Environmental Impacts of
Alternative Dam Heights

F.39.1

Attachment F.39.1

Environmental Impacts of Alternative Dam Heights

Exhibit E of the License Application considers all aspects of project construction and operation in relations to probable impacts on fish, vegetation, wildlife and other resources of the project area. That discussion is based on the Watana reservoir elevation 2185 alternative combined with subsequent construction of the Devil Canyon dam and reservoir. The following discussion generally compares the differences in impacts if a lower maximum normal water surface elevation were to be used at the Watana site.

WATANA ALTERNATIVES

The majority of the anticipated impacts on terrestrial and aquatic resources resulting from the construction and operation of the two dam project, as described in the License Application, are related to the first phase of development, the Watana 2185 dam and reservoir. The relative impacts of the proposed Watana alternatives are therefore compared to those for the base case Watana 2185 development. Dams with lower reservoir normal maximum water surface elevations (2100, 2000 or 1900 feet) would result in:

1) less area inundated,
2) less borrow material needed,
3) shorter construction periods
4) less inherent capacity for flood control and less regulation of downstream flows, and
5) greater reservoir drawdown.

These changes, in turn, would modify the impacts that are described in many sections of Exhibit E. Lower dam heights would be matched by a reduction in installed capacity (but not the turbine discharge capacity). Modified project operation schedules would, in turn, result in alterations in

seasonal, and potentially weekly and daily, release patterns and therefore in downstream flow regimes.

Area of Inundation

Table F.39a.1 shows that at reservoir elevations of 2100, 2000 or 1900 feet, the length of the reservoir would be 5, 10 and 15 miles shorter, respectively, than at elevation 2185. Also the area inundated is 26, 48 and 62 percent less, respectively than for the reservoir at elevation 2185.

Exhibit E identifies the major impact issues directly related to the amount of area inundated by the Watana development as:

Loss of grayling spawning and rearing habitat
Removal of vegetation
Loss of winter/spring moose and spring bear habitat
Interference with big game movements and potential for accidents
Inundation of Jay Creek mineral lick
Inundation of raptor nests
Impacts on other wildlife
Impacts on existing archaeologic and aesthetic resources

Loss of grayling spawning and rearing habitat. The Watana 2185 reservoir will flood 54 miles of Susitna River mainstem habitat and 28 miles of tributary habitat, including ten miles along Watana Creek, as well as portions of other tributaries. The primary long-term impact is the reduction of clear water spawning habitat in the tributaries that currently supports a substantial population of grayling (estimated to be at least 15,000 in 1982). Future aquatic habitats within the reservoir area are not expected to support a significant grayling population (page E-3-121).1/ In addition, some reduction of burbot and whitefish spawning area is expected in mainstream habitats.

-/ Unless otherwise identified, page references are to Exhibit E of the License Application as filed, February 28, 1983.

TABLE F.39a.1

SUSITNA HYDROELECTRIC PROJECT
ALTERNATIVE WATANA DEVELOPMENTS

Characteristic	2,185	2,100	2,000	1,900
Dam Height (ft)	885	800	700	600
Reservoir Area (Acres)	38,000	28,300	19,800	14,500
Total Reservoir Volume (10^3AF)	9,470	6,645	4,248	2,546
Active Reservoir Volume (10^3AF)	3,740	3,315	2,370	1,675
River Length Inundated (miles)	54	49	44	39
Inundated of Principal Clear-water Tributaries (stream miles)	23.9	18.1	14.4	10.7
Maximum Drawdown	120	150	150	150
Volume of Dam (10^6cy)	62	41	25	16

1/ License Application

Measures to minimize impoundment impacts would be to "substantially lower the surface elevation of the reservoir or to maintain surface level during the embryo incubation period" (page E-3-171). It will not be feasible to maintain constant reservoir elevations during the grayling incubation period (May and June) because of the need to refil the reservoir, but the alternative Watana developments would have substantially lower reservoir surface elevations and therefore the reservoir would inundate correspondingly fewer stream miles of tributary habitat than the 28 miles inundated by the elevation 2185 development (Table F.39a.2). Deadman, Watana, Kosina and Jay Creeks would be impacted by a reservoir at elevation 1900, but to a considerably smaller extent than by reservoirs with higher

maximum water surface elevations. The falls on Deadman Creek, with crest elevation of 1800 feet, would be inundated under all aternatives. The mouth of Goose Creek is at an elevation of approximately 2060 feet at its confluence with the Susitna River and would not be adversely affected by the two lower alternatives. The mouth of the Oshetna River would be inundated only by the Watana 2185 development.

Table F.30a.2

PRINCIPAL TRIBUTARY STREAMS[a]/
INUNDATED BY WATANA RESERVOIR

Stream	Location		Length (miles) Inundated by Reservoir El.			
	River Mile	Elevation at Confluence (feet)	1900	2000	2100	2185
Deadman Creek	186.7	1,513	0.7	1.2	1.7	2.3
Watana Creek	194.1	1,552	6.1	7.7	9.2	10.4
Kosina Creek	106.9	1,670	2.2	3.2	3.9	4.6
Jay Creek	208.6	1,700	1.7	2.3	3.0	3.6
Goose Creek	231.2	2.060	--	--	0.3	1.1
Oshetna River	233.5	2,110	--	--	--	1.9
Total for six tributaries			10.7	14.4	18.1	23.9
Other minor tributaries inundated by Watana 2185 Development			b/	b/	b/	4.1
						28.0

a/ In addition, the lower portions of 39 smaller, unnamed tributaries will be inundated, for 0.1 to 3.9 miles, by all four alternatives with an additional 4, 12 and 13 tributaries inundated by the elevation 2000, 2100 and 2185 alternatives respectively.

b/ Not determined at this time for smaller tributaries but expected to be proportionately less as reservoir elevation is lowered.

Removal of Vegetation. "Construction of the Watana Devlopment will result in the direct removal of vegetation within an area of approximately 35,605 acres (14,409 ha) covering a range of elevations from 1400 to 2400 feet (430 to 730 m). In addition, about 5,258 acres (2128 ha) of unvegetated areas will be inundated or developed" (page E-3-225 as revised by supplemental information filled with FERC on July 11, 1983). The total reservoir areas associated with the smaller projects will require correspondingly less removal of vegetation. Table F.39a.3 shows the total reservoir area and the vegetation area of the reservoir for each of the Watana alternatives. The Watana 2100, 2000 and 1900 alternatives would result in preservation of about 9,000, 17,000 and 22,000 acres of natural vegetation, respectively, with corresponding reductions in impacts to wildlife resources. Natural vegetation that would be preserved by lower Watana dam heights primarily consists of black spruce, white spruce, and mixed forest types.

Table F.39.3

RESERVOIR AREA AND REQUIRED
CLEARING FOR WATANA ALTERNATIVES

Reservoir elevation (feet, msl)	2,185	2,100	2,000	1,900
Reservoir area (acres)	38,000a/	28,300	19,800	14,500
River length inundated (miles)	54	49	44	39
Unvegetated area	5,400b/	4,900b/	4,400b/	3,900b/
Vegetated area	32,600	23,400	15,400	10,600
Percent reduction in required clearing for reservoir	-	28	53	67

a/ From Exhibit A, page A-2-1, and Exhibit E, Chapter 2, page E-2-55.

b/ Assumed to be proportional to river length inundated since this is predominately open water.

Loss of Moose and Bear Habitat. Removal of vegetation and filling of the reservoir for the Watana 2185 development will reduce the carrying capacity of the moose winter range. Also, the impoundment zones, particularly the south-facing slopes, are important as a source of early spring foods and as calving areas for moose. These zones also contain several large areas of river valley bottomland with mixed spruce deciduous woodlands that may provide critical moose habitat during years with severe winters. Brown bears likewise make heavy spring use of the riparian vegetation and south-facing slope habitat where they prey on moose calves and forage on new spring vegetation and overwintered berries. The permanent loss of habitat and early spring foods in the impoundment area may cause a decrease in the carrying capacity of the area for brown bears. Loss of habitat will be most significant for black bears. A large proportion of the acceptable black bear habitat in the middle basin will be eliminated. Whereas no known brown bear denning habitat will be affected by the Watana 2185 reservoir, 15 of 26 identified black bear den sites in the Watana impoundment area will apparently be flooded (S. Miller, ADF&G, unpub. data). Lower reservoir surface elevations would impact moose and bears to a correspondingly lesser extent for each of the smaller reservoir alternatives. For example, 10 of the 15 black bear dens potentially flooded by Watana 2185 occur within an elevation range of 1900 to 2200 feet. Therefore, the number of den sites actually flooded could vary from 5 to 15 depending on the dam height and the exact elevation of the dens.

Interference with Big Game Movements. Reduction of reservoir area, particularly in the length of mainstem and tributary streams inundated and the narrower reservoir width associated with the lower Watana developments, will reduce the magnitude of impacts on the carrying capacity of the area for big game species. Such a reduction would also reduce the potential for interference with movements and the possibility for big game fatalitis during river crossing attempts. Moose, caribou, brown and black bears, and possibly Dall sheep cross the river in the project area. Barriers and potential for accidents would be less at lower Watana elevations, and would

not be present at some key crossing areas due to the shorter reservoir lengths (e.g., in the vicinity of Goose Creek, the Oshetna River, and along a portion of Watana Creek).

Inundation of Jay Creek Mineral Lick. Partial inundation of the Jay Creek mineral lick may negatively impact the Watana Hills Dall sheep population. With the reservoir at elevation 2185, up to 42 percent of the surface area of the mineral lick would be inundated by the Watana impoundment (page E-3-512). This lick appears to be an important nutrient source for the Watana Hills Dall Sheep population. The lick extends from elevation 2000 to 2450, so lower elevations of the reservoir will inundate less of the lick area or may totally avoid it (e.g., at elevation 1900).

Inundation of Raptor Nests. Reduction of reservoir elevation may also be significant for raptors. Lowering the elevation of the Watana reservoir would reduce or eliminate impacts to two bald eagle nests, one golden eagle nest, one gyrfalcon nest, and six raven nests, depending on the alternative selected and the exact nest elevations. Two bald eagle, five golden eagle, one goshawk, and five raven nests would be inundated regardless of the alternative selected.

Impacts on Other Wildlife. Reservoir clearing and general ground disturbance associated with the Watana development will have adverse impacts on the other species of wildlife present in the area (pages E-3-512 to 517 and Tables E.3.149 to 158). Lower reservoir elevations with less needed clearing and general ground disturbance would reduce construction and inundation impacts on all wildlife species in the area, espectially forest-inhabiting species such as many birds, small mammals, and certain furbearers. The impact reduction would be especially significant for marten which is dependent on forest habitat and is the most economically important furbearer in the reservoir vicinity. A reservoir elevation of 1900 feet would reduce marten impacts substantially because only about half of the forest habitat lost with the Watana 2185 project would be inundated by the lower dam height. Areas of stream habitat utilized by mink and otter (both

moderately abundant furbearers in the Watana reservoir vicinity) would also be significantly less-affected by lower reservoir elevations.

Other Impacts of Inundation. A total of 167 historic and archaeological sites are discussed in the License Application. Of these, 30 are identified as being directly affected by the Watana Dam and impoundment (at E. 2185). Three additional sites may be affected (one site directly and two potentially) by borrow area activities. The remaining 134 sites would be unaffected by possible changes in normal maximum reservoir elevations at the Watana development. Since preparation of Exhibit E, 26 additional sites have been identified from the Watana area.

Three of these sites appear to be in the construction area and will likely be impacted regardless of elevation selected. One site is located upstream of the Oshetna River and would only be affected by the elevation 2185 development. The relative elevations of the remaining 52 sites are shown in Table F.39a.4.

Table F.39a.4

ELEVATIONS OF IDENTIFIED ARCHAEOLOGICAL
SITES IN THE WATANA RESERVOIR AREA

Elevation (ft.)	No. of Sites
1540 - 1900	20
1920 - 2000	6
2050 - 2100	10
2133 - 2185	2
2200 - 2300	14
	52

Thus, lowering the normal maximum reservoir elevation from 2185 to 2100, 2000 or 1900 would reduce the number of sites directly affected by 3, 13, and 19 respectively. These sites would remain subject to indirect impacts

during both project construction and operation, however, as discussed in Exhibit E of the License Application.

The License Application also indicates that the Watana 2185 dam and reservoir will inundate six structures, of which one, a lean-to for hunting and fishing, is presently maintained for temporary use. These six structures are located close to the river adn will be affected by the Watana Development, regardless of selected reservoir elevation.

Since the lower alternative reservoir elevations would inundate significantly fewer acres and stream miles than the reservoir as described in the License Application, the lower elevation developments would progressively reduce the total magnitude of changes in land use and related land use activities. Although development would increase the potential for access to the area, the lower alternatives would result in larger areas remaining in primitive "before project" condition for recreational activities including boating, fishing, hunting, and hiking. It is not aniticipated that changes in the dam height or reservoir level would result in any significant modifications to the project related facilities proposed in the Recreation Plan.

Differences in alternative Watana developments will not change impacts to the exceptional Natural Features in the project area as identified in Chapter 8 of the License Application. In terms of the aesthetic quality of the reservoir and the adjacent area, as the reservoir is lowered and the total number of river and tributary miles are reduced and the total size of the reservoir and borrow sites decreases, increasingly larger areas will retain their natural landscape characteristics. For example, Deadman Creek Falls, which is located approximately 0.5 miles north of the Susitna River-Deadman Creek confluence and rises to 1800 feet in elevation, will still be inundated. Sally Lake near the mouth of Watana Creek has a surface elevation of approximately 2050 feet and would be affected only by the 2100 and 2185 dam alternatives.

Borrow Material. A project at elevation 2100 reduces the total volume of the dam by 34 percent as compared with the El. 2185 development (See Table F.39a.1). A development at elevation 2000 reduces the volume by 60 percent and a development at elevation 1900 reduces the volume by 73 percent as compared with the El. 2185 development. These reductions would correspondingly reduce impacts to aquatic and terrestrial habitats.

Borrow areas for the Watana dam are shown in Figure E.2.131 of the License Application. Borrow area E is a large alluvial fan deposit at the confluence of Tsusena Creek with the surface of the deposit ranging in elevation from a low of 1410 feet near the river to 1700 feet against the valley walls. Although the mined area will be rehibilitated to provide feeding and overwintering fish habitat following construction, some increased turbidity will occur from the mining activities. The reduced volume of material needed from borrow area E will tend to reduce the extent and duration of turbidity and sedimentation in the river downstream during construction. Also, reducing the volume needed from this area may reduce impacts on the existing riparian habitat for moose and other species.

Borrow areas A and D are located in upland areas away from the reservoir. The volume of material needed for impervious fill (area D) is progressively less at lower dam heights than that for the dam as described in the License Application.

The volume of material needed from the rock quarry (area A) is also considerably less at lower dam heights but, except for the El. 1900 alternative, is greater than that for the project described in the License Application. This is due to a redistribution in the proportion of the types of materials used in dam construction under the modified design. The project modificatoins result in a reduction in material extracted from the river (area E) and a smaller increasee in material excavated from the rock quarry (area A). This results in a trade-off between less disturbance to aquatic and riparian habitats through removal of the sand and gravel sustrate and less turbidity downstream and increased disturbance to the

area around the rock quarry with increased blasting and resultant dust and increased aesthetic impact in the quarry area.

Shorter Construction Period. Many project impacts discussed in Exhibit E are essentially time dependent in that the shorter the construction period, the less the cumulative impact. Of particular concern is increased hunting and fishing pressure and the general disturbance to the environment that will occur throughout the construction period. The lower dams, with less placement of fill materials, will require less time for construction. This, in turn, will result in a reduction of cumulative impact. Although completion of construction would not totally eliminate some sources of impact (e.g. access to the area), impacts due to other factors may be reduced by shorter construction times. Such factors include:

Erosion
Potential for Oil and Hazardous Material Spills
Blasting
River Diversions
Reservoir Filling
Water Quality Changes
Maintenance of Access and Temporary Camps
Aircraft Disturbance

Flood Control. The Watana 2185 project as described in the FERC License Application is designed so that the powerhouse and outlet facilities, plus reservoir storage, will have sufficient capacity to pass floods with recurrence intervals up to one in fifty years without operating the main spillway. During floods of this magnitude, the reservoir will be allowed to surcharge to elevation 2193 if necessary. By contining the fifty year flood without use of the spillway structure, problems related to nitrogen supersaturation. If a lower elevation for the Watana project is considered (2100 to 1900), project facilities will be modified (e.g. larger outlet works capacity) so that flows up to the 1 in 50 year flood will continue to be passed without operation of the main spillway

Because of the increaseed active storage capacity of the Watana 2185 reservoir, there is a greater capacity to contain flood flows without need to use the outlet facilities. As the active storage capacity of the reservoir decreases at lower elevations, the reservoirs will tend to fill earlier in the summer high flow season and result in a greater need to use the outlet facilities, resulting inless flow regulation downstream'