review Time

Several comments stated that they did not receive the document in time for adequate review. Their comments were received and considered up to the final date of printing this final document. Is is believed that by taking comments up to the last minute, those people who expressed this concern were able to get comments in.

Anchorage District Office of BLM will go on taking comments or consultations on a continuing basis.

Land Status

Several people expressed a concern over the legal authorities BLM actually has to permit actions in the various complex land status situations occurring in the area of the proposed action.

BLM Comments:

The land status is indeed complex, with many laws and land orders affecting BLM's authorities in the area. These land status concerns are discussed in an expanded section, "Land Status" (section 2.3.5) and displayed on Map 7. The interpretations on the effect of this status on

BLM authorities was arrived at through consultation with the U.S.D I. Soliciters Office and BLM's Washington Office.

For example, recent interpretations on the effect of Native selected lands on BLM's wilderenss review responsibilities have stated that wilderness regulations will apply to those lands until actually conveyed to the Native interest.

This will significantly limit the types of surface-disturbing actions that BLM can permit.

Wild and Scenic River

The effect on the proposed action of the Public Land Order 5654 designating the Susitna River a Wild and Scenic Study River should be clarified.

BLM Comment:

This is another land status question of concern to the public. A discussion of this question is in the section on "Land Status" (section 2.3.5).

Wilderness

One comment stated that BLM's wilderness requirements must apply to the area even though the lands have been identified for selections by the Natives and/or the State of Alaska.

BLM Comment:

This is discussed in the section "Wilderness" (section 2.1.4).

Wetlands and Floodplains

Concern was expressed that the wetland and floodplain determinations and necessary consultations required to carry out certain actions have not been done.

BLM Comment:

An expanded discussion about these concerns is in the section on "Existing Environment" (section 2.1.5), and the section on "Impacts" (section 3.).

Cost Analysis

Several comments requested that a cost analysis be prepared for the feasibility study and the larger dam projects themselves.

BLM Comments:

An analysis of the economic feasibility of the large Susitna Dam project is not considered a part of BLM's responsibility.

APA has indicated that the information to be obtained during the feasibility study will be used to perfect the existing economic feasibility analysis of the project.

Authority and Funding for Feasibility Study

Three comments stated that the authority between the Corps of Engineers and Alaska Power Administration and funding arrangements to carry out the feasibility study should be clarified before BLM permits any actions.

BLM Comments:

The legal arrangements between the COE and State of Alaska to carry out the proposed feasibility study is not considered a decision criteria of BLM's. Whether the COE acts as agent for the State of Alaska in carrying out the proposed actions or whether a private contractor acts as the agent, BLM will hold the State of Alaska (APA) responsible for living up to the terms and stipulations of land permits.

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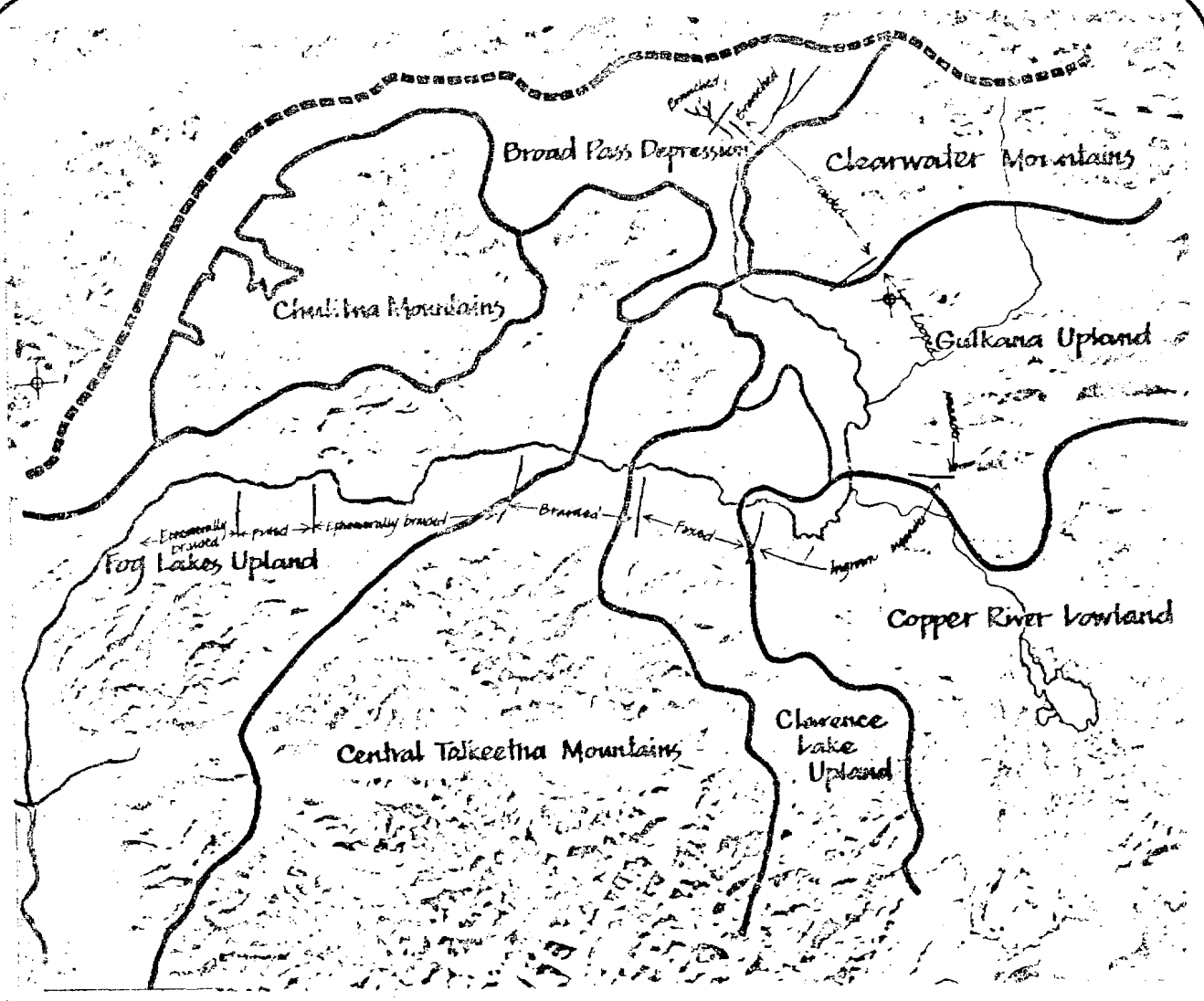
Appendix A

Scenic Quality Rating Units



Map Source: "Upper Susitna River, Alaska"
"An Inventory and Evaluation of the Environmental, Aesthetic and Recreational Resources"
by Jones & Jones for Alaska District, COE; 1975

SCENIC QUALITY RATING UNITS

UPPER SUSITNA RIVER (Segments Shown)
BROAD PASS DEPRESSION
FOG LAKES UPLAND

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SCENIC QUALITY FIELD INVENTORY

Date	1/30/79
District	Anchorage
Planning unit	Denali Block
Scenic quality rating unit	Upper Susitna River

1. Evaluators *(names)*

Jerome

2. LANDSCAPE CHARACTER *(Feature)*

	a. LANDFORM/WATER	b. VEGETATION	c. STRUCTURE *(General)*
FORM	Steep canyon dissected by river; lateral canyon dissected by creeks; gentle rolling hills on plateau.	Uniform blocks from prostrate species, vertical elements (spruce) along canyon walls.	Isolated blocks from field camp during summer of 1978.
LINE	Meandering lines created by line of river and streams.	Meander lines between species type.	Very limited line of vehicle trails from previous activities.
COLOR	Predominantly vegetative colorations high degree of variation.	High variable ranging from tan, brown to dark green.	Variable on field campsite.
TEXTURE	Smooth on gentle slopes with sharp irregular blocks along canyon walls; high degree of variation.	Lattice texture to coarse texture.	Smooth

3. Narrative

This river valley has extremely high scenic quality due to the unique rapids through Devil's Canyon. Presently, a two mile wide river corridor has been withdrawn under Sec. 204(e) of the Federal Land Policy and Management Act. The Talkeetna Mts. of the Denali Planning Block have been classified "A" Scenic Quality. The river valley will qualify as both a "wilderness area" and also an "area of critical environmental concern". Irreverisable modifications by development will impact existing visual resources.

4. SCORE *(Circle Appropriate Level)* *

	HIGH	MEDIUM	LOW	EXPLANATION OR RATIONALE
a. Landform	(5)	3	1	Steep Canyon
b. Vegetation	5	(3)	1	
c. Water	(5)	3	0	Class V rapids
d. Color	5	(3)	1	
e. Influence	(5)	3	0	Unique whitewater river
f. Scarcity	(6)	2	1	One of the wildest Alaskan
g. Cultural Modification	2	(0)	-4	rivers
TOTALS	21 + 6 + 0 = 27			

SCENIC QUALITY CLASSIFICATION

[XX] Class A – 19–33

[ ] Class B – 12–18

[ ] Class C – 11 or less

* *See Scenic Quality Rating Criteria in BLM Manual Section 8411*

Form 8400–1 (September 1978)

U.S. Government Printing Office-1978-779-309/11

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SCENIC QUALITY FIELD INVENTORY

Date 2/12/79
District Anchorag
Planning unit Denali Block
Scenic quality rating unit 007-A65 Talkeetna Mts./Fog Lakes

1. Evaluators *(names)*

Jerome

UpTanc

2. LANDSCAPE CHARACTER *(Feature)*

	a. LANDFORM/WATER	b. VEGETATION	c. STRUCTURE *(General)*
FORM	A northeast-trending area of broad rolling summits 3,000-4,500 feet in altitude which has a glacially sculptured surface in the southwestern portion but unglaciated in the northeastern portion.	Heavily timbered in drainages with prostrate species in upland areas	None apparent
Line	Angular, sloping, topographic lines	Irregular, undulating horizontally along willow edges; pointed, jagged lines from conifers.	None apparent
Color	Variable-predominantly vegetation coloration	Highly variable-tan, brown, yellow, to dark green	None apparent
Texture	Smooth on gentle slope, course on sides of drainages	Mottled clusters in willow patches, lattice to course texture in spruce forest areas.	None apparent

The Fog Lakes Upland represents a physiographic area within the Talkeetna Mountains. The Upper Susitna River cuts through the center of this region. Road access to and from both damsites (Watana and Devil Canyon) as well as some development activities are proposed in this area.

4. SCORE *(Circle Appropriate Level)* *

	HIGH	MEDIUM	LOW	EXPLANATION OR RATIONALE
a. Landform	5	(3)	1	
b. Vegetation	5	(3)	1	
c. Water	(5)	3	0	Several small drainages in
d. Color	5	(3)	1	area
e. Influence	5	(3)	0	
f. Scarcity	6	(2)	1	
g. Cultural Modification	(2)	0	-4	
TOTALS	7 + 14 + 0 = 21			

SCENIC QUALITY CLASSIFICATION

[XX] Class A – 19–33

[ ] Class B – 12–18

[ ] Class C – 11 or less

* *See Scenic Quality Rating Criteria in BLM Manual Section 8411*

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SCENIC QUALITY FIELD INVENTORY

Date: February 12, 1979
District: Anchorage
Planning unit: Denali Block
Scenic quality rating unit: 007-A62 Broad Pass Depression

1. Evaluators *(names)*

Jerome

2. LANDSCAPE CHARACTER *(Feature)*

	a. LANDFORM/WATER	b. VEGETATION	c. STRUCTURE *(General)*
FORM	Glaciated lowland with rolling morainal topography and central outwash flats. Main streams are incised in rock-walled gorges a few hundred feet deep, numerous small lakes.	Uniform blocks formed by prostrate species, pointed, vertical elements along drainages (spruce).	None apparent
LINE	Rolling, undulating topographic lines, meandering river and stream lines.	Irregular, undulating horizontally along willow edges; pointed, jagged lines of spruce vegetation.	None apparent
COLOR	Variable-predominantly vegetation coloration	Highly variable varying from tan, brown, yellow to dark green.	None apparent
TEXTURE	Smooth on gentle slopes, coarse along outwash drainages.	Mottled clusters in willow patches, lattice to course texture in spruce forest areas.	None apparent

3. Narrative

The Broad Pass Depression region will be traversed by the proposed Pioneer Road. The proposed road will leave the Denali Highway north of Butte Lake and follow the Deadman Creek drainage up to the Susitna River.

4. SCORE *(Circle Appropriate Level)**

	HIGH	MEDIUM	LOW	EXPLANATION OR RATIONALE
a. Landform	5	(3)	1	
b. Vegetation	5	(3)	1	
c. Water	5	(3)	0	
d. Color	5	(3)	1	
e. Influence	5	(3)	0	
f. Scarcity	6	(2)	1	
g. Cultural Modification	(2)	0	-4	
TOTALS	2 + 17 + 0 = 19			

SCENIC QUALITY CLASSIFICATION

[X] Class A – 19–33

[ ] Class B – 12–18

[ ] Class C – 11 or less

* *See Scenic Quality Rating Criteria in BLM Manual Section 8411*

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 2/13/79
District: Anchorage
Planning unit: Denali Block
Activity: Susitna Feasibility Study EAR

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
Pioneer Trail	Overhead	N/A

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T19S T20S T21S T22S T32N T33N	R1W R2W R3W R4W R5E R5E	N/A	See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory," page A1, A2, A3, A4

.007-A62 Broad Pass Depression
.007-A65 Fog Lakes Upland
- Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Introduction of block form and steep angles by cut, fills, stream crossings, etc. on rolling landscape.
	LINE	Introduction of straight line of road will contrast with pointed and curvilinear lines of the landscape horizon.
	COLOR	Interruption of color of natural rock faces
	TEXTURE	Introduction uniform gravel overlay on fine/smooth surfaces
2. VEGETATION	FORM	Rectangular interruption of irregular forms of vegetation clusters
	LINE	Creates long stretches of straight lines in contrast with undulating edge lines of vegetation clusters
	COLOR	Changes shades of green/yellow to shades of brown/tan
	TEXTURE	Changes variable, tufted coarse patches to uniform gravel texture
3. STRUCTURES	FORM	Blocks created by areas of cut and fills
	LINE	41 mile line generally following topography
	COLOR	Tan/brown
	EXTURE	Coarse gravel (200,000 cubic yards)

SECTION D. CONTRAST RATING [ ] SHORT TERM [X] LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND/WATER BODY (1) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	VEGETATION (2) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	STRUCTURES (3) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	(8)	4	0	12	(8)	4	0	12	(8)	4	0
	Line (3x)	9	6	(3)	0	(9)	6	3	0	(9)	6	3	0
	Color (2x)	6	4	(2)	0	6	(4)	2	0	6	(4)	2	0
	Texture (1x)	3	2	(1)	0	3	(2)	1	0	3	(2)	1	0
TOTALS		14				23				23			

1a. Maximum element contrast

Assumed VRM Class II - Moderate

b. Maximum feature contrast

Assumed VRM Class II - 12

2. Does project design meet visual resource management requirements? [ ] Yes [X] No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

Because of the strong line that would be created by the proposed 41 mile Pioneer Trail, realistic mitigation measures would not reduce visual contrast enough to conform to VRM Class II objectives.

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

2/13/79

District: Anchorage

Planning unit: Denali Block

Activity: Susitna Feasib lity Study EAR

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
Proposed Airstrips - 2000' & 5000'	Overhead	N/A

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T32N	R5E	22 & 23 or 27 & 26	See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory," page A1, A2, A3

007-A65-Fog Lakes Upland
- -Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Addition of 250,000 cubic yds. of gravel fill to landscape creating flat rectangular block with short, steep angled slopes.
	LINE	Sharp straight lines in opposition to undulating horizon lines
	COLOR	Coverage of exposed rock outcrops with tan/brown gravel overlay
	TEX-TURE	Coverage of smooth exposed rock outcrops with course gravel overlay
2. VEGETATION	FORM	Rectangular interruption of irregular forms of vegetative clusters
	LINE	Creates sharp straight lines in contrast with undulating edge lines of vegetation clusters.
	COLOR	Changes shades of green/yellow to shades of brown/tan
	TEX-TURE	Changes variable, tufted coarse patches to uniform gravel texture
3. STRUCTURES	FORM	2000'/5000' x 150' rectangular block
	LINE	Straight with sharp right angles
	COLOR	Tan/brown
	TEX-TURE	coarse gravel

SECTION D. CONTRAST RATING [ ] SHORT TERM [X] LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND/WATER BODY (1) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	VEGETATION (2) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	STRUCTURES (3) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	(12)	8	4	0	12	(8)	4	0	(12)	8	4	0
	Line (3x)	9	(6)	3	0	9	(6)	3	0	9	(6)	3	0
	Color (2x)	6	4	(2)	0	6	(4)	2	0	6	(4)	2	0
	Texture (1x)	3	2	(1)	0	3	(2)	1	0	3	2	(1)	0
TOTALS		21				20				23			

1a. Maximum element contrast

Assumed VRM Class II - Moderate

b. Maximum feature contrast

Assumed VRM Class II - 12

2. Does project design meet visual resource management requirements? [ ] Yes [XX] No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

Because of the strong form that would be created by the proposed airstrips, realistic mitigation measures would not reduce visual contrast enough to conform to VRM Class II objectives.

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

2/13/79

District: Anchorage

Planning unit: Denali Block

Activity: Susitna Feasibility Study EAR

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
Field Camp Gravel Pads	Overhead	N/A

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T32N	R5E	22 & 23 or 27 & 26	See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory", page A1, A2

.007 - A65 - Fog Lakes Upland
- - - Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Exact configuration is unknown, it is assumed that several rectangular blocks will be situated on smooth, rolling site
	LINE	Introduction of short straight lines on curvilinear topography
	COLOR	Interruption of color of rock out-crops (minor)
	TEXTURE	Introduction of uniform gravel overlay on fine/smooth surfaces
2. VEGETATION	FORM	Rectangular interruptions of irregular form of vegetation clusters
	LINE	Creates several short stretches of straight lines in contrast with natural edge lines of vegetation clusters.
	COLOR	Changes shades of green/yellow to shades of brown/tan
	TEXTURE	Changes variable, tufted coarse patches to uniform gravel overlay
3. STRUCTURES	FORM	Several rectilinear blocks created for construction pads
	LINE	Short straight lines with right angles
	COLOR	Tan/brown
	TEXTURE	Coarse gravel (5,000 cubic yards)

SECTION D. CONTRAST RATING [ ] SHORT TERM [X] LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND/WATER BODY (1) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	VEGETATION (2) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	STRUCTURES (3) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	(8)	4	0	12	(8)	4	0	12	(8)	4	0
	Line (3x)	9	6	(3)	0	9	6	(3)	0	9	(6)	3	0
	Color (2x)	6	4	(2)	0	6	(4)	2	0	6	(4)	2	0
	Texture (1x)	3	2	(1)	0	3	(2)	1	0	3	(2)	1	0
TOTALS		14				17				20			

1a. Maximum element contrast

Assumed to be VRM Class II - Moderate

b. Maximum feature contrast

Assumed to be VRM Class II - 12

2. Does project design meet visual resource management requirements? [ ] Yes [X] No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

Because of the moderate amount of line and form that would be created by the proposed gravel pads, it may be difficult to meet VRM Class II objectives. The following stipulations may accomplish a high degree of mitigation;

Management Objectives:

1. VRM Class II - Changes in any of the basic elements (form, line, color, texture) caused by the management activity should not be evident in the characteristic landscape. A contrast may be seen but should not attract attention.

2. Reduction of form and line created by gravel pads.

   a. break down sharp edge of pads to meet irregular lines of natural contours.

   b. feather edge of clearings surrounding pads to conform to natural vegetation lines.

   c. create natural seed bed by returning as much available overburden as possible to site.

   d. removal of certain pads that may display excessive visual intrusion.

   e. submission of clearing plans for approval and feedback prior to site disturbance.

   f. coordinate implementation of clearing plans with BLM landscape architect or designated representative.

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

2/14/79

District: Anchorage,

Planning unit: Denali Block

Activity: Susitna Feasibility Study EAR

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
Intra Site Trails Haul Trail - 1 mile and 4 mile	Overhead	N/A

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T32N	R5E		See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory," page A1, A2, A3

.007-A65 Fog Lakes Upland
- Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Low amount of block form and sharp angles introduced, especially critical on abutment cut and fills
	LINE	Introduction of straight line of haul road in contrast to undulating horizon lines of hills and vertical lines along river/stream bluffs
	COLOR	Interruption of color of natural rock faces
	TEXTURE	Introduction of uniform gravel overlay on fine/smooth surfaces
2. VEGETATION	FORM	Rectangular interruption of irregular forms of vegetation clusters
	LINE	Creates stretches of straight lines in contrast with feathered edge lines of vegetation clusters
	COLOR	Changes shades of green/yellow to shades of brown/tan
	TEXTURE	Changes variable, tufted coarse patches to uniform gravel texture
3. STRUCTURES	FORM	Blocks created by areas of cuts and fills
	LINE	1 mile or 4 miles of introduced line generally following topography
	COLOR	tan/brown
	TEXTURE	Coarse gravel (10,000 - 40,000 cubic yards of borrow material)

SECTION D. CONTRAST RATING [ ] SHORT TERM [X] LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	8	(4)	0	12	8	(4)	0	12	(8)	4	0
	Line (3x)	9	6	(3)	0	9	(6)	3	0	9	(6)	3	0
	Color (2x)	6	4	(2)	0	6	4	(2)	0	6	4	(2)	0
	Texture (1x)	3	2	(1)	0	3	2	(1)	0	3	2	(1)	0
TOTALS		10				13				17			

1a. Maximum element contrast

Assumed VRM Class II - Moderate

b. Maximum feature contrast

Assumed VRM Class II - 12

2. Does project design meet visual resource management requirements? [ ] Yes [XX] No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

As proposed, this action does not meet VRM Class II objectives. With proper mitigation, however, it is likely that these activities can achieve a successful degree of rehabilitation. The following measures will offer some degree of mitigation;

Management Objectives:

1. VRM Class II - Changes in any of the basic elements (form, line, color, texture) caused by the management activity should not be evident in the characteristic landscape. A contrast may be seen but should not attract attention.

2. Reduction of strong line created by intra-site and haul trails.

   a. Removal of visually intrusive sections of trails.

   b. Round and warp slopes in areas of extensive cuts and fills.

   c. Minimize amount of cut and fill.

   d. Feather edge of right-of-way clearing during alignment process.

   e. Scarify, reseed with native species, fertilize, and mulch areas which have an existing nutrient regimen, otherwise, scarify and mulch areas to create natural seed bed.

   f. Submission of clearing and alignment plans for approval and feedback prior to site disturbance.

   g. Coordinate implementation of clearing and alignment with BLM landscape architect or designated representative.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 2/13/79
District: Anchorage
Planning unit: Denali Block
Activity: Susitna Feasil ility Study EAR

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
1. Proposed Borrow Sources 2. Alternative	Overhead	N/A

4a. LOCATION

	TOWNSHIP	RANGE	SECTION
1.	T32N	R5E	16
2.	T32N	R5E	30, 31
	T32N	R4E	36

b. LOCATION MAP

See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory," page A1, A2
.007 - A65 Fog Lakes Upland
---- Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Introduction of smooth sharp cuts along creek and river by back slopes and terracing through removal of 265,000 cubic yards of gravel.
	LINE	Straight lines and sharp angles introduced into random lines of bluff area
	COLOR	Little change in color
	TEX-TURE	Introduction of smooth bluff faces in contrast to random coarse texture of original bluff
2. VEGETATION	FORM	Removal of some vegetation blocks
	LINE	Removal of some vegetation edge lines
	COLOR	Changes shades of green/yellow to brown/tan
	TEX-TURE	Changes variable, tufted coarse patches to uniform gravel texture
3. STRUCTURES	FORM	
	LINE	Not applicable to borrow sources
	COLOR	
	TEX-URE	

SECTION D. CONTRAST RATING [ ] SHORT TERM [X] LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND/WATER BODY (1) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	VEGETATION (2) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	STRUCTURES (3) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	(12)	8	4	0	12	8	(4)	0	12	8	4	(0)
	Line (3x)	9	6	(3)	0	9	6	(3)	0	9	6	3	(0)
	Color (2x)	6	4	(2)	0	6	(4)	2	0	6	4	2	(0)
	Texture (1x)	3	2	(1)	0	3	(2)	1	0	3	2	1	(0)
TOTALS		18				13				0			

1a. Maximum element contrast

Assumed VRM Class II - Moderate

b. Maximum feature contrast

Assumed VRM Class II - 12

2. Does project design meet visual resource management requirements? [ ] Yes [X] No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

The excavation of 265,000 cubic yards of gravel in either site will introduce a high degree of modification of existing form. The alternative site situated at the confluence of Tsusena Creek and the Susitna River is critical because of visual intrusion into the river corridor. In either case a high degree of mitigation will be necessary in order to meet VRM Class II objectives. The following stipulations will offer some degree of mitigation;

Management Objectives:

1. VRM Class II - Changes in any of the basic elements (form, line, color, texture) caused by the management activity should not be evident in the characteristic landscape. A contrast may be seen but should not attract attention.

2. Reduction of contrast in form created by excavation of borrow sources.

   a. Clear vegetation in sections while excavations are occuring; 100' should be maximum area cleared.

   b. Remove, stockpile, and backfill all overburden for use in rehabilitation.

   c. Develop irregular, serrated terraces and headwalls to expedite re-vegetation and maintain natural form.

   d. Strategically revegetate areas along terraces and headwalls. Reseed with native species, fertilize, and mulch areas that may have an existing nutrient regimen; otherwise, mulch areas to create natural seedbed.

   e. Submission of mining and rehabilitation plans prior to excavation activities.

   f. Coordinate mining rehabilitation plans with BLM landscape architect or designated representative.

SECTION D. CONTRAST RATING [ ] SHORT TERM [XX] LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND WATER BODY (1) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	VEGETATION (2) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	STRUCTURES (3) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	(8)	4	0	12	(8)	4	0	12	8	4	(0)
	Line (3x)	9	(6)	3	0	9	6	(3)	0	9	6	3	(0)
	Color (2x)	6	4	(2)	0	6	4	(2)	0	6	4	2	(0)
	Texture (1x)	3	2	(1)	0	3	2	(1)	0	3	2	1	(0)
TOTALS		17				14				0			

1a. Maximum element contrast

Assumed VRM Class II - Moderate

b. Maximum feature contrast

Assumed VRM Class II - 12

2. Does project design meet visual resource management requirements? [ ] Yes [XX] No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not preclude additional mitigating measures; propose as stipulations, and list in section E.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

Because of the moderate amount of modification in the landform, this activity will not meet VRM Class II objectives as proposed. The following measures may accomplish a certain amount of mitigation;

Management Objectives:

1. VRM Class II - Changes in any of the basic elements (form, line, color, texture) caused by the management activity should not be evident in the characteristic landscape. A contrast may be seen but should not attract attention.

2. Reduction of contrast of form and line created by blasting activities.

   a. Minimize area to be blasted.

   b. Limit casting of material to within 50' of trench.

   c. Leave overburden and prostrate plant species in place during blasting activities to expedite revegetation.

   d. Use hand tools to smooth disturbed areas after exploration is completed. Light earthwork equipment may be utilized if no further site disturbance will occur.

   e. Coordinate blasting and rehabilitation activities with BLM landscape architect or designated representative.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 2/14/79
District: Anchorage
Planning unit: Denali Block
Activity: Susitna Feasibility Study EAR

SECTION A. PROJECT INFORMATION

1. Project name: Watana Borrow Site Exploration and Testing - Quarry Site A (Blasting)
2. Critical viewpoint number: Overhead
3. MFP Step III VRM class: N/A

4a. LOCATION

TOWNSHIP	RANGE	SECTION
T32N	R5E	

b. LOCATION MAP: See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory," page A1, A2, A3

.007-A65 Fog Lakes Upland
- Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Reduction of solid rock face to random, scattered blocks of irregular size and shape
	LINE	Introduction of numerous opposing, angular, straight lines on smooth rock face
	COLOR	Little change in color
	TEXTURE	Introduction of sharp, rough texture
2. VEGETATION	FORM	Removal
	LINE	Removal
	COLOR	Removal
	TEXTURE	Removal
3. STRUCTURES	FORM	
	LINE	Not applicable to Quarry Site A exploration
	COLOR	
	TEXTURE	

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 2/15/79
District: Anchorage
Planning unit: Denali Block
Activity: Susitna Feasiblity Study EAR

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
Watana Damsite Drilling - trenches	Over head	N/A

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T32N	R5E		See proposed activity map in EAR

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

See "Scenic Quality Field Inventory", page A1, A2, A3

.007-A65 Fog Lakes Upland
- Upper Susitna River

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	Introduction of 20 trenches, 10'x50'x15' deep, along each abutment; forming rectangular blocks in opposition to natural bluff form.
	LINE	Straight lines and sharp angles introduced into random lines of bluff
	COLOR	Little change in color
	TEXTURE	Little change in texture
2. VEGETATION	FORM	Extremely visible rectangular interruptions of irregular form of vegetation clusters
	LINE	Creates uniform rows of straight lines in contrast with natural edge lines of vegetation clusters
	COLOR	Changes shades of green/yellow to shades of brown/tan
	TEXTURE	Creates exposed coarse soil texture from tufted vegetation patches
3. STRUCTURES	FORM	
	LINE	Not applicable to Watana Damsite Drilling - trenches
	COLOR	
	TEXTURE	

SECTION D. CONTRAST RATING | | SHORT TERM | X | LONG TERM

DEGREE OF CONTRAST		FEATURES: LAND/WATER BODY (1) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	VEGETATION (2) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	STRUCTURES (3) Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	(8)	4	0	(12)	8	4	0	12	8	4	(0)
	Line (3x)	9	6	(3)	0	9	(6)	3	0	9	6	3	(0)
	Color (2x)	6	4	(2)	0	6	(4)	2	0	6	4	2	(0)
	Texture (1x)	3	2	(1)	0	3	(2)	1	0	3	2	1	(0)
TOTALS		14				24				0			

1a. Maximum element contrast

Assumed VRM Class II - Moderate

b. Maximum feature contrast

Assumed VRM Class II - 12

2. Does project design meet visual resource management requirements? ☐ Yes ☒ No

If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section F.

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

Because of the strong amount of form modification to vegetation patterns that would be created by the proposed activity, it may be difficult to meet VRM Class II objectives. The following actions may accomplish some degree of mitigations;

Management Objectives:

1. VRM Class II - Changes in any of the basic elements (form, line, color, texture) caused by the management activity should not be evident in the characteristic landscape. A contrast may be seen but should not attract attention.

2. Reduction form and line created by trenches aligned perpendicular to slope along abutments.

   a. Backfill all trenches and re-contour to grade.

   b. Reseed with native species, fertilize, and mulch areas that may have an existing nutrient regimen; otherwise, mulch areas to create natural seed bed.

   c. Allow controlled drainage between trenches to re-establish vertical bluff lines.

   d. Coordinate trenching activities with BLM landscape architect or authorized representative before commencing activity.

EXPLANATION OF GENERAL MITIGATION MEASURES

1. SLOPE ROUNDING

Slope rounding, although beneficial for revegetative purpose, is also a definite and positive means of blending landform modifications with existing landforms. It breaks the sharp unnatural edges formed by the junction of a constant pitch cut slope with the natural rounded landform.

2. WARPING SLOPES

A further refinement of slope blending is to vary the pitch of cut and full slopes. It involves slope rounding in both vertical and horizontal form as a more natural extension of landform surface configurations. In some cases, it has been improperly used in conjunction with constant clearing widths in order to simplify staking.

3. SHAPING OF BORROW AREAS

Similar methods of blending landforms of cut and fill slopes can be applied to borrow area excavations. Slopes can be improved by a combination of slope warping and rounding to simulate natural landform configurations.

4. SPREADING TOPSOIL ON DISTURBED SOIL

Since most disturbed soils in mountainous areas are much lighter colored than the undisturbed cover, there is a high potential for contrast reduction if dark topsoils are spread over such cut and fill slopes. The primary benefit of such action is improved revegetation potential.

5. MULCHING WITH LOW CONTRAST MATERIALS

Closely related to topsoil dressing of slopes is the use of mulching material of colors that blend with undisturbed soil areas. Increased revegetative potential is a by-product.

6. MULCHING AND TOPSOILING

The mulching and topsoiling of cut and fill slopes will often have a beneficial texture constrast-reduction effect. It has the added advantage of reducing color contrast and improving revegetation.

7. SCARIFIED CUT SLOPES

Cut slopes which are highly manicured are seldom in harmony with the natural land surface texture. Cut faces have in some cases been known to shine for lack of texture or surface variation. Random pattern scarification is most desirable. Again, a side benefit of scarification is improved moisture retention and revegetation potential.

8. BROKEN-FACE ROCK BLASTING

Strive for a broken-faced rock cut effect in areas where it would blend in (exception - glacially polished areas). Encourage minimal manicuring of rock cuts to allow for rough texture with interplay of light and shadow. This will also provide planting pockets in the rocks which will allow more rapid revegetation for additional texture and color.

9. REVEGETATION

There are several actions that can be taken to reduce contrast in revegetation activities.

Dispersion of new plantings into existing vegetative patterns. ——Ordinarly, from a purely erosion-control standpoint, revegetation is limited to those areas within the clearing limits. Such limitations tend to further accentuate contrast.

It would be more desirable to feather the revegetation edge as well as the clearing edge. Again, this would allow a transitional band rather than a sharp edge. Some modification of standard specifications would be necessary to accomplish this effect.

Encouraging mixtures of plants.——Rather than utilize a single type of plant in revegetation, it will often be desirable to utilize a mix of grasses, wildflowers, shrubs and trees.

Greater variety of line, form, color, and texture thus achieved will better blend with adjacent undisturbed areas. Chances of plant establishment are also improved. Of course, this should be done with discretion; planting or seeding of trees across meadow or grassland cut or fill slopes would be entirely out of order.

Selection of plants with sizes, forms, colors, and textures which blend with existing vegetation.——Normally, plants of a type native to the area should be utilized to reduce contrasts. In cases where it is necessary to utilize nonnative species, they should be selected on the basis of their visual compatibility with the remaining native plants.

10. FEATHERING CLEARING EDGES FOR GRADUAL TRANSITION

In addition to undulating the clearing line, another key method of reducing the line, form, color, and texture contrast is to feather the edges. Successful feathering involves a reduction of vegetative density in transitional degrees as well as a gradation of tall vegetation down to low vegetation at the clearing edge. Thus, the contrast is faded out into a wide transitional band and focalization on an artificial line is decreased.

11. DEVELOPING PLANTING HOLES OR POCKETS IN ROCK OR STEEP SLOPES

A variation of serrations is individual planting pockets on steep slops. Although the function is similar, this method would almost always require handwork. In soft but pure granite rock, planting have been made by punching holes in weak spots with a bar and inserting 2-inch potted plants or by direct seeding.

On rock slopes which have been unevenly fractured, there are opportunities to create planting pockets by filling in natural pockets with soil or by purposely developing them by additional blasting. The length of time required to revegetate such sterile slopes can be significantly decreased.

SOURCE: National Forest Landscape Management; "Volume 2, Chapter 4 - Roads"
Forest Service, USDA

Appendix B

Tabulation Of Field Activities According To Season And Year Of Accomplishment

APPENDIX B

TABULATION OF FIELD ACTIVITIES ACCORDING TO SEASON AND YEAR OF ACCOMPLISHMENT

YEAR 1

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SURVEY												
Survey River Cross Sections									X	X	X	X
Damsites, Reservoirs, Access Roads, Transmission Corridors						X	X	X				
HYDROLOGY												
Collect Climatic Data						X	X	X	X	X	X	X
Collect Water Data						X	X	X	X	X	X	X
Collect Wind Data						X	X	X	X	X	X	X
ENVIRONMENTAL (WATER QUALITY)												
Collect Physical, Chemical & Biological Water Data						X	X	X	X	X	X	X
RECREATION												
Develop Plans for Public Recreation & Resource Uses												
FOUNDATIONS AND MATERIALS												
Siesmic Monitoring			X	X	X	X	X	X	X	X	X	X
Access Road Studies					X	X	X	X	X			
Transmission Line Studies					X	X	X	X	X			
Watana Site Geology			X	X	X	X	X	X	X			
Watana Borrow Site Exploration & Testing						X	X	X	X	X	X	X
Watana Damsite Drilling			X	X	X	X	X	X	X	X	X	X
Watana Geophysical Investigation						X	X	X	X			
Watana Features Design			X	X	X	X	X	X	X	X	X	X
Devil Canyon Geology			X	X	X	X	X	X	X	X		
Devil Canyon Damsite Drilling							X	X	X	X	X	X
Devil Canyon Aggregate Studies							X	X	X	X	X	X
DESIGN												
Site Inspections					X	X	X	X	X			
REAL ESTATE												
Aerial Field Inspections							X					
CULTURAL RESOURCES												
Archeological & Historical Site Recon						X	X	X	X			
FIELD CAMP												
Operate Field Camp			X	X	X	X	X	X	X	X	X	X
BIOLOGICAL STUDIES												
Anadromous & Resident Fisheries Studies					X	X	X	X	X	X	X	X
Wildlife Studies					X	X	X	X	X	X	X	X

(NOTE: YEAR 1 activities will not begin until March)

TABULATION OF FIELD ACTIVITIES ACCORDING TO
SEASON AND YEAR OF ACCOMPLISHMENT

YEAR 2

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SURVEY												
Survey River Cross Sections	X	X										
Damsites, Reservoirs, Access Roads, Transmission Corridors				X	X	X	X	X	X			
HYDROLOGY												
Collect Climatic Data	X	X	X	X	X	X	X	X	X	X	X	X
Collect Water Data	X	X	X	X	X	X	X	X	X	X	X	X
Collect Wind Data	X	X	X	X	X	X	X	X	X	X	X	X
ENVIRONMENTAL (WATER QUALITY)												
Collect Physical, Chemical & Biological Water Data	X	X	X	X	X	X	X	X	X	X	X	X
RECREATION												
Develop Plans for Public Recreation & Resource Uses							X					
FOUNDATIONS AND MATERIALS												
Siesmic Monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Access Road Studies					X	X	X	X	X			
Transmission Line Studies					X	X	X	X	X			
Watana Site Geology			X	X	X	X	X	X	X			
Watana Borrow Site Exploration & Testing	X	X	X	X	X	X	X	X	X	X	X	X
Watana Damsite Drilling	X	X	X	X	X	X	X	X	X	X	X	X
Watana Geophysical Investigation						X	X	X	X			
Watana Features Design	X	X	X	X	X	X	X	X	X	X	X	X
Devil Canyon Geology			X	X	X	X	X	X	X	X		
Devil Canyon Damsite Drilling	X	X	X	X	X	X	X	X	X	X	X	X
Devil Canyon Aggregate Studies					X	X	X	X	X			
DESIGN												
Site Inspections					X	X	X	X	X			
REAL ESTATE												
Aerial Field Inspections							X					
CULTURAL RESOURCES												
Archeological & Historical Site Recon						X	X	X	X			
FIELD CAMP												
Operate Field Camp	X	X	X	X	X	X	X	X	X	X	X	X
BIOLOGICAL STUDIES												
Anadromous & Resident Fisheries Studies	X	X	X	X	X	X	X	X	X	X	X	X
Wildlife Studies	X	X	X	X	X	X	X	X	X	X	X	X

TABULATION OF FIELD ACTIVITIES ACCORDING TO
SEASON AND YEAR OF ACCOMPLISHMENT

YEAR 3

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SURVEY												
Survey River Cross Sections Damsites, Reservoirs, Access Roads, Transmission Corridors				X	X	X	X	X	X			
HYDROLOGY												
Collect Climatic Data	X	X	X	X	X	X	X	X	X	X	X	X
Collect Water Data	X	X	X	X	X	X	X	X	X	X	X	X
Collect Wind Data	X	X	X	X	X	X	X	X	X	X	X	X
ENVIRONMENTAL (WATER QUALITY)												
Collect Physical, Chemical & Biological Water Data	X	X	X	X	X	X	X	X	X	X	X	X
RECREATION												
Develop Plans for Public Recreation & Resource Uses												
FOUNDATIONS AND MATERIALS												
Siesmic Monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Access Road Studies					X	X	X	X	X			
Transmission Line Studies					X	X	X	X	X			
Watana Site Geology			X	X	X	X	X	X	X			
Watana Borrow Site Exploration & Testing	X	X	X	X	X	X	X	X	X	X	X	X
Watana Damsite Drilling	X	X	X	X	X	X	X	X	X	X	X	X
Watana Geophysical Investigation						X	X	X	X			
Watana Features Design	X	X	X	X	X	X	X	X	X	X	X	X
Devil Canyon Geology			X	X	X	X	X	X	X	X		
Devil Canyon Damsite Drilling	X	X	X	X	X	X	X	X	X	X	X	X
Devil Canyon Aggregate Studies					X	X	X	X	X			
DESIGN												
Site Inspections					X	X	X	X	X			
REAL ESTATE												
Aerial Field Inspections												
CULTURAL RESOURCES												
Archeological & Historical Site Recon						X	X	X	X			
FIELD CAMP												
Operate Field Camp	X	X	X	X	X	X	X	X	X	X	X	X
BIOLOGICAL STUDIES												
Anadromous & Resident Fisheries Studies	X	X	X	X	X	X	X	X	X	X	X	X
Wildlife Studies	X	X	X	X	X	X	X	X	X	X	X	X

TABULATION OF FIELD ACTIVITIES ACCORDING TO
SEASON AND YEAR OF ACCOMPLISHMENT

YEAR 4

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SURVEY												
Survey River Cross Sections Damsites, Reservoirs, Access Roads, Transmission Corridors				X	X	X	X	X	X			
HYDROLOGY												
Collect Climatic Data	X	X	X	X	X	X	X	X	X	X	X	X
Collect Water Data	X	X	X	X	X	X	X	X	X	X	X	X
Collect Wind Data	X	X	X	X	X	X	X	X	X	X	X	X
ENVIRONMENTAL (WATER QUALITY)												
Collect Physical, Chemical & Biological Water Data	X	X	X	X	X	X	X	X	X	X	X	X
RECREATION												
Develop Plans for Public Recreation & Resource Uses												
FOUNDATIONS AND MATERIALS												
Siesmic Monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Access Road Studies					X	X	X	X	X			
Transmission Line Studies					X	X	X	X	X			
Watana Site Geology			X	X	X	X	X	X	X			
Watana Borrow Site Exploration & Testing	X	X	X	X	X	X	X	X	X	X	X	X
Watana Damsite Drilling	X	X	X	X	X	X	X	X	X	X	X	X
Watana Geophysical Investigation						X	X	X	X			
Watana Features Design	X	X	X	X	X	X	X	X	X	X	X	X
Devil Canyon Geology			X	X	X	X	X	X	X	X		
Devil Canyon Damsite Drilling	X	X	X	X	X	X	X	X	X	X	X	X
Devil Canyon Aggregate Studies					X	X	X	X	X			
DESIGN												
Site Inspections					X	X	X	X	X			
REAL ESTATE												
Aerial Field Inspections												
CULTURAL RESOURCES												
Archeological & Historical Site Recon						X	X	X	X			
FIELD CAMP												
Operate Field Camp	X	X	X	X	X	X	X	X	X	X	X	X
BIOLOGICAL STUDIES												
Anadromous & Resident Fisheries Studies	X	X	X	X	X	X	X	X	X	X	X	X
Wildlife Studies	X	X	X	X	X	X	X	X	X	X	X	X

APPENDIX C

REFERENCES

APPENDIX C

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