SUSITNA
HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

WILDLIFE AND BOTANICAL RESOURCES IMPACT ASSESSMENT AND MITIGATION PLANNING SUMMARY

LGL Alaska Research Associates

UNDER CONTRACT TO

HARZA-EBASCO
SUSITNA JOINT VENTURE

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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

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Report by
LGL Alaska Research Associates, inc.

Under Contract to
Harza-Ebasco Susitna Joint Venture

Prepared for
Alaska Power Authority

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NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING
THIS REPORT SHOULD BE DIRECTED TO
THE ALASKA POWER AUTHORITY
SUSITNA PROJECT OFFICE

P R E F A C E

This document provides an overview of potential impacts of the Susitna Hydroelectric Project on wildlife and botanical resources of the project area, and indicates the status of planning to mitigate those impacts. The purpose is to provide a working record of impact assessment and mitigation planning in the form of a summary that is updated periodically. During the course of major energy development projects, the tracking of environmental concerns from impact assessment through mitigation proposals and subsequent action can become a cumbersome process. The following summary is organized in matrix format to ease this process and to provide quick reference to current impact and mitigation reasoning. This record is presented to encourage input by all interested parties and to inform decision-makers of the current state of thought concerning relevant resource issues.

Much of the information contained in the matrix was summarized from Exhibit E of the project license application to the Federal Energy Regulatory Commission (FERC). Descriptions of ongoing and planned studies were obtained from the Alaska Power Authority's Fiscal Year 1984 and Fiscal Year 1985 plans of study for terrestrial programs. Most of the potential impact mechanisms listed in the matrix were defined by project biologists on the basis of studies sponsored since 1981 by the Alaska Power Authority. Other impact mechanisms suggested by resource agencies are also listed. Although they have received attention, the inclusion of these additional hypotheses does not imply that they are based on results of studies by project biologists, or that the conjectured mechanisms will produce significant impacts.

A potential impact mechanism is considered to be significant if, in the judgment of project biologists, that mechanism is likely to produce an observable and persistent change, beyond natural cyclic fluctuations, in the number or distribution of individuals of a particular species (or group of species) in the Susitna project area as a result of project construction and/or operation. About 22 percent of the impact mechanisms listed in the matrix are currently considered to be in this category. For most of these, sufficient information already exists to support ongoing mitigation planning, and additional studies are not necessary. The remaining potentially significant but unresolved mechanisms are receiving further study, and the list of topics requiring such study is shortening as results accrue.

About 78 percent of the potential impact mechanisms listed in the matrix are marked with an asterisk. This indicates that they are not considered to be significant and will not be subject to further studies or mitigation planning beyond standard engineering practice and, in some cases, field monitoring. Future revisions of this tracking system will provide an updated record of potential impact mechanisms that are, or are not, considered to significant by the Alaska Power Authority.

The matrix is organized to show for each type of potential impact the current assessment status, ongoing or planned studies, monitoring plans, and mitigation plans that are relevant to that impact. The major column headings describe the steps in the planning process as follows:

I) Affected Species or Group: lists each species or group of species of concern in the project area and surrounding region.

II) Impact Mechanism: briefly explains how various aspects of the project might affect each listed species or group.*

III) Impact Assessment Status: provides an evaluation of the potential impact, including its perceived importance to the affected species or group and any quantification of the impact that has been developed.

IV) Ongoing and Planned Studies: provides a summary of investigations that are in progress or planned for the near future and that are relevant to refining the particular impact assessment or mitigation plan.

V) Proposed Monitoring: summarizes field monitoring programs that are proposed to be conducted during project construction and operation to document impacts and to assist in mitigating them.

VI) Proposed Mitigation Measures: summarizes measures that have been proposed to assist in mitigating the effects of the pertinent impact mechanism.

* Indicates that the potential impact mechanism is not likely to be significant and does not warrant further study or mitigation planning beyond standard engineering practice and, in some cases, field monitoring.

(continued on next page)

Each cell of the matrix can be uniquely identified by column (vertical) and row (horizontal). To identify a particular cell, it should be cited first by the Affected Species or Group letter; second, by the Impact Mechanism number; and third, by column heading III, IV, V, or VI. For example, the cell on page 1 describing proposed measures to mitigate permanent loss of moose habitat due to the impoundments and other permanent facilities would be cited as A1/VI. This format provides a shorthand notation intended to allow specific topics within the matrix to be cited quickly and precisely in communications concerning impact assessment and mitigation topics.

A reference section is provided at the end of this document. It explains that, to save space, citations in the matrix differ from standard citation formats typically used in reports. Successive revisions of the matrix will include an increasing number of citations; the goal is to provide document and page references for all project-related reports and other project communications in which a particular impact mechanism, impact assessment, existing or proposed study, proposed monitoring program, or proposed mitigation plan is discussed.

The information contained in the present revision (Revision 0) of this document represents the status of impact assessment and mitigation planning in the spring of 1984. Ongoing studies sponsored by the Alaska Power Authority are continuing to provide new and updated information pertinent to the evaluation of potential impacts. Revision 1 and subsequent revisions of this document will include information provided by these studies and by impact assessment and mitigation planning refinement reports, in some cases altering the conclusions contained in Revision 0.

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(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	(1) Permanent habitat loss due to the impoundments and other permanent facilities	Habitat-based assessment is in progress; refinement of moose carrying capacity model will quantify estimated impact magnitude (pp. E-3-412 to E-3-414)	Refinement of population (FY84 Task 4.1.10; FY85 Task 16) and carrying capacity (FY84 Task 4.1.9; FY85 Task 11) models to better estimate impacts on moose and determine acreage of habitat compensation is being conducted and planned. 1:63,360 scale vegetation mapping emphasizing understory moose forage is currently underway (FY84 Task 4.1.5) and is scheduled for completion in Jan. 1985 (FY85 Task 8). A food habits study (FY84 Task 4.1.7) and browse inventory (FY84 Task 4.1.8; FY85 Task 13) planned for FY85-86 will support the ongoing carrying capacity model development by ADF&G. A pilot browse study identifying appropriate methodology for the browse inventory has been completed (FY84 Task 4.1.6). Identification and assessment of candidate compensation lands is underway (FY84 Task 4.1.12) and planned for 1985 (FY85 Task 12). A literature review of habitat enhancement techniques is underway (FY84 Task 4.1.11) and field studies of disturbed areas are planned (FY85 Task 14). Field studies designed to census the area surrounding the impoundments, monitor habitat use, document calf mortality, and monitor winter severity have been conducted (FY84 Task 4.1.3). Continued documentation of calf mortality (FY85 Task 9) and monitoring of habitat use and winter severity (FY85 Task 10) are planned. Impacts will be further addressed through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Transmission corridors will provide almost 78,100 acres of winter habitat of reasonable quality (p. E-3-528; Table E.3.145). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7). If needed, controlled moose hunt to avoid over-browsing by displaced moose (p. E-3-530 #8). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	(2) Permanent habitat loss and habitat alteration due to the access corridor.	Small area of permanent habitat loss. Regeneration of woody plants will eventually provide additional areas of high quality browse along the corridor (p. E-3-398).	Included in (A)(1).	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7). Changes in design and alignment of access road to reduce impacts on caribou and other species (p. E-3-533 #11). Minimize loss of forest areas through alignment of access road and transmission corridor, and other measures (pp. E-3-539 #23, E-3-525 #1, E-3-526 #2). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (pp. E-3-291, E-3-292 #1-11). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	(2) Permanent habitat loss and and habitat alteration due to the access corridor (cont.).				Avoidance of the Prairie Creek, Stephan Lake, Fog Lakes and Indian River areas by access routing (p. E-3-292 #14). Design and alignment measures to minimize impacts on wetlands (p. E-3-292 #18, 19).
	* (3) Alteration of moose distribution due to corridor traffic and disturbance.	May cause some initial displacement of a small number of animals. Moose may become habituated to traffic and other neutral or predictable disturbances over time (Table E.3.145). Not expected to be significant.	Impact severity not sufficient to require study.	Collect mortality data on road and railroad collisions (p. E-3-523 #1).	Major ground activity will be prohibited near sensitive wildlife areas during sensitive periods (p. E-3-532 #10). Changes in design and alignment of access road to reduce impacts on caribou and other species (p. E-3-533 #11). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12). Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13). Avoidance of the Prairie Creek, Stephan Lake, Fog Lakes and Indian River areas by access routing (p. E-3-292 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit impacts on vegetation and wildlife (p. E-3-292 #16-17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	(4) Clearing of the impoundment area will reduce winter carrying capacity prior to flooding.	Clearing may reduce winter carrying capacity of the impoundment zone 1-2 years prior to filling (p. E-3-398; Table E.3.145).	Refinement of population (FY84 Task 4.1.10; FY85 Task 16) and carrying capacity (FY84 Task 4.1.9; FY85 Task 11) models to better estimate impacts on moose and determine acreage of habitat compensation is being conducted and planned.	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7). If needed, controlled moose hunt to avoid over-browsing by displaced moose (p. E-3-530 #8). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (p. E-3-291, E-3-292 #1-11). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12).
	*(5) Temporary loss of winter habitat on borrow sites.	Winter habitat for an estimated 37 moose will be affected based on preliminary carrying capacity data. Revegetation is likely to restore these areas as moose habitat from 2-20 years following disturbance (Table E.3.145).	Included in (A)(4).	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Revegetation and fertilization of disturbed sites (p. E-3-526 #3).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	*(5) Temporary loss of winter habitat on borrow sites (cont.).				Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7). Minimize loss of forest areas through alignment of access road and transmission corridor, and other measures (pp. E-3-539 #23, E-3-525 #1, E-3-526 #2). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12). Design and alignment measures to minimize impacts on wetlands (p. E-3-292 #18, 19).
	*(6) Continued habitat loss due to erosion of impoundment shores.	Erosion will be most prevalent on currently unstable slopes. Expected to be of limited significance (Table E.3.145).	Further analysis of areas potentially affected by this impact mechanism is underway through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #4).	Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	(7) Habitat improvement will occur along the transmission line corridor due to maintenance of vegetation at early successional stages.	The transmission corridors will provide up to 78,100 acres of winter habitat of reasonable quality (p. E-3-529; Table E.3.145). Represents a beneficial impact on moose.	A literature review of habitat enhancement techniques is underway (FY84 Task 4.1.11) and field studies of disturbed areas are planned (FY85 Task 14).		Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4).
	* (8) Drifting snow from the impoundment surface may preclude use of a narrow band of winter browse along the impoundment shore.	Snow drifts are unlikely to extend more than 100-200 yds into wooded habitats. The drawdown zone and ice shelves will catch much windblown snow. The value of the Fog Lakes area will be unaffected (Table E.3.145).	Assessment of snow drifting impacts will be addressed during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6).
	*(9) Drifting snow in the transmission line corridor may preclude use of winter browse.	Impact not quantified but not expected to be significant (Table E.3.145).	Assessment of snow drifting impacts will be addressed during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Selective clearing in the transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Minimize loss of forest areas through alignment of access road and transmission corridor, and other measures (p. E-3-539 #23).
	*(10) Delayed melting of snow drifts in a narrow band along both impoundment shores and the transmission corridor may reduce availability of spring forage.	Availability will be delayed in this zone but forage will eventually become usable as the spring thaw progresses. Actual area of early spring forage that may be affected will be a narrow band (100-200 yds) confined along the impoundment shore. Impacts are not expected to be significant (Table E.3.145).	Assessment of snow drifting impacts will be addressed during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	* (11) Climatic changes due to the impoundments (e.g., increased summer rainfall, increased winds, cooler summer temperatures, increased early-winter snowfall, and hoar frost deposition) may reduce habitat carrying capacity (p. E-3-406). Delayed plant phenology may occur immediately adjacent to the reservoir due to its cooling effect, reducing spring forage for moose, and possibly causing some changes in plant composition (p. E-3-400).	Available data from Williston Reservoir, B.C., indicate that these subtle climatic effects will likely be undetectable and of little impact on moose habitats (Table E.3.145). Impact would be influenced by the reservoir width and prevailing wind direction in spring.	1983 plant phenology study will document physical and environmental variables affecting availability and development of early spring forage (FY84 Task 4.1.4). Impacts of local climate changes will be addressed during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7).
	* (12) Altered plant phenology due to open and warmer water may affect moose spring forage and cover in downstream areas.	Impact not quantified but not expected to be significant.	Impact severity not sufficient to require study.	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).
	* (13) Vegetation icing (hoar frost) downstream may render some browse unavailable, and metabolic demands of moose may increase.	Impact not quantified but not expected to be significant (Table E.3.145). Icing (hoar frost) will likely be heaviest within the steep canyon and may not preclude use of browse by moose. Impacts of increased metabolism for moose eating hoar frost would be difficult to detect (p. E-3-408).	Assessment of ice accumulation on downstream vegetation is being refined during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).
	(14) Alteration of downstream habitats will occur due to altered seasonal and annual river flow regimes.	Impact not quantified. Reduced size of river islands, loss of fertilization effects of spring flooding, and loss of some early successional habitats (particularly early seral stages dominated by willow) may lower habitat values for moose (p. E-3-408). See impact category (R)(12).	Refinement of downstream vegetation impact assessment to better assess effects on moose habitat will continue (FY84 Task 4.2.4; FY85 Tasks 5, 15, and 23).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	* (15) Open water and/or ice shelving in the impoundments may block access to traditional calving and wintering areas.	Some moose may not cross the impoundment due to ice blockage and visual barrier effects. Moose will probably alter seasonal movements and crossings to maximize use of surrounding browse and forage supplies (p. E-3-410). Not expected to be significant.	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #4).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9).
	*(16) Ice shelving or floating debris may cause direct mortality to moose attempting to cross the impoundment.	Impact not quantified but not expected to be significant (Table E.3.145).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #4).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9).
	*(17) Prior to filling, clear-cut areas in the impoundment may inhibit movements due to slash piles and human disturbance.	Noisy and unpredictable activities will probably cause avoidance of the area and extend the range of effective habitat loss during clearing beyond the mechanically disturbed area (Table E.3.145).	Impact severity of this disturbance is not sufficient to require study.		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Major ground activity will be prohibited near sensitive wildlife areas during sensitive periods (p. E-3-532 #10).
	*(18) Snow drifts may impede movements south and southwest of the reservoir and reduce the value of the Fog Lakes area as winter range.	Snow drifts are unlikely to extend more than 100-200 yds into wooded habitats. The drawdown zone and ice shelves will catch much windblown snow. The value of the Fog lakes area will be unaffected. Impact not expected to be significant (Table E.3.145).	Impact assessment refinement will address this impact (FY84 Task 3.1.3; FY85 Task 5).		
	*(19) Increase in mortality due to train and automobile collisions caused by increase in traffic levels.	Impact not quantified, likely to be most severe during construction phases (Table E.3.145).	Impact will be addressed through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect mortality data on road and railroad collisions (p. E-3-523 #1).	Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	* (20) Open water downstream may restrict movements across the river and to island wintering areas (as far downstream as Gold Creek [Watana only] and Talkeetna [both dams]). Attempted crossings of open river areas in winter may lead to mortality.	Moose are unlikely to cross open water in winter (most crossings were from May to November [p. E-3-409]). Impact not quantified, but effects on moose survival would be difficult to measure (p. E-3-410). Impact not expected to be significant.	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6).
	* (21) Drifted snow along railroad and road access corridors and roadway berms may impede movements of moose and/or subject them to higher risk of collision mortality.	Impact not quantified (Table E.3.145).	Impact will be addressed through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect mortality data on road and railroad collisions (p. E-3-523 #1).	Changes in design and alignment of access road to reduce impacts on caribou and other species (p. E-3-533 #11). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12).
	*(22) Impeded drainage caused by road berms may alter moose habitat due to flooding of forest or shrubland areas.	Impeded drainage in certain areas may improve moose habitat, although some habitat alteration could occur due to flooding (p. E-3-227).	Impact will be addressed through impact assessment refinement (FY84 Task 3.1.3).		Minimize loss of forest areas through alignment of access road and transmission corridor and other measures (p. E-3-539 #23; p. E-3-525 #1; p. E-3-526 #2). Design and alignment measures to minimize impacts on wetlands (p. E-3-292 #18, 19).
	(23) Displacement of moose during reservoir filling years and alteration of movements between winter and summer range after project completion could increase predation rates, possibly driving moose populations to low levels which may be maintained there by continued predation.	Impact not quantified (Appendix E11J, Volume 10B).	Moose calf mortality study (FY84 Task 4.1.3; FY85 Task 9); moose population modeling (FY85 Task 16).	Collect information on wolf populations throughout construction and into operation (p. E-3-525 #7). Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	If needed, controlled moose hunt to avoid over-browsing by displaced moose (p. E-3-530 #8).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	* (24) Decrease in habitat quality may occur near the impoundments due to locally high densities of moose dispersing from impounded areas.	Because the moose population of the middle Susitna Basin is probably below carrying capacity at present (Ballard et al. 1982, p. 52), major or widespread habitat deterioration surrounding the impoundments is not likely unless large moose population increases occur in the future.	Refine and test moose carrying capacity model (FY85 Task 11).	Document browse production on lands enhanced for moose browse (p. E-3-525 #11).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). If needed, controlled moose hunt to avoid over-browsing by displaced moose (p. E-3-530 #8). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12).
	*(25) Increase in ground-based human activity (road traffic, village activities, dam construction) may preclude use of some areas by moose (particularly sensitive areas such as calving sites and winter habitat).	Impact not quantified; some habituation can be expected (Table E.3.145).	Previous studies provided sufficient information for impact assessment. No further studies are planned.		Major ground activity will be prohibited near sensitive wildlife areas during sensitive periods (p. E-3-532 #10). Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	* (26) Increase in aircraft overflights may stress animals or preclude use of some areas.	Impact not quantified but not expected to be significant unless direct harassment occurs. Habituation is possible to neutral and predictable disturbance, such as near airports (Table E.3.145).	Previous studies provided sufficient information for impact assessment. No further studies are planned.		Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	(27) Increase in mortality due to hunting and poaching.	Impact not quantified. Hunting can be regulated (Table E.3.145) but increased poaching due to increased access may represent an unavoidable adverse impact.	Further data collection and analysis regarding current and future use of wildlife in the project area is planned (Social Science FY85 Recreation Tasks 4-6).		Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
	*(28) Increase in risk of fires due to human activities.	Fires may destroy some moose habitat over the short term but regenerated burns may provide productive moose habitat several years later (Table E.3.145).	A literature review of habitat enhancement techniques is underway (FY84 Task 4.1.11) and field studies of disturbed areas are planned (FY85 Task 14).		Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(A) Moose	* (29) Increase in disturbance over the entire basin due to increases in human recreational activities.	Impact not quantified (Appendix E11J, Volume 10B).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impact on vegetation and wildlife (p. E-3-292 #16-17).
(B) Caribou	*(1) Permanent loss of 0.3% of total range (low quality grazing habitat) due to the impoundments and transmission corridors.	Impact not expected to be significant (p. E-3-416; Table E.3.147).	Continued studies of movements of herd and range use (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size, especially as relates to impoundment crossing (p. E-3-523 #3).	Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4).
	*(2) Temporary alteration and permanent loss of 0.3% of summer range for bulls due to borrow sites.	Impact not expected to be significant (p. E-3-415; Table E.3.147).	Continued studies of movements of herd and range use (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size (p. E-3-523 #3).	Revegetation and fertilization of disturbed sites (p. E-3-526 #3).
	(3) Potential effects of the impoundment as a barrier to movements include: a) altered movement patterns may reduce the frequency of crossing of the Watana impoundment area with consequent decreases in use of portions of the range, reducing habitat availability; b) isolation of subherds having separate calving grounds; c) increase in accident mortality associated with ice shelving, drifting ice flows, floating debris, and extensive mud flats; d) increased energy expenditure due to lengthened migration routes, possibly resulting in reduced viability of newborn calves and other consequences of reduced physical condition.	Impact difficult to quantify or predict; may be serious, or may result in little adverse impact (pp. E-3-416 to 417, Table E.3.147).	Continued studies of movement of herd, range use, population size, and productivity; continued studies of movements of upper Susitna-Nenana subherd and its population size (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size, especially as relates to impoundment crossing (p. E-3-523 #3). Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #5).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(B) Caribou	*(4) Drifted snow south and southwest of the reservoir may block movements to portions of the range.	Impact not quantified, but not expected to be significant (Table E.3.147).	Continued studies of movements of herd (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size, especially as relates to impoundment crossing (p. E-3-523 #3). Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #4).	
	(5) Blockage or alteration of herd movements by the access road.	Impact not quantified, but alteration of movement of upper Susitna-Nenana subherd could be significant (p. E-3-479 to E-3-482, Table E.3.147).	Continued studies of movements and population size of subherd (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size (p. E-3-523 #3).	Changes in design and alignment of access road to reduce impacts on caribou (p.E-3-533 #11). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12). Reduction of dust on road (p. E-3-511).
*	(6) Avoidance of construction sites and clearing operations, particularly by cows and calves due to human disturbance.	Impact not quantified but not expected to result in any population effects (p. E-3-415).	Continued studies of movements of herd (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size (p. E-3-523 #3).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Clearing activities will be prohibited near concentrations of migrating caribou during sensitive periods (p. E-3-532 #10).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(B) Caribou	* (7) Increased energy demands (particularly to pregnant cows or cows with calves) due to disturbance by construction traffic on the access road between the Denali Highway and Watana.	Impact not quantified, but could be significant to upper Susitna-Nenana subherd, as in (B)(5) (p. E-3-481, Table E.3.147).	Continued studies of movements of the herd and subherd (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size (p. E-3-523 #3).	Changes in design and alignment of access road to reduce impacts on caribou (p.E-3-533 #11). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12).
	*(8) Disturbance of calving cows by aircraft overflights may cause direct calf mortality.	Project not expected to significantly increase harassment, particularly with regulation of project aircraft (p. E.3.415).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.		Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights, and possibly 2000 ft over calving areas (p. E-3-531 #10, E-3-416). Aircraft landings will be prohibited within calving areas in Talkeetna Mountains, 15 May - 30 June (p. E-3-531 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	*(9) Overflights by aircraft may adversely impact caribou through increased energy costs. High levels of disturbance may affect productivity (groups with females and calves are most sensitive).	Impact not quantified, but not expected to be significant if pilots maintain sufficient altitude (p. E-3-416, Table E.3.147).	Sufficient information is available for impact assessment and mitigation planning. No further studies are planned.		Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights, and possibly 2000 ft over calving areas (pp. E-3-416, E-3-531 #10). Aircraft landings will be prohibited within calving area in Talkeetna Mountains 15 May - 30 June (p. E-3-531 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(B) Caribou	*(10a) Increased legal harvest levels may result from increased road access by hunters to caribou range. (10B) Increased mortality may result from increased road access by illegal hunters to caribou range.	Because caribou hunting is regulated by permit, increased access will affect only the distribution of legal hunters, not their total number. The maximum number of animals legally havested in the project vicinity will not increase. However, increased access by poachers may lead to increased illegal harvest levels.	Continued studies of movements and range use of herd and subherd (FY84 Task 4.3; FY85 Task 22).		Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
	*(11) Increase in collision mortality due to construction traffic and increased recreational traffic.	Impact not quantified, but not expected to be significant (pp. E-3-479 to 482; Table E.3.147).	Continued studies of movements and range use of herd and subherd (FY84 Task 4.3; FY85 Task 22).	Collect mortality data on road and railroad collisions (p. E-3-523 #1).	Changes in design and alignment of access road to reduce impacts on caribou and other species (p. E-3-533 #11). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12). Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(B) Caribou	*(12) Changes in range use, disruption of migration patterns and abandonment of traditional calving areas due to an increase in recreational activities and an increase in non-project development activities, both facilitated through increased access.	Impact not quantified (Table E.3.147).	Continued studies of movements and range use (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size (p. E-3-523 #3).	Changes in design and alignment of access road to reduce impacts on caribou and other species (p. E-3-533 #11). Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
	*(13) Decrease in range values due to increased risk of fire.	Difficult to quantify; caribou are less likely than moose to benefit from occurrence of fire (Table E.3.147).	Continued studies of movements and range use (FY84 Task 4.3; FY85 Task 22).	Collect data on caribou movements and population size (p. E-3-523 #3).	Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
(C) Dall Sheep	*(1) Partial inundation of the Jay Creek mineral lick. Inundation will cover over 22% of the lick surface area during the months of maximum use. At maximum impoundment level in October, 42% of lick surface will be flooded.	Unlikely that sheep will discontinue use of the lick due to partial inundation (pp. E-3-419 to 420, Table E.3.148).	Study of sheep use of lick area, of mineral content of licks, and of sheep distribution in study area (FY84 Task 4.4).	Collect information on sheep use of mineral lick and on leaching of soils after inundation (p. E-3-524 #5).	If needed, exposure of new soil at Jay Creek mineral lick (p. E-3-534 #13).
	*(2) Increase in accident mortality due to ice shelves on lower sections of the Jay Creek mineral lick in early spring.	Impact not quantified (Table E.3.148).	Study of sheep use of lick area (FY84 Task 4.4).	Collect information on sheep use of mineral lick and on leaching of soils after inundation (p. E-3-524 #5).	

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(C) Dall Sheep	* (3) Impoundment may block some movement to lick sites on the east side of Jay Creek.	Impact not quantified, but may reduce use of lick on east side (p. E-3-512).	Study of sheep use of lick area (FY84 Task 4.4).	Collect records of impoundment crossings and impoundment-caused mortality during open-water period (at Jay Creek)(p. E-3-524 #4). Collect information on sheep use of mineral lick and on leaching of soils after inundation (p. E-3-524 #5).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9). If needed, exposure of new soil at Jay Creek mineral lick (p. E-3-534 #13).
	* (4) Areas of the lick below maximum fill level may suffer some leaching and erosion, making this area less valuable as a lick site.	Erosion here may also increase availability of minerals; however, some leaching will also occur (pp. E-3-419 to 420, Table E.3.148).	Study of sheep use of lick area, and of mineral content of licks (FY84 Task 4.4).	Collect information on sheep use of mineral lick and on leaching of soils after inundation (p. E-3-524 #5).	If needed, exposure of new soil at Jay Creek mineral lick (p. E-3-534 #13).
	*(5) Increased metabolic energy requirements and abandonment of some areas due to aircraft overflights.	Impact not quantified but not expected to be significant if height restrictions are maintained (pp. E-3-418 to 419, Table E.3.148).	Sufficient information is available for impact assessment and mitigation planning. No studies planned.		Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	*(6) Disturbance of sheep utilizing low elevation winter and spring habitats due to impoundment clearing activities.	Impact not quantified. Disturbance will occur only over the short-term period of impoundment clearing and will probably not produce a serious population effect (Table E.3.148).	Studies of sheep winter distribution (FY84 Task 4.4).		Impoundment clearing schedule to be determined in consultation with resource agencies (p. E-3-526 #1).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(C) Dall Sheep	* (7) Disturbance from aircraft landings, clearing activities, and recreational boats near the Jay Creek mineral lick may affect its use by sheep.	Impact not quantified; but not expected to be significant with planned project controls, provided there is little recreational disturbance. Frequent visits could result in abandonment of the lick with resultant changes in distribution and local population levels (p. E-3-420, Table E.3.148).	Sufficient information is available for impact assessment and mitigation. No studies planned.	Collect information on sheep use of mineral lick and on leaching of soils after inundation (p. E-3-524 #5).	Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Aircraft landings and boat traffic will be prohibited within 0.5 mile of Jay Creek licks, 15 April to 15 June (p. E-3-531 #10). Major ground activity (including boat and floatplane use) will be prohibited within 0.5 mile of Jay Creek licks, 15 April to 15 June (p. E-3-532 #10).
	*(8) Watana impoundment may delay spring phenology and lead to increased snow acumulation in south-facing slopes of Watana Hills.	Impact not quantified, but not expected to be significant (Table E.3.148).	Impact severity not sufficient to require study.		
	*(9) Watana impoundment may block very occasional in-migration of sheep into Watana Hills herd from Talkeetna Mountains population.	Impact not quantified and importance not known.	If in-migration occurs it is too infrequent to make its study feasible.		
(D) Brown Bear	(1) Permanent loss of some spring feeding habitat due to impoundments.	Of radio-collared brown bears present in the project area, 50% in 1980 and 61% in 1981 moved into the future impoundment zones in spring. This loss is expected to be most important to brown bear populations in spring when greatest use of inundated and adjacent areas occurs. Some use also occurs in summer and fall. (p. E-3-420 to 425, Table E.3.149).	Continued studies of habitat use and timing, den site characteristics, and seasonal food habits (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss will benefit bears (p. E-3-527 #6).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(D) Brown Bear	* (2) Reductions in upstream ungulate prey populations may cause corresponding reductions in available food supply for bears, especially in the spring.	Impact not quantified (pp. E-3-425 to 426, Table E.3.149).	Continued studies of seasonal food habits (FY84 Task 4.5; FY85 Task 17). Moose calf mortality study (FY84 Task 4.1.3; FY85 Task 9).		Impacts from decreased prey availability should be reduced by measures to mitigate impacts to ungulate populations (p. E-3-536 #16).
	* (3) Disturbance from access corridors, villages, airstrips, and clearing of transmission line may displace bears from current denning areas.	Significant impact not expected because brown bear dens are typically at higher elevations than proposed project facilities; identified dens are not in the vicinity of such facilities (Miller 1984, Table 23 and Fig 8).	Continued studies of den site characteristics (FY84 Task 4.5; FY85 Task 17).	Collect information on den locations throughout construction (p. E-3-524 #6).	Ground activity will be prohibited within 0.25 miles of known active bear dens between 15 September and 15 May (p. E-3-532 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	* (4) Impoundment clearing will affect habitat quality for brown bears in spring.	Impact not expected to be significant in the 2-3 years before filling (p. E-3-422, Table E.3.149).	Continued studies of seasonal food habits (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
	* (5) Loss or alteration of habitat due to borrow sites.	Impact not quantified. Habitat values may increase on reclaimed areas during early stages of plant succession (p. E-3-421 to 422).	Continued studies of habitat use and timing (FY84 Task 4.5; FY85 Task 17).		Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Revegetation and fertilization of disturbed sites (p. E-3-526 #3).
	*(6) Potential impact on denning areas due to impoundment shore erosion.	Impact may occur on potential or unknown den sites, but has not been quantified; not expected to be significant (Table E.3.149).	Continued studies of den site characteristics (FY84 Task 4.5; FY85 Task 17).		
	(7) Broken ice and ice shelving, open water in the impoundments, roads, and other facilities may block or hinder access to habitually used areas.	Impact not quantified (pp. E-3-426, 483, 484, Table E.3.149).	Continued studies of seasonal habitat use and movements (FY84 Task 4.5; FY85 Task 17).	Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #4).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9).

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(D) Brown Bear	* (8) Avoidance of traditional use areas caused by increase in human activity at construction sites and operations facilities.	Impact includes loss of feeding habitat near access corridors, villages, airstrips, and borrow sites. Some bears may be displaced or alter their movements; other may habituate and lead to human/bear interaction problems. (p. E-3-424, Table E.3.149).	Continued studies of habitat use and timing (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12). Avoidance of the Prairie Creek and Stephan Lake areas by access routing (p. E-3-292 #14).
	* (9) Increase in mortality of bears due to attraction to human refuse and revegetated areas near construction sites, and the resultant increase in the incidence of human/bear encounters, resulting in destruction of the "offending bear".	Impact not quantified and difficult to predict (p. E-3-423 to 424, Table E.3.149).	Sufficient information is available for impact assessment and mitigation. No studies planned.	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Education program, and strict garbage-control measures and enforcement to prevent creation of nuisance animals (p. E-3-535 #15). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	* (10) Greater susceptibility of bears (particularly habituated bears) to hunting and poaching mortality due to improved access in the area.	Hunting policy for the project area currently allows liberal brown bear harvest levels which can be regulated in the future. Losses to poachers will be an unavoidable adverse impact (pp.E-3-423, 426, 484; Table E.3.149).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #15-17).
	*(11) Lower population sizes and decreased recruitment of bears in the study area may result in fewer subadults from the study area available to disperse out to and populate adjacent areas.	Impact difficult to quantify, but may affect nearby populations.	Opportunistic information on dispersal in the course of marked bear studies (FY84 Task 4.5; FY85 Task 17).		

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(D) Brown Bear	(12) Displacement of bears from presently used habitats (especially in spring) may result in locally more dense populations and greater intraspecific competition and strife in adjacent areas.	May affect cub survival, increase predation pressure on ungulates, increase intraspecific mortality, and decrease reproduction.	Continued studies of seasonal habitat use and food habits (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	
	* (13) Possible reduction in availability of animal prey (e.g., salmon, moose) and vegetable foods in downstream reaches.	Mitigation for salmon and moose may negate this aspect of the impact. Altered plant succession may reduce or increase plant foods available to bears.	Downstream moose studies (FY84 Task 4.2.3; FY85 Task 23). Downstream hydrologic and vegetative studies (FY84 Task 4.2.4; FY85 Task 15). Salmon studies (Aquatic FY85 Tasks 12-16).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	Impacts from decreased prey availability should be reduced by measures to mitigate impacts to salmon and ungulate populations (p. E-3-536 #16).
	*(14) Overflights or harassment by aircraft may disrupt feeding, resting and denning activities.	*(14) Aircraft overflights may disrupt feeding, resting, and denning.	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.		Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	(15) Recreational disturbance facilitated by increased access may cause avoidance of traditional use areas and may lead to increase in human/bear interactions.	Impact not quantified, but could be significant. Most significant impact would likely be from recreational activity in the Prairie Creek-Stephan Lake area -- a traditional area for summer feeding on salmon (p. E-3-421, Table E.3.149).	Continued studies of seasonal habitat use and food habits (FY84 Task 4.5; FY85 Task 17).		Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Avoidance of the Prairie Creek and Stephan Lake areas by access routing (p. E-3-292 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
(E) Black Bear	(1) Permanent loss of high quality forest habitats due to impoundments.	Will exclude black bears upstream from Watana Creek and significantly lower populations in the project area (p. E-3-427, Table E.3.150).	Continued monitoring of black bear populations and movements in the area is planned (FY84 Task 4.5; FY85 Task 17). Refinement of bear population models will also continue (FY84 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Habitat enhancement measures in the middle basin and on replacement lands to compensate for permanent habitat loss will provide some benefits for black bears (p. E-3-527 #6).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(E) Black Bear	(2) Permanent loss of some den sites due to impoundments, and due to disturbance and displacement from construction and operation facilities and activities.	Of known black bear dens in the project area, 54% were in the Watana and 6% were in the Devil Canyon impoundment zones (Miller 1983).	Identification of active den sites of black bears will continue (FY84 Task 4.5; FY85 Task 17).	Collect information on black bear den locations throughout construction (p. E-3-524 #6).	Major ground activity will be prohibited within 0.25 miles of all known active bear dens between September 15 and May 15 (p. E-3-532 #10).
	(3) Loss of cover and foraging areas in forest habitats due to impoundment clearing.	This will be realized prior to impoundment filling due to clearing activities (p. E-3-428, Table E.3.150).	Continued monitoring of black bear populations and movements in the area is planned (FY84 Task 4.5; FY85 Task 17).		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
	* (4) Temporary loss of forest habitats in borrow sites.	Impact represents a temporary loss of habitat for black bears. Revegetation will provide spring forage during early successional stages, and regrowth of forest will provide continued habitat for bears (p. E-3-427, Table E.3.150).	Continued studies of black bear populations and movements (FY84 Task 4.5; FY85 Task 17).		Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (p. E-3-291 #1-11).
	*(5) Possible impact on den sites due to impoundment shore erosion.	Impact not quantified; potential or unknown den sites may be affected but impacts are not expected to be significant (Table E.3.150).	Continued studies of den site characteristics (FY84 Task 4.5; FY85 Task 17).	Collect information on den locations throughout construction (p. E-3-524 #6).	
	*(6) Habitat alteration along the transmission corridor.	Positive and negative impacts on black bears. Loss of forest habitats along the corridor will constitute some habitat loss, although spring forage within the corridors will provide added food (p. E-3-494, Table E.3.150).	Continued studies of black bear habitat use and movements (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Minimize loss of forest areas through alignment of access road and transmission corridor, and other measures (p. E-3-539 #23).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(E) Black Bear	* (7) Reduction in availability of low shrub habitats in spring due to delayed melting of snow drifts south and southwest of the impoundment.	Impact not quantified, but not expected to be significant (Table E.3.150).	Impact severity not sufficient to require study.	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	
	* (8) Reductions in prey populations, if they occur (e.g., salmon, moose), would negatively impact black bears in downstream areas.	Project impacts on some food resources of black bears are as yet uncertain, and bears may not be adversely affected (p. E-3-429, Table E.3.150).	Continued investigations of bear food habits will better document important food sources of black bears (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Impacts from decreased prey availability should be reduced by measures to mitigate impacts to salmon and ungulate populations (p. E-3-536 #16).
	*(9) Increased availability of early spring forage downstream from impoundments due to alteration of vegetation phenology.	No noticeable impact expected on black bears (p. E-3-429).	Impact severity not sufficient to require study.	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).
	*(10) Decreased availability of early successional vegetation types due to river hydrologic changes downstream of the impoundments.	Impact not quantified but not expected to be significant (p. E-3-429, Table E.3.150).	Continued refinement of downstream hydrology modeling may better enable prediction of effects on black bears (FY84 Task 4.2.4).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	
	* (11) Broken ice and/or shelving, open water in the impoundments, roads, and other facilities may block or hinder access to habitually used areas (e.g., seasonally used feeding areas).	Impact not quantified but not expected to be significant (Table E.3.150).	Continued study of habitat use and movements (FY84 Task 4.3; FY85 Task 17).	Collect records of impoundment crossings and impoundment-caused mortality during open-water periods (p. E-3-524 #4).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9).
	*(12) Increase in interspecific competition with and predation by brown bears and intraspecific competition among black bears during dispersal from impoundment zones.	Impact not quantified (Table E.3.150).	Investigations of bear movements and mortality sources are continuing (FY84 Task 4.5; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(E) Black Bear	* (13) Some indirect habitat loss (especially berry foraging shrubland) and possible blockage of movements to important habitat areas due to avoidance of construction sites, access roads, impoundment clearing activities, and recreational use of the area.	Impact not quantified, although some habituation to human activities will occur (p. E-3-427, Table E.3.150).	Continued studies of habitat use and black bear movements (FY 84 Task 4.3; FY85 Task 17).	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12). Public access to access road and airfield prohibited during construction (p. E-3-534 #12). Avoidance of the Fog Lakes and Indian River areas by access routing (p. E-3-292 #14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 16-17).
	*(14) Increase in mortality of bears due to attraction to human refuse, revegetated areas near construction sites, and increase in human/bear encounters, resulting in destruction of the "offending bear".	Destruction of some black bears likely during construction phases (p. E-3-427, Table E.3.150).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned		Education programs and strict garbage-control measures and enforcement to prevent creation of nuisance animals (p. E-3-535 #15). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(E) Black Bear	* (15) Greater susceptibility of habituated bears to hunting and poaching mortality.	Hunting mortality can be regulated, although increased poaching losses may represent an unavoidable adverse impact (Table E.3.150).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.	Collect information on bear populations and distribution of bear harvest (p. E-3-534 #14).	Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14).
	*(16) Disturbance from aircraft overflights may disrupt normal feeding, resting and denning activities.	Impact not quantified, but not expected to be significant (Table E.3.150).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.		Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10).
	*(17) Lower population sizes and decreased recruitment of bears in the study area may result in fewer subadults from the study area available to disperse out to and populate adjacent areas.	Impact difficult to quantify, but may affect nearby populations.	Opportunistic information on dispersal in the course of marked bear studies (FY84 Task 4.5; FY85 Task 17).		
(F) Wolf	(1) Permanent loss of portions of territories of at least six packs.	Impact represents an absolute habitat loss for wolves, but is unlikely to affect local wolf populations. Wolf numbers are currently highly regulated by trapping and removal for game management purposes (p. E-3-431, Table E.3.151).	Continued studies of wolf pack sizes and distributions (FY84 Task 4.6; FY85 Task 28).	Collect information on wolf populations throughout construction and into operation (p. E-3-525 #7).	
	*(2) Inundation of parts of ranges of six packs will cause upheaval of the historical distribution of packs due to associated social strife.	Impact will occur over the short-term, when ungulate prey populations are also undergoing shifts; effects are not expected to be significant (p. E-3-431, Table E.3.151).	Continued studies of wolf pack sizes and distributions (FY84 Task 4.6; FY85 Task 28).	Collect information on wolf populations throughout construction and into operation (p. E-3-525 #7).	

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(F) Wolf	(3) Reduction of carrying capacity of wolves due to reduction of moose (and other prey) carrying capacities.	Impact not quantified (pp. E-3-430 and 431, Table E.3.151).	Continued studies of wolf pack sizes and distributions (FY84 Task 4.6; FY85 Task 28). Studies of moose calf mortality and of wolf predation during a severe winter (FY84 Task 4.1.3; FY85 Tasks 9 and 10).	Collect information on wolf populations throughout construction and into operation (p. E-3-525 #7).	Impacts from decreased prey availability to wolves should be reduced by measures to mitigate impacts to ungulate populations (p. E-3-536 #16). Habitat enhancement measures for moose in the middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6).
	*(4) Increase in wolf numbers near the impoundment zones due to displacement of moose caused by impoundment clearing activities.	Short-term beneficial impact (p. E-3-431, Table E.3.151).	Continued studies of wolf pack sizes and distributions (FY84 Task 4.6; FY85 Task 28).	Collect information on wolf populations throughout construction and into operation (p. E-3-525 #7).	Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
	*(5) Presence of the impoundment and dam facilities may hinder movement of some packs to caribou and moose calving areas.	Impact not quantified (Table E.3.151).	Continued studies of wolf pack distributions (FY84 Task 4.6; FY85 Task 28).	Collect records of impoundment crossings and impoundment-caused mortality during open-water period (p. E-3-524 #4).	Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9).
	*(6) Wolves may use the access road to their benefit when hunting ungulate prey.	Beneficial impact not quantified; not expected to be significant (Table E.3.151).	Impact severity not sufficient to require study.		
	*(7) Open water downstream from the dams may hinder movements of wolves.	Impact not quantified; not expected to be significant (Table E.3.151).	Continued studies of wolf pack distributions (FY84 Task 4.6; FY85 Task 28).		
	*(8) Wolves are likely to avoid areas of intense human activity (e.g., construction areas) or heavy road traffic, at least initially.	Some habituation will likely occur; impact not expected to be significant (p. E-3-430, Table E.3.151).	Continued studies of wolf pack distributions (FY84 Task 4.6; FY85 Task 28).	Collect information on den locations throughout construction (p. E-3-524 #6).	Ground activity will be prohibited within 0.25 miles of known active wolf dens or rendezvous sites between 1 May and 31 July (p. E-3-532 #10). Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(F) Wolf	* (9) Disturbance of wolves by human activities or aircraft at den sites could lead to pup mortality if the dens are abandoned during the early weeks of a pup's life.	Impact not quantified (p. E-3-430, Table E.3.151).	Continued studies of wolf pack distributions (FY84 Task 4.6; FY85 Task 28).	Collect information on den locations throughout construction (p. E-3-524 #6).	Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Aircraft landings will be prohibited within 0.25 miles of known active wolf dens or rendezvous sites during 1 May to 31 July (p. E-3-531 #10). Ground activity will be prohibited within 0.25 miles of known active wolf dens or rendezvous sites between 1 May and 31 July (p. E-3-531 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13).
	*(10) Wolves may habituate to human use areas and have the potential to become nuisance animals, increasing the likelihood of destruction of the "offending wolf".	Destruction of some nuisance wolves may occur if mitigation measures are not enforced (p. E-3-430, Table E.3.151), however, this impact is unlikely to be significant in these heavily exploited wolf populations.	Impact severity not sufficient to require study.		Education program, and strict garbage-control measures and enforcement to prevent creation of nuisance animals (p. E-3-535 #15).
	*(11) Disturbance at den sites from increased access for recreational activities could lead to pup mortality if dens are abandoned during early weeks of a pup's life.	Impact not quantified (p. E-3-430, Table E.3.151).	Continued studies of wolf pack distributions (FY84 Task 4.6; FY85 Task 28).	Collect information on den locations throughout construction (p. E-3-524 #6).	Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(F) Wolf	(12) Increased mortality of wolves due to hunting, poaching, and trapping.	Hunting of wolves can be regulated, but increased poaching losses may represent an unavoidable adverse impact (p. E-3-485 and 518, Table E.3.151).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.		Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14).
(G) Coyote	* (1) Increase in coyote population may occur near developed areas.	Impact represents a beneficial effect on coyotes (p. E-3-439).	Continued surveys of furbearer distribution, including downstream areas, will document changes in coyote populations (FY85 Task 26, subtask 1).		
(H) Wolverine	(1) Permanent loss of winter foraging habitat due to impoundments.	Winter habitat for several wolverines will be lost; changes in movements, densities and productivity will affect surrounding populations (p. E-3-432 to 433, Table E.3.152).	Opportunistic collection of data during wolf surveys (FY84 Task 4.6).		
	*(2) Secondary loss of small mammal and grouse prey bases. Changes in prey density will affect movements, population densities, and productivity.	Difficult to predict whether increases in ungulate carrion availability will offset losses of smaller prey (p. E-3-433, Table E.3.152).	Impact severity not sufficient to require study.		
	*(3) Increase in availability of prey in areas adjacent to impoundment clearing zones.	Impact represents a short-term beneficial effect (Table E.3.152).	Impact severity not sufficient to require study.		
	(4) Disturbance and habitat loss due to impoundment clearing will displace wolverines, particularly in winter.	Impact will be similar to (H)(1) and will occur 1-2 years prior to impoundment filling (Table E.3.152).	Opportunistic collection of data during wolf surveys (FY84 Task 4.6).		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
	*(5) Increase in carrying capacity of the transmission corridor for moose and ptarmigan may beneficially impact wolverines.	Impact represents a small but beneficial effect on wolverines (Table E.3.152).	Impact severity not sufficient to require study.		Selective clearing in the transmission corridors, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(H) Wolverine	* (6) Alteration of use patterns due to presence of the impoundments and changes in home range boundaries.	Conflicting data on home range boundaries of wolverines and terrain features make this impact difficult to predict; not expected to be significant (p. E-3-432).	Opportunistic collection of data during wolf surveys (FY84 Task 4.6).		
	* (7) Avoidance of all areas of human activity (including access road during heavy traffic periods and areas with high levels of recreational activity), at least initially, causing some changes in use patterns or preclusion of use in some areas.	Impact not quantified; not expected to be significant unless high levels of recreational disturbance occur (p. E-3-486, Table E.3.152).	Opportunistic collection of data during wolf surveys (FY84 Task 4.6).		Possible controls on volume, speed and frequency of access road traffic (p. E-3-534 #12). Public access to access road and airfield prohibited during construction (p. E-3-534 #12). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
	(8) Increase in mortality due to hunting, trapping, and poaching.	Impact not quantified but likely the most important impact on wolverines. Hunting and trapping can be regulated, but poaching may represent an unavoidable adverse impact (p. E-3-486, Table E.3.152).	Sufficient information is available for impact assessment and mitigation planning. No studies are planned.		If needed, recommendations for restrictions to hunting and trapping regulations to reduce harvest pressure (p. E-3-534 #14). Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14).
(I) Belukha	*(1) Water temperature changes at the mouth of the Susitna River due to the project may affect calving.	Water temperatures will not change significantly at the river mouth; impact not expected to occur (p. E-3-433).	Impact severity not sufficient to require study.		Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(I) Belukha	* (2) Food supplies of belukhas may be decreased due to alterations or blockage in the availability of spawning streams for salmon.	Salmon decreases would at most be 5-8% of Susitna river stocks; impact not expected to be significant (p. E-3-434).	Impact severity not sufficient to warrant further study.		Impacts from decreased prey availability should be reduced by measures to mitigate impacts to salmon populations (p. E-3-536 #16).
(J) Beaver and Muskrat	* (1) Permanent loss of habitat for 5-10 muskrats and possibly a few beaver due to impoundments and other permanent facilities.	Impact is of minor significance to area populations due to the small numbers affected (Table E.3.153).	Beaver cache surveys may be extended to include the impoundment zones to confirm numbers of beaver affected (FY85 Task 18, subtask 1).		Development of downstream beaver carrying capacity model to yield better impact predictions and refinements to mitigation measures (p. E-3-537 #18). Enhancement of sloughs downstream from Devil Canyon (p. E-3-537 #19).
	*(2) Loss of some habitat for both species due to siltation of ponds, alteration of drainage patterns, and disturbance near access roads and borrow pits (primarily in the Deadman Creek area).	Impact is of minor significance to area populations due to the small numbers affected (65 beaver) (pp. E-3-434 to 436, Table E.3.153).	Previous surveys have provided sufficient information for impact assessment. No further work is planned.	Collect information on beaver distribution in Deadman Creek and in downstream floodplain (p. E-3-525 #8).	Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Modifications of borrow requirements and techniques to minimize loss of habitat for aquatic furbearers (p. E-3-536 #17). Development of downstream beaver carrying capacity model to yield better impact predictions and refinements to mitigation measures (p. E-3-537 #18). Enhancement of sloughs downstream from Devil Canyon (p. E-3-537 #19). Minimize loss of forest areas through alignment of access road and transmission corridor, and other measures (p. E-3-539 #23).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(J) Beaver and Muskrat	* (2) Loss of some habitat for both species due to siltation of ponds, alteration of drainage patterns, and disturbance near access roads and borrow pits (primarily in the Deadman Creek area)(cont.).				Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (p. E-3-291 to 292 #1-11). Design and alignment measures to minimize impacts on wetlands (p. E-3-292 #18, 19).
	(3) Increased winter flows, stabilized flows, and lack of ice cover will benefit beaver and muskrat downstream.	Impact represents a beneficial effect on beavers and muskrat and will probably compensate for losses due to the impoundments and other facilities (p.E-3-434 to 436, Table E.3.153).	Additional information will be obtained from downstream hydrologic and vegetation modelling (FY84 Task 4.2.4). Efforts to refine the beaver population model and field studies to provide information for modeling will continue (FY84 Task 4.8; FY85 Tasks 18, 19 and 20).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2). Collect information on beaver distribution in Deadman Creek and in the downstream floodplain (p. E-3-525 #8).	Development of downstream beaver carrying capacity model to yield better impact predictions and refinements to mitigation measures (p. E-3-537 #18). Enhancement of sloughs downstream from Devil Canyon (p. E-3-537 #19).
	(4) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, but poaching losses may represent an unavoidable adverse impact (p. E-3-436, Table E.3.153).	Surveys of trappers are continuing to document current harvest levels (FY85 Task 20).		Use of project facilities or equipment prohibited to employees and families for hunting and trapping (p. E-3-534 #14). If needed, recommendations for restrictions to hunting and trapping regulations to reduce harvest pressure (p. E-3-534 #14).
	*(5) Downstream daily flow fluctuations may freeze out or flood beaver lodges and/or food caches in winter.	Short-term flow fluctuations in winter are not anticipated to be of a magnitude detrimental to beaver survival (p. E-3-469).	Information from ice-modeling efforts is being incorporated in the beaver model (FY85 Task 19).		Development of downstream beaver carrying capacity model to yield better impact predictions and refinements to mitigation measures (p. E-3-537 #18).
(K) Mink and Otter	(1) Permanent habitat loss due to the impoundments.	Elimination of a substantial portion of good quality habitat for both species (53 miles of mainstem plus 9.7 miles of stream habitat) will occur (p. E-3-436, Table E.3.155).	Distribution of furbearers in the downstream area and in the impoundment zones will be studied (FY85 Task 26, subtask 1). Fall concentrations of mink and otter along the Susitna River will also be surveyed to improve impact assessment (FY85 Task 26, subtask 2).		

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(K) Mink and Otter	* (2) Habitat loss due to impoundment clearing activities and resultant decrease in cover and prey availability.	Short-term impact affecting the same populations affected by impoundment filling. Impact will occur 2-3 years prior to filling (Table E.3.155).	See (K)(1).		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
	* (3) Habitat loss due to the access corridor.	Proposed road route will remove 12.3 miles of stream shore habitats along Deadman Creek (p. E-3-438).	Previous studies provided sufficient information for impact assessment. No further studies are planned.		Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Modifications of borrow requirements and techniques to minimize loss of habitat for aquatic furbearers (p. E-3-536 #17). Minimize loss of forest areas through alignment of access road and transmission corridor and other measures (p. E-3-539 #23). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (p. E-3-291, 292 #1-11).
	*(4) Increase in small mammal prey in reclaimed areas.	This impact represents a beneficial impact to mink, although benefits will probably be of little significance (Table E.3.155).	Impact severity not sufficient to require study.		Revegetation and fertilization of disturbed sites (p. E-3-526 #3).
	*(5) Increase in beaver population, stabilization of water levels, and open water downstream will benefit mink and otter.	Impact represents a beneficial effect on mink and otter (Table E.3.155).	Surveys of furbearer populations and distribution in the downstream area are planned (FY85 Task 26, subtask 1).		Enhancement of sloughs downstream from Devil Canyon (p. E-3-537 #19).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(K) Mink and Otter	*(6) Abandonment of habitat near construction zones and recreation areas due to human disturbance.	Effects would be most noticeable on the remaining habitat areas along the upper reaches of tributary creeks near the impoundments (p. E-3-438, Table E.3.155).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Major ground activity will be prohibited near sensitive wildlife areas during sensitive periods (p. E-3-532 #10). Prohibition of access during construction, discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #15-17).
	(7) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, but poaching losses may represent an unavoidable adverse impact (Table E.3.155).	Surveys of trappers are continuing to document current harvest levels (FY85 Task 20).		Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce harvest pressure (p. E-3-534 #14).
(L) Red Fox	*(1) Habitat alterations due to impoundment clearing and reclaimed lands will increase prey availability.	Impact represents a beneficial effect on foxes (Table E.3.156).	Impact severity not sufficient to require further study.		Revegetation and fertilization of disturbed sites (p. E-3-526 #3).
	*(2) Open water downstream may hinder movements in winter.	Impact not quantified but not expected to be significant (Table E.3.156).	Impact severity not sufficient to require study.		Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).
	*(3) Habituation of foxes to human presence may lead to increase in mortality due to destruction of problem animals.	May represent an important impact on local fox populations (p. E-3-440, Table E.3.156).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Education programs and strict garbage control measures and enforcement to prevent creation of nuisance animals (p. E-3-535 #15).
	*(4) Abandonment of some den sites may occur due to human disturbance.	Some negative effects may occur but habituation to human activities is very likely; impact not expected to be significant (p. E-3-439; Table E.3.156).	Surveys of fox den use in areas of potential impact (FY85 Task 26, subtask 3).	Collect information on fox den locations throughout construction (p. E-3-524 #6).	Major ground activity will be prohibited near sensitive wildlife areas during sensitive periods (p. E-3-532 #10).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(L) Red Fox	(5) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, but poaching losses may represent an unavoidable adverse impact (p. E-3-439, Table E.3.156).	Surveys of trappers are continuing to document current harvest levels (FY85 Task 20).		Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting and trapping regulations to reduce harvest pressure (p. E-3-534 #14).
(M) Marten, Weasel, and Lynx	(1) Permanent habitat loss for all species due to impoundments.	Impact will result in loss of habitat for probably all lynx (a few animals), approximately 100 marten, and approximately 5% of the population of weasels within the middle basin (p. E-3-440 to 442).	Continued surveys of furbearer distribution will improve impact assessment and mitigation planning (FY85 Task 26, subtask 1).		
	(2) Permanent loss of some habitat for marten and weasel due to the access corridor.	Impact will likely result in redistribution of home ranges of affected furbearers (p. E-3-487, Table E.3.157).	Impact severity not sufficient to require further study.		Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Minimize loss of forest areas through alignment of the access road and transmission corridor, and other measures (p. E-3-539 #23). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (pp. E-3-291 to 292 #1-11).
	*(3) Loss of habitat in impoundment areas due to clearing operations.	Short-term impact that will precede habitat loss due to impoundment filling (Table E.3.157).	Continued surveys of furbearer distribution will improve impact assessment and mitigation planning (FY85 Task 26, subtask 1).		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(M) Marten, Weasel, and Lynx	* (4) Loss of forest habitats due to the transmission corridors.	Impact will result in loss of 3831 acres of forest habitats useful to marten, lynx and weasels (Table E.3.86).	Previous studies have provided sufficient information for impact assessment. No further studies are planned.		Selective clearing in the transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (p. E-3-291 to 292 #1-11).
	* (5) Loss of habitat due to borrow sites and other areas that will be reclaimed.	Removal of 3341 acres of spruce forest habitats. Revegetation will probably not return habitat to spruce communities during the license period (Table E.3.157).	Previous studies have provided sufficient information for impact assessment. No further studies are planned.		Revegetation and fertilization of disturbed sites (p. E-3-526 #3) will provide some foraging habitat prior to forest succession.
	* (6) Impoundments will block movements of marten and impede dispersal of weasels and lynx.	Redistribution of home ranges to conform to impoundment shores will occur (Table E.3.157).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9) will aid dispersal but will not completely mitigate barrier effects.
	* (7) Increase in the incidence of road kills due to presence of the access corridor.	Impact not quantified but not expected to be significant (Table E.3.157).	Impact severity not sufficient to require further study.	Collect mortality data on road and railroad collisions (p. E-3-525 #1).	
	*(8) Open water downstream will block movements of marten.	Marten usually align home ranges along rivers and other water bodies. Impact not expected to be significant (Appendix E11J, Volume 10B).	Previous studies have provided sufficient information for impact assessment. No further work is planned.		Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).
	*(9) Avoidance of some areas near intense human activities (e.g., construction zones) due to disturbance, especially for lynx.	Marten and weasel are unlikely to be affected, lynx are uncommon and will be able to avoid developed areas. Not expected to be a significant impact (Table E.3.157).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Major ground activity will be prohibited near sensitive wildlife areas during sensitive periods (p. E-3-532 #10). Prohibition of access during construction, discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #15-17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(M) Marten, Weasel, and Lynx	(10) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, but poaching losses may represent an unavoidable adverse impact (Table E.3.157).	Surveys of trappers are continuing to document current harvest levels (FY85 Task 20).		Use of project facilities or equipment by employees and families for hunting and trapping will be prohibited (p. E-3-534 #14). If needed, recommendations for restrictions to hunting and trapping regulations to reduce harvest pressure (p. E-3-534 #14).
(N) Raptors and Ravens	(1) Permanent loss of some nest sites and feeding habitat for bald and golden eagles, goshawks, ravens, and smaller raptors due to impoundments.	Some nesting locations of raptors on cliffs and large trees will be lost. Quantification includes 7 of 16 known golden eagle, 4 of 8 bald eagle, 2 of 3 goshawk, and a considerable number of raven nesting locations that will be lost. Some hunting habitat will also be lost, although this is not expected to have a significant impact on any of the raptor species (pp. E-3-443 to 451, Table E.3.159).	Surveys to determine raptor cliff nest elevations and nest site use will be made in 1984 (FY84 Task 4.9.3). Food habits and foraging range of bald eagles will be studied. Information will be used for mitigation planning efforts to help determine the optimal locations of artificial eagle nests (FY85 Task 21).		Site enhancement and creation of artificial nesting locations for raptors (p. E-3-538 #21, Appendix 3.I).
	(2) Loss of one nesting location of bald eagle on Deadman Creek and some nesting locations for ground-nesting raptors due to the access corridor.	The forest stand containing this nest is the best (and possibly only) bald eagle nesting habitat on Deadman Creek (p. E-3-489, Table E.3.159).	Previous studies have provided sufficient information for impact assessment. No further work is planned.	Collect information on active raptor nest locations throughout construction (p. E-3-525 #9).	Raptor protection criteria (Table E.3.168). Changes in road alignment to remain 0.5 miles from bald eagle nesting location (p. E-3-537, Figure E.3.81). Site enhancement and creation of artificial nesting locations for raptors (p. E-3-538 #21, Appendix 3.I).
	(3) Loss of nest sites due to impoundment clearing prior to flooding.	Three of the bald eagle and all of the goshawk nests are tree nests within the impoundment zone; they would be lost early due to impoundment clearing (Table E.3.159).	Surveys to determine bird activity at raptor nesting locations are planned (FY84 Task 4.9.3).		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation, including known nest trees, will be left until just before filling (p. E-3-515, E-3-525 #1). Site enhancement and creation of artificial nesting locations for raptors (p. E-3-538 #21, Appendix 3.I).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(N) Raptors and Ravens	(4) Loss of a golden eagle nesting location and a possible gyrfalcon nesting location due to borrow pits and reclaimed lands.	The golden eagle nesting location is within Borrow Site E (p. E-3-445, Table E.3.159).	Surveys to determine bird activity at raptor nesting locations are planned (FY84 Task 4.9.3).		Raptor protection criteria (Table E.3.168). Area where golden eagle nest is located will not be mined (p. E-3-537 #20). Changes in facility siting or alignment or in construction schedules to avoid disturbance to raptor nest sites (pp. E-3-537 #20, E-3-533 #10). Site enhancement and creation of artificial nesting locations for raptors (p. E-3-538 #21, Appendix 3.I).
	*(5) Increase in electrocution of large raptors on transmission poles.	Impact difficult to quantify. Selected tower and line configuration for permanent transmission line is unlikely to cause electrocution. Electrocution may occur on 34 kv construction transmission line. (p. E-3-497, Table E.3.159).	Previous studies provided sufficient information for impact assessment. No further studies are planned.		Use of pole/line configurations and other safeguards to prevent electrocution of raptors by temporary transmission lines (p. E-3-539 #22).
	*(6) Potential abandonment of several raptor and raven nests or nesting locations (including a peregrine falcon nest) due to human activities along the transmission corridor.	Impact not completely quantified but will affect at least 1 peregrine falcon and 2 gyrfalcon nesting locations if construction activities occur during nest site attendance periods (pp. E-3-452 to 454, Table E.3.159).	Surveys to look for and determine use of bald eagle and peregrine falcon nest sites along the transmission corridor (FY85 Tasks 24 and 29).	Collect information on active raptor nest locations throughout construction (p. E-3-525 #9).	Raptor protection criteria (Table E.3.168). Changes in facility siting or alignment or in construction schedules to avoid disturbance to raptor nest sites (pp. E-3-537 #20, E-3-533 #10).
	*(7) Detrimental impacts on salmon and other fish prey in downstream areas could affect bald eagle habitat quality.	Proposed mitigation of impacts to salmon should also lessen impacts on bald eagles. Not expected to be significant (Appendix E11J, Volume 10B).	Surveys of bald eagle nest sites in downstream reaches are planned and will provide baseline population data for future monitoring studies (FY85 Task 27).		Impacts from decreased prey availability should be reduced by measures to mitigate impacts to salmon populations (p. E-3-536 #16).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(N) Raptors and Ravens	*(8) Increase in disturbance due to aircraft traffic, construction activity and recreational activity that is facilitated by increased access.	Impact not quantified but may cause abandonment of nests or nest failure (p. E-3-451 to 454, Table E.3.159).	Surveys to determine bird activity at raptor nesting locations are planned (FY84 Task 4.9.3).	Collect information on active raptor nest locations throughout construction (p. E-3-525 #9).	Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Aircraft landings will be prohibited within 0.5 miles of active golden eagle nests between 15 March and 31 August, and within 0.25 miles of active bald eagle nests between 15 March and 31 August and active gyrfalcon nests between 15 February and 15 August (p. E-3-531 #10). Raptor protection criteria (Table E.3.168). Changes in facility siting or alignment or in construction schedules to avoid disturbance to raptor nest sites (pp. E-3.533 #10, including specific measures for specific sites). Public access to access road and airfield prohibited during construction (p. E-3-534 #12, 14). Discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #16-17).
	*(9) Loss of nest sites and habitat alteration due to secondary impacts of erosion, blowdowns, etc., on forest vegetation.	Impacts not quantified, but not expected to be significant (Appendix E11J, Volume 10B).	Impact severity not sufficient to require study.		

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(O) Waterbirds	* (1) Permanent loss of river and stream habitats for waterfowl, shorebirds, dippers, and kingfishers due to impoundments.	Numbers of birds affected have not been estimated but impact is unlikely to have a major effect on regional populations. Effects will be greatest on riverine species, particularly harlequin duck, common and red-breasted mergansers, spotted sandpiper, semipalmated plover, and dipper (pp. E-3-454 to 455).	Previous studies provided sufficient information for impact assessment. No further work is planned.		
	*(2) Alteration of shoreline nesting habitats due to impoundment clearing and facility site clearing.	Temporary impact; in most areas preceding impoundment filling by 2 to 3 years (p. E-3-455).	Impact severity not sufficient to require study.		Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Design and alignment measures to minimize impacts on wetlands (p. E-3-292 #18, 19).
	*(3) Avoidance by waterbirds of areas of intense human activity (e.g., construction zones, impoundment clearing activities).	Impact not quantified, but not expected to be significant (pp. E-3-455, E-3-491).	Impact severity not sufficient to require study.	Collect information on swan nest locations throughout construction (p. E-3-525 #10).	Aircraft will maintain minimum altitudes of 1000 ft above ground level during flights (p. E-3-531 #10). Aircraft will maintain a 0.25 mile buffer around lakes used by trumpeter swans during the nesting period (p. E-3-531 #10). Major ground activity will be prohibited within 0.5 miles of waterbodies used by swans when swans are present (p. E-3-532 #10). Prohibition of access during construction, discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #15-17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(O) Waterbirds	* (4) Transmission corridor may cross waterfowl nesting areas or movement corridors, resulting in displacement of breeding birds (particularly trumpeter swans), or mortality due to transmission line collisions.	Impact not quantified (p. E-3-496 to 497).	Surveys of all affected areas for trumpeter swans and nests, including the transmission corridor (FY85 Task 24).	· Collect information on swan nest locations throughout construction (p. E-3-525 #10).	Major ground activity will be prohibited within 0.5 miles of waterbodies used by swans when they are present (p. E-3-532 #10). Design and alignment measures to minimize impacts on wetlands (p. E-3-292 #18, 19).
	* (5) Increased mortality of gamebirds due to hunting and poaching.	Hunting can be regulated but poaching losses may represent an unavoidable adverse impact.	Impact severity not sufficient to require study.		Use of project facilities or equipment prohibited to employees and families for hunting and trapping (p. E-3-534 #14). If needed, recommendations for restrictions to hunting regulations to reduce hunting pressure (p. E-3-534 #14).
(P) Other Birds	(1) Permanent habitat loss due to the impoundments and other permanent project facilities.	Loss of 25,047 acres of habitats used by over 100,000 birds, resulting in loss and displacement of breeding, migrating, and resident birds (pp. E-3-456 to 459; Tables E.3.165 and 166).	Planned surveys of winter bird use of the impoundment zones will improve impact assessment (FY85 Task 25).		Impoundment clearing will not begin under 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
	*(2) Alteration of habitats for birds due to the transmission corridor.	A preliminary estimate indicates that habitat for 2000 breeding birds will be affected (p. E-3-490).	Previous studies provided sufficient information for impact assessment. No further work is planned.		Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Minimize loss of forest areas through alignment of transmission corridor (pp. E-3-539 #23). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (pp. E-3-291, E-3-292 #1-11).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(P) Other Birds	* (3) Loss of forested habitats for birds due to borrow sites and access corridors.	Loss included in figure for (P)(1) (p. E-3-496, Table E.3.165).	Previous studies provided sufficient information for impact assessment. No further studies planned.		Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Minimize loss of forest areas through alignment of access road and transmission corridor and other measures (pp. E-3-539 #23). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (pp. E-3-291 to 292, #1-11).
	*(4) Avoidance of areas of intense human activity (e.g., construction zones, impoundment clearing activities, recreational activities) due to disturbance.	Impact not quantified (p. E-3-460), but not expected to be significant for most species.	Impact severity not sufficient to require study.		Prohibition of access during construction, discouragement of off-road recreational vehicle activity, and phasing in of recreational plan to limit recreational impacts on vegetation and wildlife (p. E-3-292 #15-17).
	*(5) Increase in breeding habitat for some species due to vegetation encroachment on downstream river floodplains.	Impact represents a beneficial effect on most birds (p. E-3-459).	Impact not sufficient to require study.	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	
	*(6) Increase in mortality due to collisions with transmission lines and towers.	Impact difficult to prevent and population loss is usually insignificant (p. E-3-497).	Impact severity not sufficient to require study.		

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(P) Other Birds	* (7) Loss of nest sites and habitat alteration due to secondary effects of erosion, blowdowns, etc., on forest vegetation.	Impact not quantified but not expected to be significant (Appendix E11J, Volume 10B).	Impact severity not sufficient to require study.		
(Q) Small Mammals	(1) Permanent habitat loss due to impoundments and other permanent project facilities.	Habitats lost are identical to those of birds [see Section (P)(1)]. Normally rapid population turnover rates and reshuffling of territories by small mammals will minimize immediate impacts; however, long-term loss of habitat will reduce overall regional populations (p. E-3-461).	Previous studies provided sufficient information for impact assessment. No further studies planned.		Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Minimize loss and alteration of habitat, particularly less abundant habitats and sensitive wildlife habitats (pp. E-3-291 to 292 #1-11).
	*(2) Increase in numbers of certain species in revegetated areas of reclaimed borrow sites.	Impact represents a beneficial effect on most small mammal species (p. E-3-462).	Impact severity not sufficient to require study.		Revegetation and fertilization of disturbed sites (p. E-3-526 #3).
	*(3) Displacement during impoundment filling of small mammals that have recolonized disturbed areas in the impoundment clearing zone.	Temporary adverse impact, which resulted from a previously beneficial effect on small mammal populations (Appendix E11J, Volume 10B).	Impact severity not sufficient to require study.		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1).
(R) Botanical Resources	(1) Permanent loss of vegetation from impoundments, access roads, transmission line facilities, and other permanent facilities.	Permanent loss of approximately 45,672 acres of primarily forest and shrub vegetation types (pp. E-3-225, 240, 243, 244 and 253, Table E.3.144).	1:63,360 scale vegetation mapping emphasizing understory shrub species is currently underway (FY84 Task 4.1.5) and is scheduled for completion in Jan. 1985 (FY85 Task 8). Mapping of wetlands is being conducted (FY84 Task 4.11.3) and planned for FY85 (FY85 Task 7). A literature review of habitat enhancement techniques is underway (FY84 Task 4.1.11) and field studies of disturbed areas are planned (FY85 Task 14). Identification of candidate lands is underway (FY84 Task 4.1.12).		Mitigation plan provides for minimization, rectification, reduction, and compensation of impacts in a variety of ways (see pp. E-3-252 to 285). Minimize facility dimensions (p. E-3-291 #1). Consolidate structures (p. E-3-291 #2). Site facilities in areas of low biomass (p. E-3-291 #3). Site facilities to minimize clearing of less abundant vegetation types (p. E-3-291 #4).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	(1) Permanent loss of vegetation from impoundments, access roads, transmission line facilities, and other permanent facilities (cont.).				Site facilities to minimize clearing of vegetation types productive as wildlife habitat components (p. E-3-291 #5). Minimize volume requirements for borrow extraction (p. E-3-291 #6). Disposal of spoil within the impoundments or previously excavated areas (p. E-3-292 #7). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12). Avoidance of the Prairie Creek, Stephan Lake, Fog Lakes, and Indian River areas by access routing (p. E-3-292 #14). Siting and alignment of all facilities to avoid wetlands to the maximum extent feasible (p. E-3-292 #18). Agency coordination and participation in detailed engineering design and construction planning of civil engineering measures to minimize potential wetlands impacts (p. E-3-292 #19). Minimize loss of forest areas through alignment of access road and transmission corridor and other measures (pp. E-3-539 #23, E-3-525 #1, E-3-526 #2).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	* (2) Temporary loss of vegetation from non-permanent facilities and disturbed areas.	Temporary loss of 44,741 acres of vegetation (Table E.3.144).	Field studies of disturbed areas are planned (FY85 Task 14).	Monitor progress of rehabilitation to identify locations requiring further attention (p. E-3-292 #11).	Minimize facility dimensions (p. E-3-291 #1). Consolidate structures (p. E-3-291 #2). Site facilities in areasof low biomass (p. E-3-291 #3). Site facilities to minimize clearing of less abundant vegetation types (p. E-3-291 #4). Site facilities to minimize clearing of vegetation types productive as wildlife habitat components (p. E-3-291 #5). Minimize volume requirements for borrow extraction (p. E-3-291 #6). Disposal of spoil within the impoundments or previously excavated areas (p. E-3-292 #7). Dismantle nonessential structures as soon as they are vacated (p. E-3-292 #9). Development of a comprehensive site rehabilitation plan (p. E-3-292 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13). Restriction of public access during construction by gating the access road (p. E-3-292 #15). Use of signs and possibly regulatory designations and measures to discourage use of ORVs and ATVs (p. E-3-292 #16). Siting and alignment of all facilities to avoid wetlands to the maximum extent feasible (p. E-3-292 #18).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	* (2) Temporary loss of vegetation from non-permanent facilities and disturbed areas (cont.).				Agency coordination and participation in detailed engineering design and construction planning of civil engineering measures to minimize potential wetlands impacts (p. E-3-292 #19). Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or deplected borrow areas, and consolidation of project facilities (p. E-3-526 #2). Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Minimize loss of forest areas through alignment of access road and transmission corridor and other measures (pp. E-3-539 #23, E-3-525 #1, E-3-526 #2).
	*(3) Temporary loss and alteration of vegetation communities due to forest clearing operations in the impoundment zone.	Impacts similar to (R)(1) will occur 1 to 2 years earlier; effects will be most prevalent on forest vegetation types (p. E-3-225).	1:63,360 scale vegetation mapping emphasizing understory shrub species is currently underway (FY84 Task 4.1.5) and is scheduled for completion in Jan. 1985 (FY85 Task 8). Identification of candidate lands is underway (FY84 Task 4.1.12).		Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7). If needed, controlled moose hunt to avoid over-browsing by displaced moose (p. E-3-530 #8).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	* (4) Loss and alteration of vegetation communities due to erosion at permanent facilities and along hillsides of impoundment shores resulting from slides, flows, and slumpages partly caused by reservoir waters melting permafrost.	Approximately 1,379 acres of vegetation upstream of the Watana Dam site and a small acreage in Devil Canyon will be subject to loss and alteration through: a) destabilization of till, b) blowdowns; c) thawing of permafrost; d) desiccation of exposed soils; and e) changes in drainage patterns (pp. E-3-226 and 240). Impacts may occur along 70 miles of impoundment shores (pp. E-3-285 to 286).	Acreages impacted and extent of expected impact will be addressed through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Monitor progress of rehabilitation to identify locations requiring further attention (p. E-3-292 #11).	Development of a comprehensive site rehabilitation plan (p. E-3-292 #10). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12). Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7).
	* (5) Damage to vegetation near cleared areas and along impoundment shores from wind and dust.	Blowdowns of trees may occur near cleared areas and along impoundment shores, mainly affecting black spruce stands. Windblown dust may affect vegetation through alteration of snowmelt regimes and changes in the chemical composition of soils (p. E-3-226).	Further analysis of this impact mechanism is underway through impact assessment refinement (FY84 Task 3.1.3: FY85 Task 5).	Monitor progress of rehabilitation to identify locations requiring further attention (p. E-3-292 #11).	Minimize facility dimensions (p. E-3-291 #1). Consolidate structures (p. E-3-291 #2). Minimize volume requirements for borrow extraction (p. E-3-291 #6). Disposal of spoil within the impoundments or previously excavated areas (p. E-3-292 #7). Development of a comprehensive site rehabilitation plan (p. E-3-292 #10). Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Reduction measures for road dust (p. E-3-511).

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(R) Botanical Resources	* (6) Damage and alteration of vegetation along the access roads due to dust deposition, erosion, leaching of nutrients in drained areas, water-logging in areas of blocked drainage, and thawing of adjacent permafrost.	Impacts will occur within a few hundred yards of a road and within zones of blocked or altered drainage, which may extend to a mile from a road (p. E-3-227).	Further analysis of this impact mechanism is underway through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Monitor progress of rehabilitation to identify locations requiring further attention (p. E-3-292 #11).	Site facilities in areas of low biomass (p. E-3-291 #3). Site facilities to minimize clearing of vegetation types productive as wildlife habitat components (p. E-3-291 #5). Development of a comprehensive site rehabilitation plan (p. E-3-292 #10). Acquisition of replacement lands for implementation of habitat enhancement measures (p. E-3-292 #12). Siting and alignment of all facilities to avoid wetlands to the maximum extent feasible (p. E-3-292 #18). Agency coordination and participation in detailed engineering design and construction planning of civil engineering measures to minimize potential wetlands impacts (p. E-3-292 #19). Habitat loss will be minimized by side borrow techniques for road construction, spoil deposition in impoundments or depleted borrow areas, and consolidation of project facilities (p. E-3-526 #2). Revegetation and fertilization of disturbed sites (p. E-3-526 #3). Habitat enhancement measures in middle basin and on replacement lands to compensate for permanent habitat loss (p. E-3-527 #6).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	* (7) Alteration of soil surface albedo in cleared areas may affect vegetation.	Impact not quantified. Changes in albedo will result in changes in surface hydrology, affecting the type of vegetation that will become established, but they should not prevent revegetation (p. E-3-227).	Impact severity not sufficient to require study.	Monitor progress of rehabilitation to identify locations requiring further attention (p. E-3-292 #11).	Minimize facility dimensions (p. E-3-291 #1). Consolidate structures (p. E-3-291 #2). Site facilities to minimize clearing of vegetation types productive as wildlife habitat components (p. E-3-291 #5). Development of a comprehensive site rehabilitation plan (p. E-3-292 #10).
	* (8) Increased incidence of disease or insect infestations due to clearing activities.	Impact not quantified (p. E-3-227).	Impact severity not sufficient to require study.		Impoundment clearing will not begin until 2 or 3 years before filling; patches of vegetation will be left until just before filling (p. E-3-525 #1). Clearing of impoundments prior to flooding and removal of floating debris to reduce hazards to crossing (p. E-3-530 #9). Burning of slash piles will minimize effects of insects and disease (p. E-3-271 and 509).
	(9) Increased risk of fire from increased human populations and easier access.	Impact not quantified (p. E-3-227).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13). Restriction of public access during construction by gating the access road (p. E-3-292 #15). Use of signs and possibly regulatory designations and measures to discourage use of ORVs and ATVs (p. E-3-292 #16). Phased implementation of the project Recreation Plan with interagency review and concurrence (p. E-3-292 #17).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	(9) Increased risk of fire from increased human populations and easier access (cont.).				Public access to airfield prohibited during construction (p. E-3-534 #14).
	* (10) Alteration of vegetation due to flooding along impoundment shores and delta formation where creeks enter the impoundments.	Impact not quantified but not expected to be a significant loss; some alteration of vegetation types will occur (p. E-3-230).	Impact severity not sufficient to require study.		
	(11) Alteration of vegetation successional patterns in downstream floodplains due to flow regulation and resultant changes in stream morphology and ice scouring effects.	Impact not quantified and difficult to predict.	Continued refinement of downstream floodplain impact assessment will increase our understanding of effects on vegetation (FY84 Task 4.2.4).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measuares (p. E-3-530 #7).
	* (12) Alteration of vegetation communities due to climatic changes near the reservoirs.	Effects would extend 2 miles from the reservoirs and would be most noticeable along the south shore of the reservoirs. Extent of effects on vegetation itself has not been quantified (pp. E-3-236 to 237).	Spring 1983 plant phenology study will document physical and environmental variables affecting plant phenological development in and near the impoundment zones (FY84 Task 4.1.4). Impact mechanism will be addressed further through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		Use of multilevel intake structures on the dams to maintain downstream river temperatures as close to normal as possible (p. E-3-526 #5).
	*(13) Damage to understory vegetation from rime ice and hoar frost deposition caused by persistent fog banks near the reservoirs and open-water reaches downstream.	Impact not quantified, but rime icing will be limited to the immediate area around the spillways. Hoar frost is expected near open water but is not expected to be a significant negative impact (pp. E-3-236 to 237).	Impact mechanism will be addressed and clarified through impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	
	* (14) Increase in damage and alteration of vegetation communities due to increase in use of off-road vehicles near project facilities.	Impact not quantified (pp. E-3-237 to E-3-238).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Monitor progress of rehabilitation to identify locations requiring further attention (p. E-3-292 #11).	Development of a comprehensive site rehabilitation plan (p. E-3-292 #10). Planning and development of an environmental briefings program for all field personnel (p. E-3-292 #13). Restriction of public access during construction by gating the access road (p. E-3-292 #15).

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	* (14) Increase in damage and alteration of vegetation communities due to increase in use of off-road vehicles near project facilities (cont.).				Use of signs and possibly regulatory designations and measures to discourage use of ORVs and ATVs (p. E-3-292 #16). Phased implementation of the project Recreation Plan with interagency review and concurrence (p. E-3-292 #17). Public access to airfield prohibited during construction (p. E-3-534 #14).
	* (15) Removal of overstory vegetation in forested portions of the transmission line corridor.	Will result in removal of approximately 6041 acres (2557 from Healy to Fairbanks, 1702 from Healy to Willow, 1274 from Willow to Cook Inlet, 46 from Watana to Devil Canyon, and 462 from Devil Canyon to Gold Creek) of habitats containing trees, changing these areas to shrub or tundra vegetation types (p. E-3-244, Tables E.3.79, 80, and 86; Supplemental Information Response to FERC Request 3B-7).	This impact mechanism will receive further attention during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Restriction of tree removal to areas beneath the transmission lines for access to the corridor, and removal of trees which could fall on lines or guy wires.	Site facilities to minimize clearing of vegetation types productive as wildlife habitat components (p. E-3-291 #5). Design transmission corridors to allow selective cutting of trees and to accommodate uncleared low shrub and tundra vegetation within rights-of-way (p. E-3-292 #8). Selective clearing in transmission corridor, permitting seral vegetation up to 10 ft in height (p. E-3-526 #4). Development of moose-habitat model to yield better impact predictions and refinements to mitigation and compensation measures (p. E-3-530 #7).
	(16) Blockage of sediment travel by the impoundments may increase erosion downstream, affecting vegetation on islands in the floodplain.	Impact not quantified.	Refinement of downstream impacts (FY84 Task 4.2.4) will better enable prediction of erosion effects.	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Ongoing and Planned Studies	(V) Proposed Monitoring	(VI) Proposed Mitigation Measures
(R) Botanical Resources	*(17) Potential removal or alteration of habitats for endangered plant species.	Impact not quantified. No such species have been found in surveys to date (p. E-3-197).	Previous studies provided sufficient information for impact assessment. No further studies planned.		Site facilities to minimize clearing of less abundant vegetation types (p. E-3-291 #4). Design transmission corridors to allow selective cutting of trees and to accommodate uncleared low shrub and tundra vegetation within rights-of-way (p. E-3-292 #8). Use of signs and possibly regulatory designations and measures to discourage use of ORVs and ATVs (p. E-3-292 #16).
	* (18) Leaching of potentially toxic heavy metals, such as mercury, from flooded soils and vegetation into the reservoir impoundment.	Impact not quantified. Primarily affects predatory fish, and tertiary consumers.	A literature search and analysis of the potential for leaching from soils and vegetation into impoundments (Aquatic FY85 Task 51).		
(S) All Species	*(1) Changes in local climate (air temperatures, precipitation, etc.) may have subtle direct effects on distribution or habitat use by wildlife and more profound effects on vegetation, which in turn may affect wildlife use of the area.	Impact not quantified but unlikely to extend more than 2 miles from the reservoirs (pp. E-3-236 to 237).	Impact mechanism will be addressed during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).	Collect data on changes in downstream vegetative cover (p. E-3-523 #2).	
	(2) Minor or insignificant impacts may prove to be major impacts when considering the cumulative effects of all project facilities and the impact of nearby developments on wildlife and their habitats.	Cumulative impacts are not quantified but may constitute some significant impacts (pp. E-3-499 to 507).	Further analysis of cumulative impacts is being addressed during impact assessment refinement (FY84 Task 3.1.3; FY85 Task 5).		

REFERENCES

The citations in the matrix differ from the standard citations used in reports. This has been done to save space, because there is repeated reference to a few reports by the same authors.

The license application has been cited repeatedly. It is the following document:

> Alaska Power Authority. 1983. Before the Federal Energy Regulatory Commission. Application for License for Major Project. Susitna Hydroelectric Project. Anchorage. 13 volumes.

It is not referred to specifically, but page references of the form p. E-3-532 (as well as references to Tables such E.3.168, Figures such E.3.81, and Appendices EIIJ or 3.I) all refer to the license application.

Ongoing and planned studies are taken from two reports that outline plans of study for the fiscal years 1984 and 1985. These reports are cited as "FY84" and "FY85" in the matrix. The reports are the following:

> Harza-Ebasco Susitna Joint Venture. 1984. Susitna Hydroelectric Project. Terrestrial programs. Fiscal year 1984 detailed plan of study. Doc. No. 1190. Prepared for Alaska Power Authority. Anchorage.

> Harza-Ebasco Susitna Joint Venture. 1984. Susitna Hydroelectric Project. Draft terrestrial plan of study. Fiscal year 1985. Doc. No. 1119. Prepared for Alaska Power Authority. Anchorage. 92 pp.

Two other plans of study and one report have been referenced infrequently. "Aquatic FY85" refers to:

> Harza-Ebasco Susitna Joint Venture. 1984. Susitna Hydroelectric Project. Draft aquatic plan of study. Fiscal year 1985. Doc. no. 591. Prepared for Alaska Power Authority. Anchorage.

"Social Science FY85" refers to:

> Harza-Ebasco Susitna Joint Venture. 1984. Susitna Hydroelectric Project. Draft social science program study tasks. Fiscal year 1985. Prepared for Alaska Power Authority. Anchorage.

"Supplemental Information Response to FERC Request 3B-7" refers to:

> Alaska Power Authority. 1983. Responses to FERC supplemental information request of April 12, 1983. Filed with FERC July 11.

The following references are cited in the normal fashion:

> Ballard, W.B., C.L. Gardner, J.H. Westlund, and J.R. Dau. 1982. Susitna Hydroelectric Project. Phase I final report. Big game studies. Vol. III. Moose - upstream. Alaska Department of Fish and Game. Anchorage. 175 pp.

> Miller, S.D. 1983. Susitna Hydroelectric Project. Phase II progress report. Big game studies. Vol. VI. Black bear and brown Bear. Alaska Department of Fish and Game. Anchorage. 99 pp.

> Miller, S.D. 1984. Susitna Hydroelectric Project. Draft Phase II progress report. Big game studies. Vol. VI. Black bear and brown bear. Alaska Department of Fish and Game. Anchorage.