3. PROJECT LOCATION, FACILITIES, AND OPERATION

This section of the PAD contains specific information regarding the proposed Project location, facilities and operations. This information will serve as a basis for evaluating project impacts during the licensing process.

3.1. Authorized Agents for the Applicant

The Applicant to the Federal Energy Regulatory Commission (FERC) for the Pre-Application Document (PAD) is the Alaska Energy Authority (AEA), a public corporation of the State of Alaska. The individual authorized to act as an agent for AEA during the process of applying for a license is:

Name: Wayne Dyok
Agency: Alaska Energy Authority
Position: Susitna-Watana Project Manager
Address: 813 West Northern Lights Boulevard
Anchorage, AK 99503
Phone: 907-771-3000
Email: wdyok@aidea.org

3.2. Project Location

The proposed Project is to be located along the east-west segment of the Susitna River at 184 river miles above the mouth, approximately half-way between Anchorage and Fairbanks. The Susitna River has its headwaters in the mountains of the Alaska Range about 90 mi south of Fairbanks. It flows generally southwards for about 318 mi before discharging into Cook Inlet just west of Anchorage. The nearest community is the unincorporated community of Cantwell in the Denali Borough which is located about 45 air mi from the proposed Project dam while Anchorage is approximately 180 air mi generally south of the Project area.

3.3. Proposed Project Facilities

The currently envisioned project would include a Watana Dam with a top level of elevation (El.) 2,025 ft above mean sea level (msl) with a maximum normal reservoir surface of El. 2,000 ft msl. During the course of studies leading to a license application, depending on operating and environmental studies and optimization of various reservoir levels, drawdown characteristics, and operational requirements – the final proposed project configurations may vary and may include a maximum reservoir elevation nearing 2,125 ft msl, thecorresponding maximum height of the dam. The Watana Dam will be a concrete gravity structure, most likely constructed by the roller compacted concrete (RCC) methodology. Optimization of the project during licensing studies may result in a proposal for a nominal curve in the dam resulting in an arch-gravity structure which would benefit the stability of the dam.

Construction materials for the dam and appurtenant structures will utilize, as far as possible, rock from the structure excavations to minimize the quarry development. Stable excavations and rock cuts will be designed with suitable rock reinforcement and berms.

Thick alluvial deposits will be removed from the river bed in order to found the dam on sound bedrock.

The powerhouse will be located immediately downstream of the dam, and will house three generating units, each with a nominal capability of 200 MW unit output under average net head (which will be close to the design head) for a total plant capacity of 600 MW under average head. Unit sizing studies are continuing and the final unit size may be as low as 100 MW. The firm energy of the project during the critical November - April time frame will be 1,094 gigawatt hours. The powerhouse will be designed and constructed with an extra empty generating unit bay for the potential installation of a fourth unit at some future time. Optimization studies are ongoing and the capacity of the Project eventually proposed for licensing could extend up to 800 MW.

There would be two outlet works facility structures and four power intake structures (one corresponding to the extra unused powerhouse bay). The outlet works facility in conjunction with the three powerhouse units will be sized to allow discharge of a 50-year flood before flow would be discharged over the spillway.

3.3.1. Project Structures

3.3.1.1. General Arrangement

The proposed Watana Dam will create a reservoir approximately 39 mi long, with a surface area of about 20,000 ac , and a gross storage capacity of 4,300,000 acre-feet (ac-ft) at the normal maximum operating level of El. 2,000 ft msl (See Figure 1-1).

If the proposed optimization studies were to lead to a normal maximum operating level of El. 2,100 ft msl, the accompanying reservoir would be longer and have a greater surface area.

The maximum water surface elevation of the project shown in the accompanying figures during probable maximum flood (PMF) conditions will be El. 2,017 ft msl. The minimum operating level of the reservoir will be El. 1,850 ft msl, providing 2,400,000 acre-ft of active storage during normal operation.

The dam will likely be a concrete gravity structure (or an arch gravity structure) constructed by the RCC methodology. The nominal crest elevation of the dam will be El. 2,025 ft msl, with a maximum dam height of approximately 700 ft above the foundation and a crest length of approximately 2,700 ft msl. Following completion of the studies mentioned above, a nominal crest elevation up to El. 2,125 ft msl may be proposed in the license application, corresponding to a maximum dam height of up to 800 ft above the foundation. The total volume of the concrete structure will be approximately 5,200,000 cubic yards. During construction, the Susitna River will be diverted through a concrete-lined diversion tunnel on the north side of the river, approximately 35 ft in diameter and approximately 1,800 ft long, together with a sluice through the base of the concrete dam of approximately 400-square foot (sf) cross section.

Each installed generating unit will be served by a single power intake located on the upstream face of the dam. Each power intake will be a concrete structure with multi-level gates capable of operating over the full reservoir operating range. From each intake structure, a steel penstock will penetrate the concrete dam and will be anchored to the downstream face of the dam leading to the powerhouse complex; after "day lighting", the steel penstock will be surrounded in a concrete encasement. The powerhouse will house three generating units with vertical shaft Francis-type hydraulic turbines driving direct connected synchronous generators. A fourth penstock will pass through the concrete dam, and the downstream end will be semi permanently capped–to be removed only if and when an additional generating unit is eventually installed in the future.

Access to the powerhouse floor level will be by means of a shotcrete-lined access tunnel, necessary because of the steep valley sides, and a road from the north bank of the downstream river valley. Turbine discharge will flow through three draft tubes (one per unit) and into the common tailrace. Unit generator step up transformers will be located on the powerhouse deck just downstream of the powerhouse building.

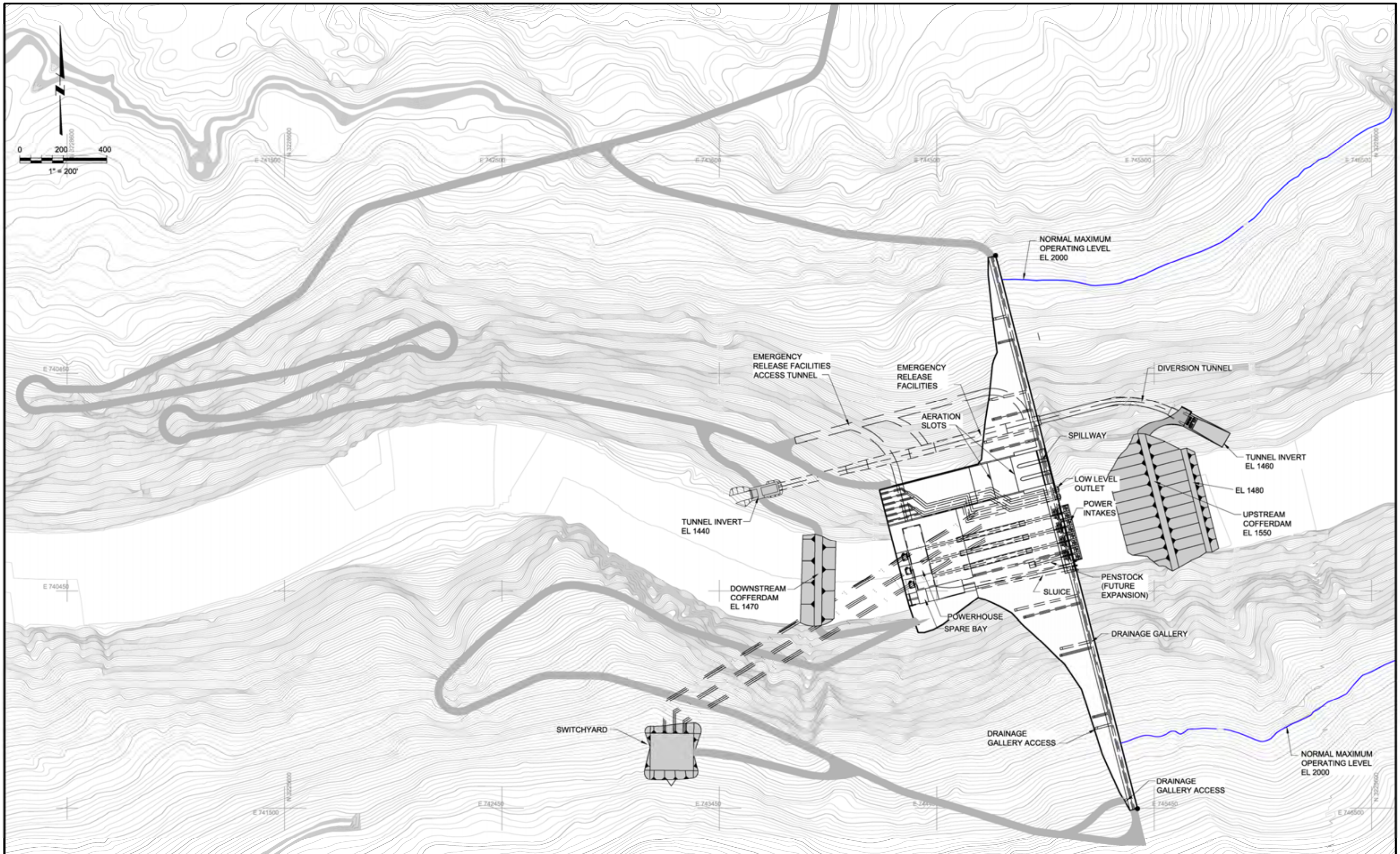
One three-phase generator step up transformer for each unit will be mounted on the deck, together with a spare transformer. From the transformer bushings there will be 230-kV high voltage lines that will connect to a switchyard on the left downstream abutment. The switchyard will provide switching to three transmission lines.

The intakes for the low-level outlet facilities will be located on the upstream face of the dam to the north side of the spillway, with a total combined capacity of approximately 24,000 cubic feet per second (cfs). In combination with the average powerhouse flow of 7,380 cfs, the arrangement provides for the storing and releasing of the 50-year flood without raising the pool level above El. 2,000 ft msl and without spillway operation.

The spillway located on the north side of the powerhouse will consist of an upstream ogee control structure with three radial gates and an inclined concrete chute and flip bucket designed to pass a maximum discharge of 278,300 cfs. This spillway, together with the outlet facilities, will be capable of discharging the estimated PMF of 326,000 cfs, while maintaining 8 ft of freeboard on the dam. Additionally, emergency release facilities will be located in the diversion tunnels after closure to allow controlled filling and for lowering of the reservoir over a period of time for emergency inspection or repair of impoundment structures.

3.3.1.2. Dam Structure

The Watana Dam structure will be located at Susitna River RM 184, in a broad U-shaped valley approximately 2.5 mi upstream of the Tsusena Creek confluence. The dam will be of concrete most likely placed by the RCC methodology. A plan overview is shown on Figure 3.3-1 and is described below.



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SUSITNA-WATANA HYDROELECTRIC PROJECT

SITE PLAN

FIGURE
3.3-1

3.3.1.3. Construction Diversion

Diversion of the river flow during construction will be accomplished primarily with a single 35-foot diameter circular diversion tunnel. The approximately 1,800-foot concrete-lined tunnel will be located on the north bank of the Susitna River as shown on Figure 3.3-1. The dam structure will incorporate a low level sluice approximately 20 ft wide and 20 ft high to form a second diversion conduit. The tunnel, in conjunction with the sluice, is designed to pass a flood with a return frequency of 1:50 years, equivalent to a peak inflow of 89,500 cfs. Routing effects are small, and thus at peak flow the diversion will discharge 77,000 cfs. The estimated maximum water surface elevation upstream from the cofferdam for this discharge will be El. 1,532 ft msl. The design of the diversion facilities will take into account the special circumstances associated with “break up”.

3.3.1.4. Emergency Release Facilities

The diversion tunnel will be converted to a permanent low-level outlet, or emergency release facility. A local enlarging of the tunnel diameter to 45 ft will accommodate the low-level outlet gates and expansion chamber. These facilities will be used to pass the required minimum discharge during the reservoir filling period and will also be used for draining the reservoir in an emergency.

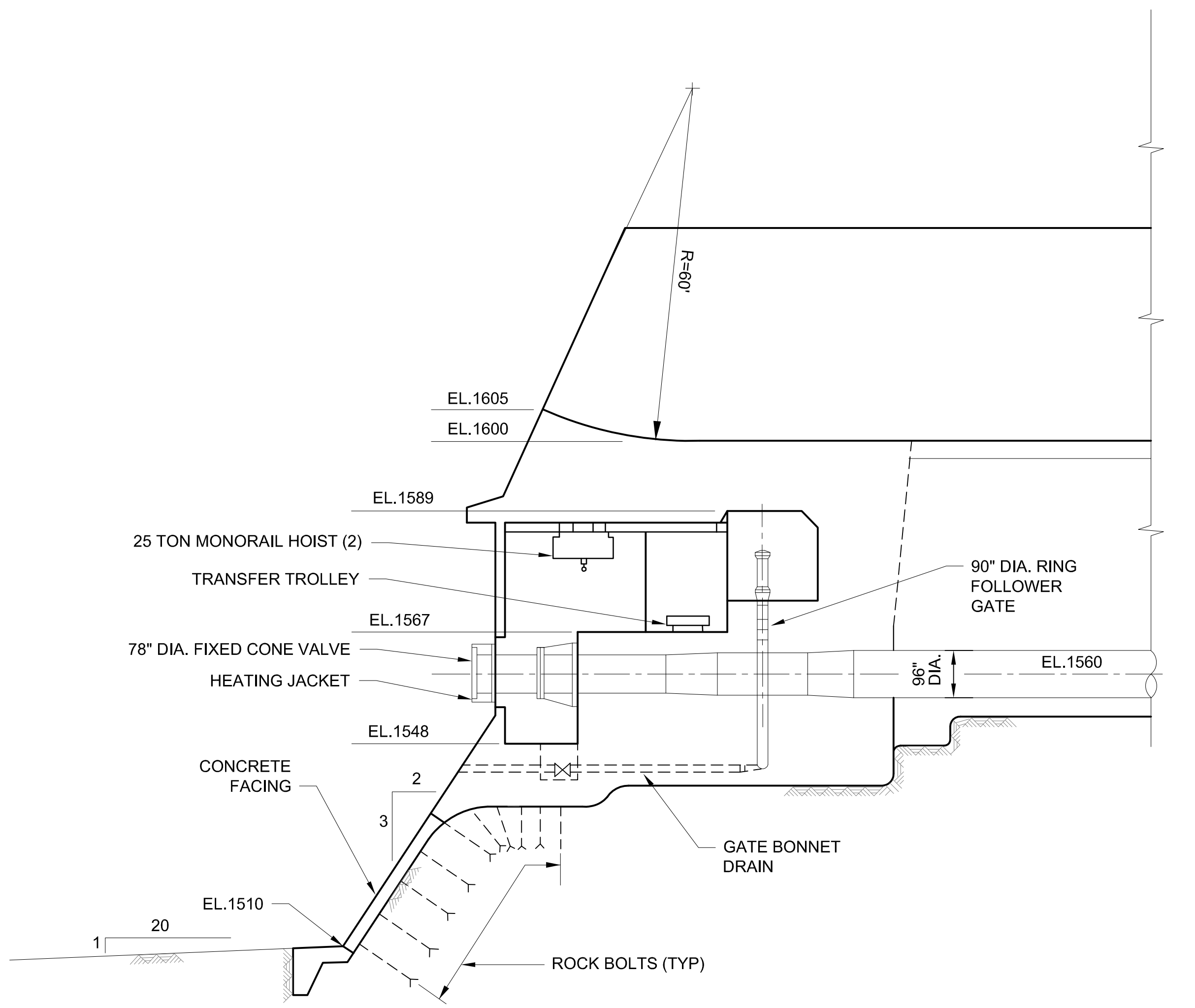
During operation, energy will be dissipated by means of two gated concrete plugs separated by a 340-foot length of tunnel. Each plug will contain three water passages.

Bonneted high pressure slide gates will be installed in each of the passages in the tunnel plugs. The gate arrangement will consist of one emergency gate and one operating gate in the upstream plug and one operating gate in the downstream plug. The 340-foot length of tunnel between plugs will act as an energy dissipating expansion chamber, and will be vented.

3.3.1.5. Permanent Outlet Facilities

The primary function of the outlet facilities will be to provide continuing flows if the powerplant is inoperative. The arrangement of the outlet facilities is indicated on Figure 3.3-1 and Figure 3.3-2 presents further details. The use of fixed-cone discharge valves will ensure that downstream erosion will be minimal and will be configured so that any increase in the dissolved nitrogen content (as a result of the discharges) is minimized. The outlet facility will be able to release water from a lower level than the dam spillways and thus provide a method of discharging high flows without using the spillway. A secondary function will be to provide the capability to draw down the reservoir during an emergency situation.

The facilities will be located on the north end of the dam structure close to the spillway and will consist of two gated structures, and two steel conduits, each trifurcating into three steel pipes and an energy dissipation and control structure housing located beneath the spillway flip bucket. This structure will accommodate six fixed-cone valves which will discharge into the river below.



OUTLET SECTION
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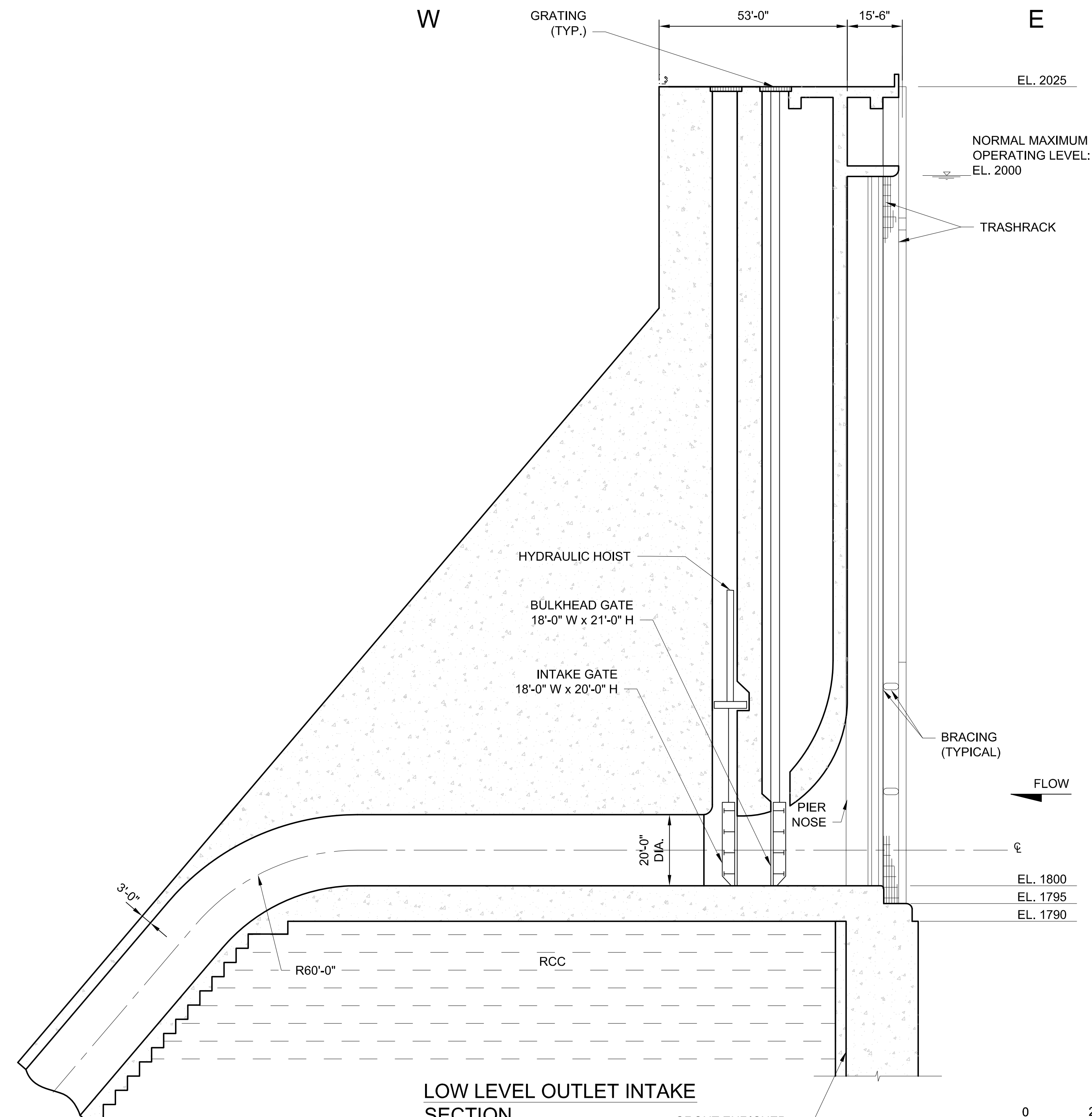

LOW LEVEL OUTLET INTAKE SECTION
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SUSITNA-WATANA HYDROELECTRIC PROJECT

LOW LEVEL OUTLET

FIGURE 3.3-2

3.3.1.6. Spillway

The spillway will provide discharge capability for floods exceeding the capacity of the outlet facilities. The combined total capacity of the spillway and outlet facilities will be sufficient to safely pass the routed PMF.

The spillway, shown on Figures 3.3-1 and 3.3-3, will be located on the dam structure and the north bank of the Susitna River and will consist of a gated ogee control structure, a concrete-lined chute, and a flip bucket.

The spillway is designed to discharge flows corresponding to a maximum reservoir elevation of El. 2,014 ft msl.

3.3.1.7. Power Intake

Each of the three active penstocks will have its own power intake which will be a concrete structure mounted at the upstream face of the dam. Access to the structure will be from the dam crest road.

In order to draw from the reservoir surface over an expected drawdown range of 150 ft, two parallel vertical openings will be provided in the upstream concrete wall of the structure for each of the intakes. Sliding steel shutters operated in a common guide will be able to be adjusted to facilitate selective withdrawal. All openings will be protected by upstream trash racks. A heated boom will operate in guides upstream from the racks following the water surface, keeping the racks ice free.

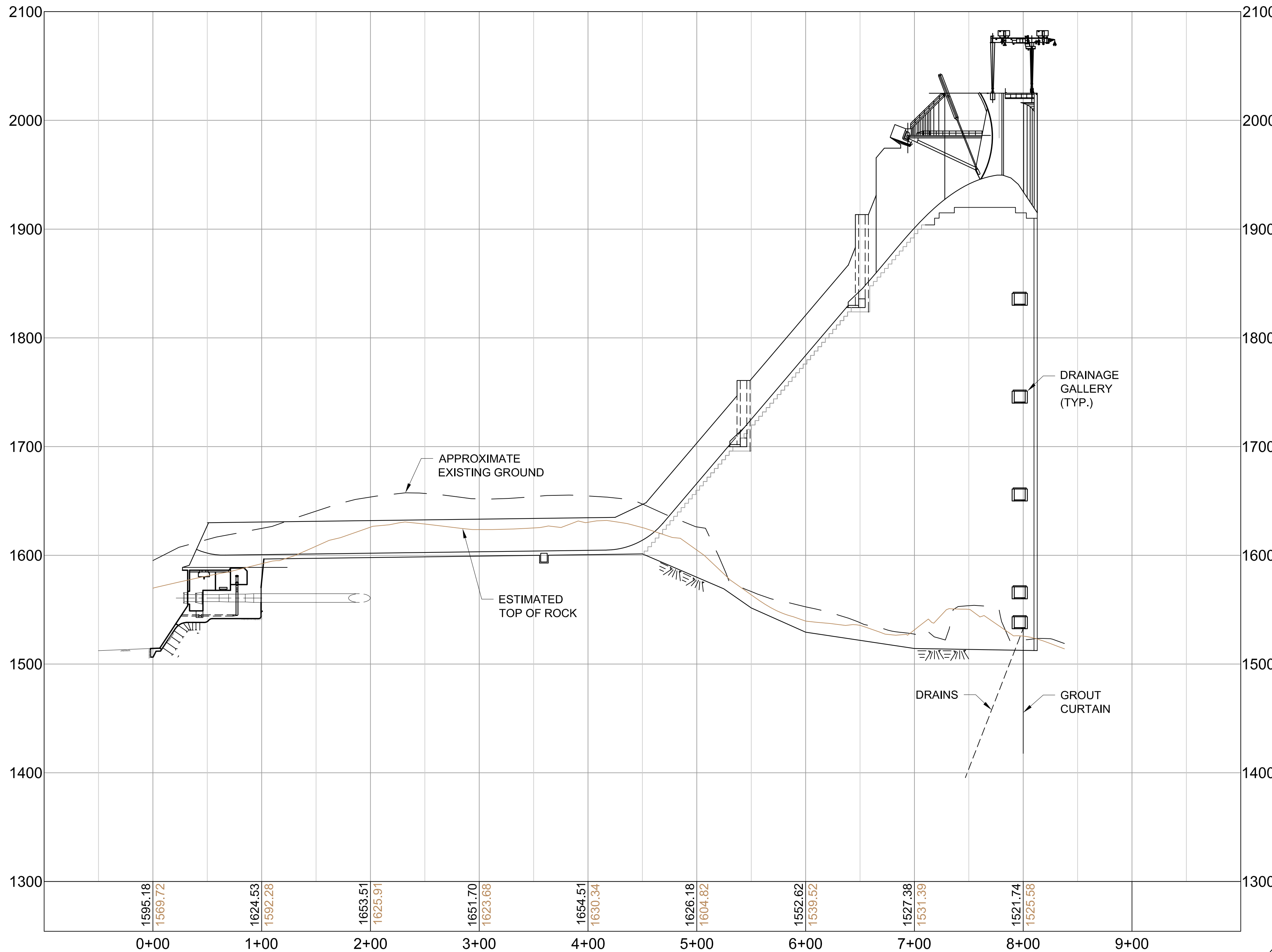
Lower control gates will be provided in each intake unit. A single set of upstream bulkhead gates will be provided for routine maintenance of the individual intake gates.

The overall width of each intake will be 65 ft.

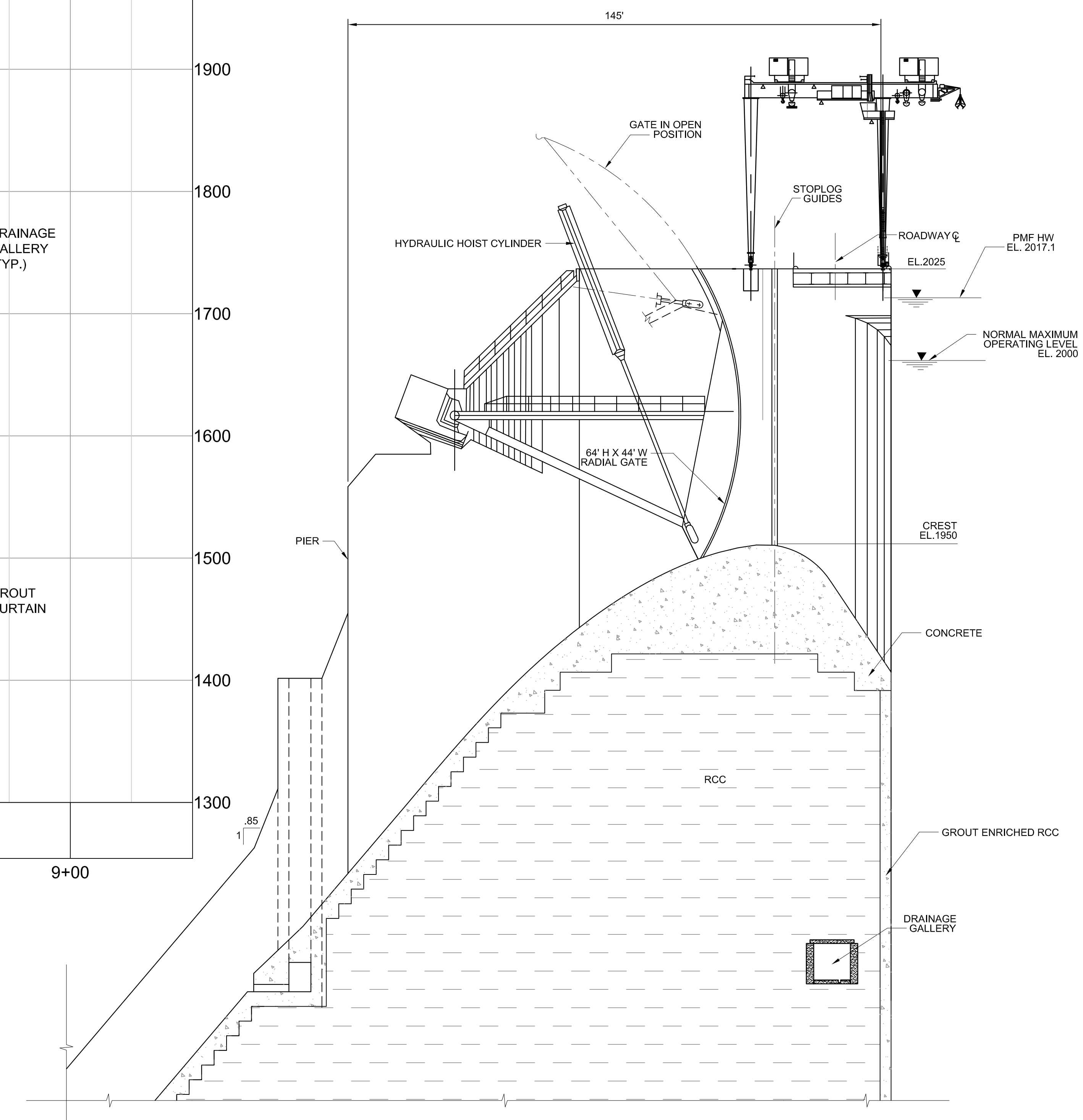
The upper level of the concrete structure will be set at El. 2,025 ft msl, corresponding to the crest road. The level of the lowest intake is governed by the vortex criterion for flow into the penstock from the minimum reservoir level elevation of El. 1,850 ft msl.

The spare intake for the unused bay will be constructed at the time of dam construction, but will only be outfitted with stop logs to isolate the first part of the penstock.

The general arrangement of the power intake is shown on Figure 3.3-4.



SPILLWAY
SCALE B



SPILLWAY CREST SECTION
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SCALE A

0 60 120
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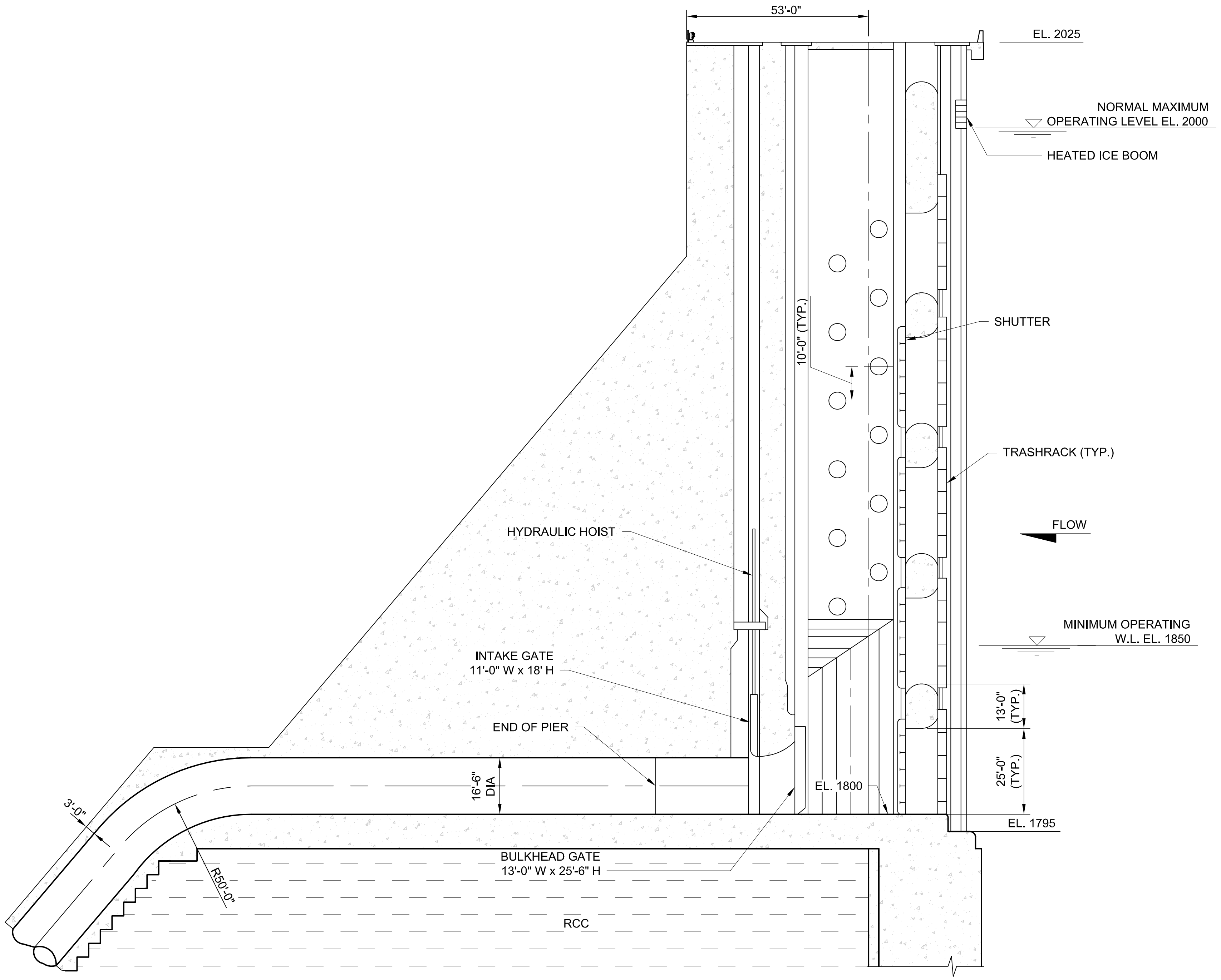
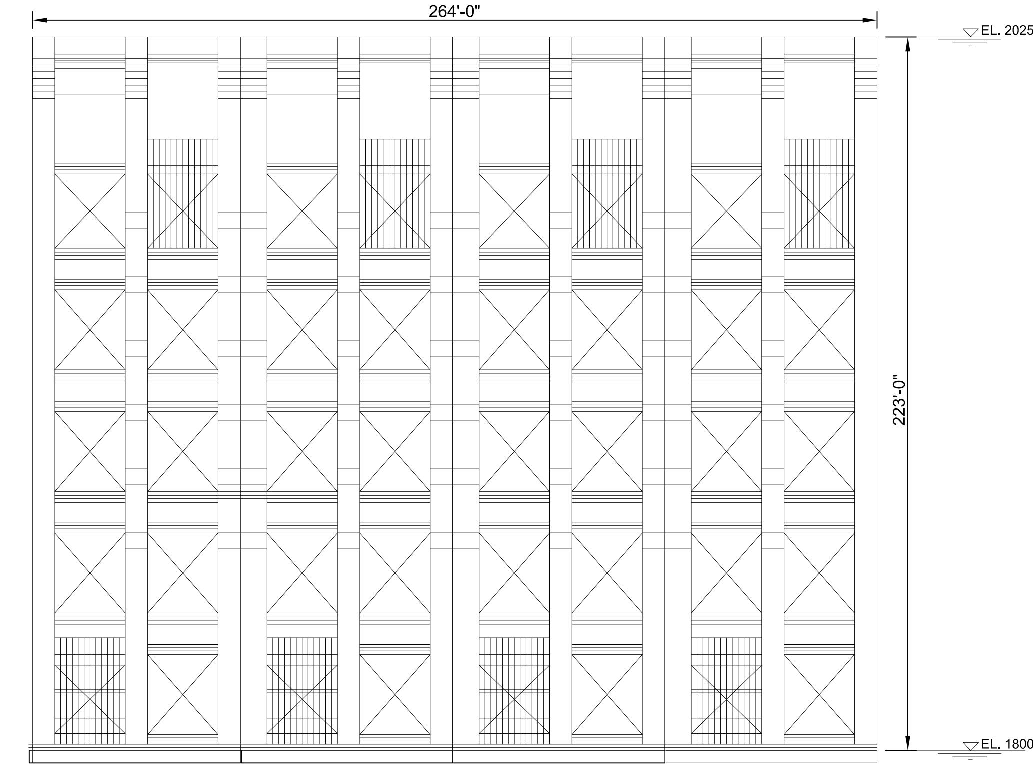
SUSITNA-WATANA HYDROELECTRIC PROJECT

OUTLET SPILLWAY

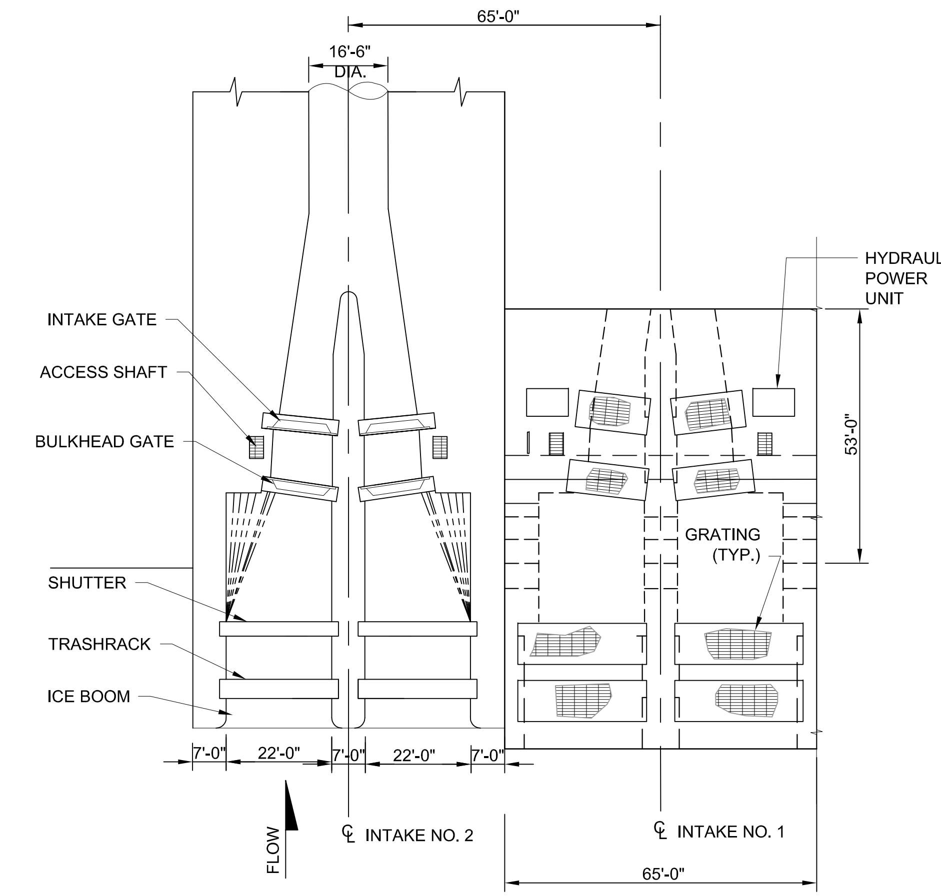
FIGURE
3.3-3



SECTION THROUGH POWER INTAKE
SCALE A



POWER INTAKE
ELEVATION
SCALE B



PLAN AT EL. 1812
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PLAN AT EL. 2025
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POWER INTAKE STRUCTURE

FIGURE
3.3-4

3.3.1.8. Penstocks

Each penstock is provided to convey water from the power intake to the powerhouse, one penstock for each generating unit. The penstock geometry consists of a short horizontal reach through the dam structure, a 50 degree bend, a penstock down the downstream face of the dam, another 50 degree bend and a short horizontal reach before the spiral case. The penstock will be approximately 16.5 ft in diameter, but their exact dimensions remain to be optimized. The penstock on the downstream face of the dam will be encased in concrete for protection.

The design static head on each penstock is 570 ft, at centerline distributor level (El. 1,430 ft msl). An allowance of up to 35 percent will be made for pressure rise in the penstock caused by hydraulic transients.

3.3.1.9. Powerhouse

The powerhouse will be a surface structure approximately 285 ft long by 78 ft wide constructed at the downstream toe of the dam, and will be founded on bedrock. Depending on the exact level of sound rock in the river bed, the powerhouse may be founded, effectively, on a concrete "infill" forming a downstream extension of the dam structure. This may be either RCC or conventional concrete. The exact method of placement will be determined during the project design.

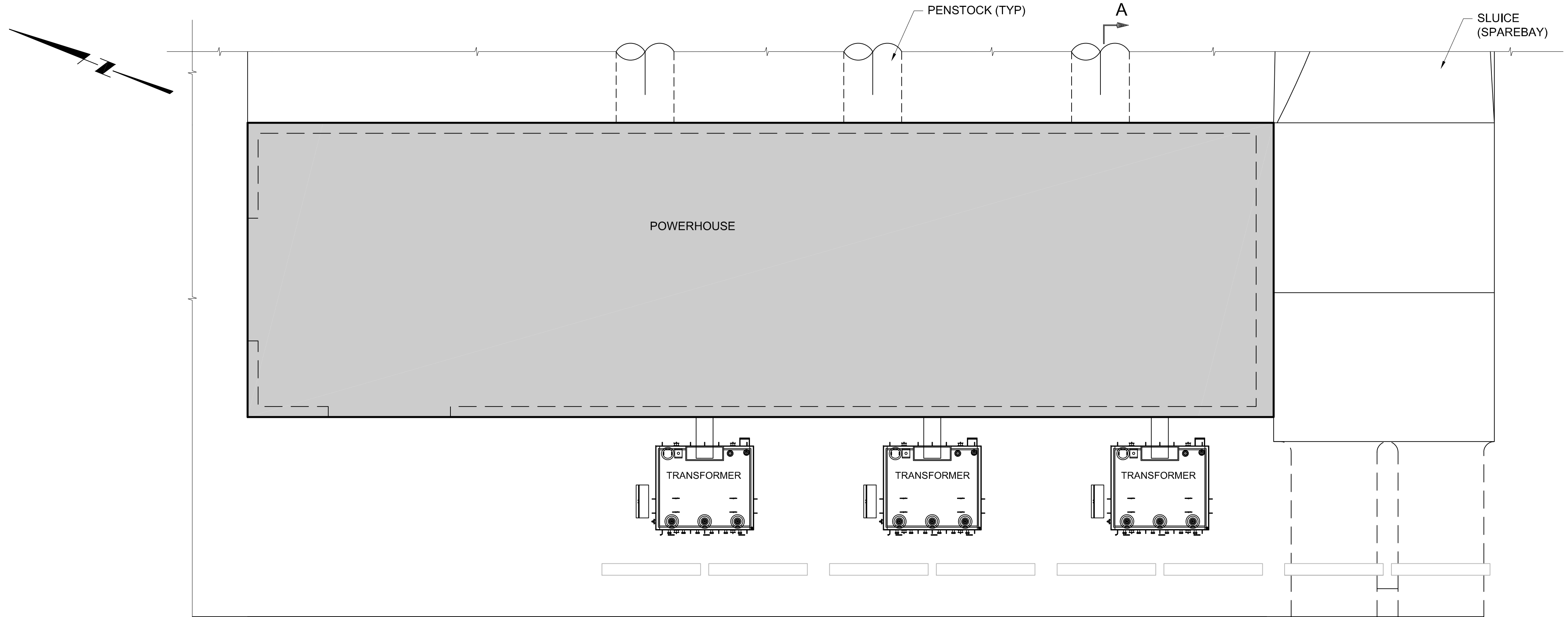
The powerhouse will be a surface structure parallel to the longitudinal access of the dam. Vehicular access will be from the north, through an access tunnel and under the spillway structure. The powerhouse will include an assembly bay, and three unit bays. Beyond the end wall of the powerhouse - to the south - a further bay will be constructed in case, in the future, AEA wishes to install a fourth unit.

On the draft tube deck will be mounted three unit transformers, together with a spare transformer. High voltage power lines will be anchored to the downstream face of the dam, spanning to the switchyard on the south bank of the river, downstream.

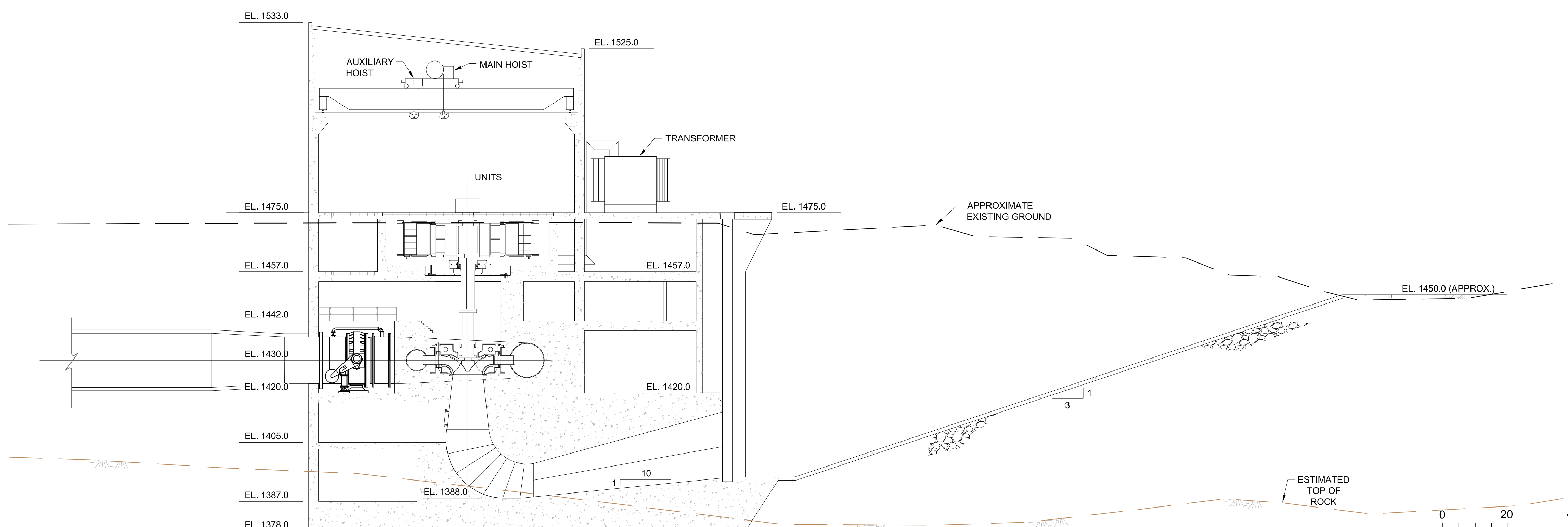
The general layout of the powerhouse complex is shown in plan and section on Figure 3.3-5.

The draft tube gate crane will be located on the draft tube deck, above the anticipated maximum tail water level.

Vehicular access to the powerhouse at Watana Dam will be provided by a single unlined rock tunnel from the north bank area at El. 1,560 ft msl, adjacent to the diversion tunnel portal. The access tunnel will descend to the deck level at El. 1,475 ft msl and will continue under the spillway structure to the powerhouse entrance. Access to the draft tube deck will either be from outside the powerhouse, or from the erection bay, and will be arranged so that a transformer can be offloaded and moved, or large equipment can access the areas around the powerhouse. The gradient will not exceed 9.5 percent in the permanent access tunnel.



POWERHOUSE PLAN



POWERHOUSE SECTION A-A

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POWERHOUSE

FIGURE
3.3-5

A completely separate emergency egress will be provided at the southern end of the powerhouse. In emergencies, personnel can exit and withdraw from the powerhouse across the spare bay and up the separate access on the south abutment.

The main powerhouse will be designed to accommodate three vertical-shaft Francis turbines, in line, with direct coupling to synchronous generators. The length of the powerhouse will allow for a unit spacing of 65 ft, with a 90-foot long service bay at the north end for routine maintenance and for construction erection. Multiple stairway access points will be available from the main floor to each gallery level. Access to the transformer and draft tube deck from the powerhouse will be by a door in the west side of the erection bay. A service elevator will be provided for access to the various powerhouse floors.

Hatches will be provided through all main floors for installation and maintenance of heavy equipment using the powerhouse cranes.

3.3.1.10. Main Site Access Plan

3.3.1.10.1. Access Objectives

The primary objective of both temporary and permanent site access facilities is to provide a transportation system to support construction activities, and allow for the orderly development and maintenance of the Project. The current planning assumes restricted access during construction for safety considerations and permanent controlled public access. Another goal is to co-locate access roads and transmission facilities, as far as possible, in the same corridor to minimize impacts.

3.3.1.10.2. Access Plan Selection

The original license application in the 1980s reviewed 18 alternative access plans within three distinct corridors. The three corridors identified at that time were described as:

- A corridor running west to east from the George Parks Highway to the dam site on the north side of the Susitna River;
- A corridor running west to east from the George Parks Highway to the two dam sites on the south side of the Susitna River; and,
- A corridor running north to south from the Denali Highway to the Watana Dam site.

The final choice articulated in the 1985 draft amended license application after reflecting on the criteria, was an access road from the north (Denali Highway).

The final choice in the 1980s (identified as Access Plan 18, and as Denali Corridor in this document) continues to be a viable route now and would include a railhead facility at Cantwell. A new road would start at mile post (MP) 113.7 of the Denali Highway, although it is assumed that there would be improvements to approximately 20 mi of the Denali Highway at the Cantwell end to support the increased traffic during construction. At MP 113.7 a new road would be constructed south for approximately 44mi - as shown on Figure 1-1 to the Watana Camp site. The highest elevation of this route is 4,100 ft msl.

Other routes were studied by Alaska Department of Transportation and Public Facilities (ADOT&PF) in 2011. For this PAD there are three potential corridors including two western corridors paralleling the Susitna River described below.

The second route (termed Chulitna) runs east-west along the north side of the Susitna River, commencing at a new railroad facility at the Chulitna station. From this location, the road would cross Indian River before heading east into the Portage Creek valley, crossing Devil Creek and Tsusena Creek at higher elevations, before reaching the Watana camp. The new road construction is approximately 45 mi with a maximum elevation of approximately 3,250 ft msl.

The third route (termed Gold Creek and similar to Access Plan 16) commences at a new railroad facility to be constructed at the Gold Creek station. From Gold Creek, the route follows the Susitna River on the south bank and is approximately 50 mi long with a maximum elevation of 3,500 ft.

AEA proposes to study these three corridors. Creeks would be crossed using standard ADOT&PF bridge design, or using culverts as appropriate, and the construction is expected to be achieved using standard methods and local borrow pits/quarries within the corridor for fill and surfacing.

As noted the two east-west routes would not interconnect with a public road, terminating at the railhead at Chulitna or Gold Creek.

A study corridor width of up to approximately 5,000 ft has been shown on Figure 1-1, although at certain specific locations extra width may be required to skirt or surmount topographical features. The corridor width is slightly increased at both Watana Camp and the railheads.

3.3.1.10.3. Description of Access Plan

Permanent access to the Watana Dam site will connect with the existing Alaska Railroad either at Chulitna, Cantwell or Gold Creek, where at the chosen location a railhead and storage facility occupying up to 40 ac will be constructed alongside the existing passing bays. New sidings of a length up to 5,000 ft will be constructed so that off loading and transfer of goods and materials can take place without interrupting the operations of the Alaska Railroad Corporation (ARRC). This facility will act as the transfer point from rail to road transport and as a back up or interim storage area for materials and equipment, and as an inspection and maintenance facility for trucks and their loads. Within the 40 ac would be a small residential camp for drivers trucking equipment to the construction site, for laborers and staff operating the transfer, and for support staff such as cooks, etc.

If the Denali Corridor is chosen for road access, in the community of Cantwell the pavement on the first section of the Denali Highway will be extended for a distance of approximately 4 mi to eliminate any problem with dust and flying stones. In addition, the following measures will be taken:

- Speed restrictions will be imposed along appropriate segments;
- Improvements will be made to the intersections including pavement markings and traffic signals.

3.3.1.10.4. Right-of-Way

If the Denali Corridor is selected the affected sections of the Denali Highway will be upgraded in order to facilitate safe construction of the Project. It is not anticipated that the Denali Highway would be a part of the Project.

Notwithstanding which road is chosen, the majority of the new road will follow terrain and soil types which allow construction using side borrow techniques, resulting in a minimum of disturbance to areas away from the alignment. A berm type cross section will be formed, with the crown of the road being approximately 2 to 3 ft above the elevation of adjacent ground. To reduce the visual impact, the side slopes will be flattened and covered with excavated peat and other naturally occurring materials. A 200-foot right-of-way will be sufficient for this type of construction. Typical road facilities are shown in Figure 3.3-6.

3.3.1.11. Site Facilities

Construction of the Watana Dam site development will require various facilities to support the construction activities throughout the entire construction period. Following construction, the operation of the Project will require a small permanent staff and facilities to support the permanent operation and maintenance (O&M) program.

The most significant item among the temporary site facilities will be a construction camp. The construction camp will be a largely self-sufficient community normally housing approximately 800 persons, but with a peak capacity of up to 1,000 people during construction of the project. After construction, it is planned to remove most of the camp facility, leaving only those aspects that are to be used to support the smaller permanent residential and operation and maintenance facilities.

Other site facilities include contractors' work areas, site power, services, and communications. Site power and fiber optic cabling will be brought either on the transmission line route, or along the side of the access road. Items such as power and communications will be required for construction operations, independent of camp operations.

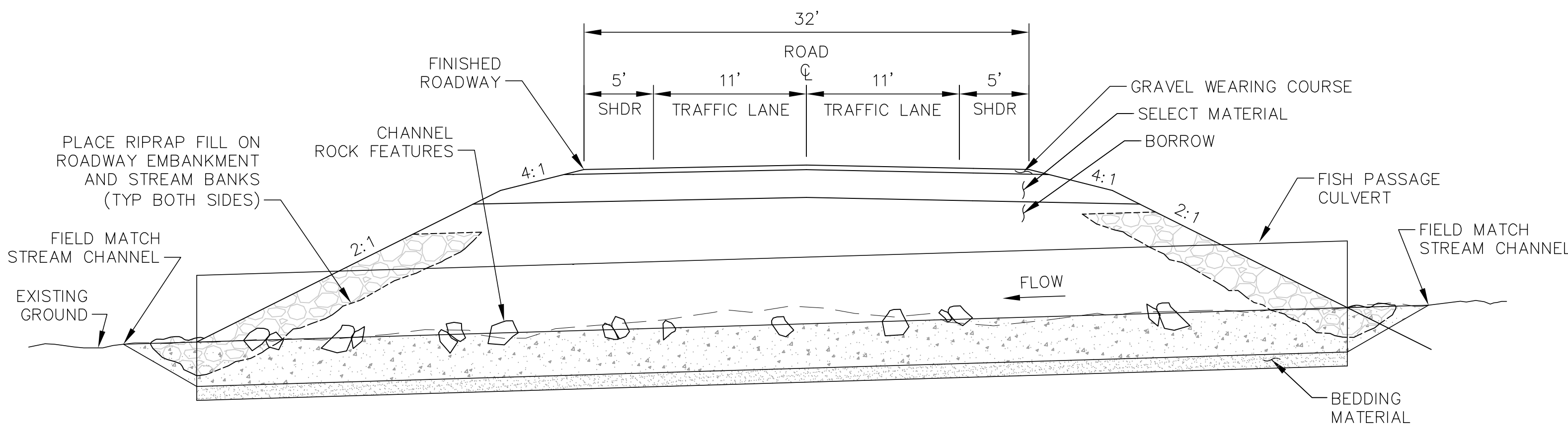
Permanent facilities will include community facilities for O&M staff members and any families. Other permanent facilities will include maintenance buildings for use during operation of the power plant.

The airstrip and helicopter/airplane hard standing will be left in place after construction.

The location of the various facilities was essentially chosen during the infrastructure studies in the 1980s, with due regard to: size; accessibility; soils; wetlands; topography; water supply;

visual quality; living environment; recreational impacts; wildlife habitat; fishery impacts; cultural resources; and land ownership.

The construction camp will be surrounded by robust fencing to discourage local wildlife and will need to be properly maintained during the construction period and beyond.



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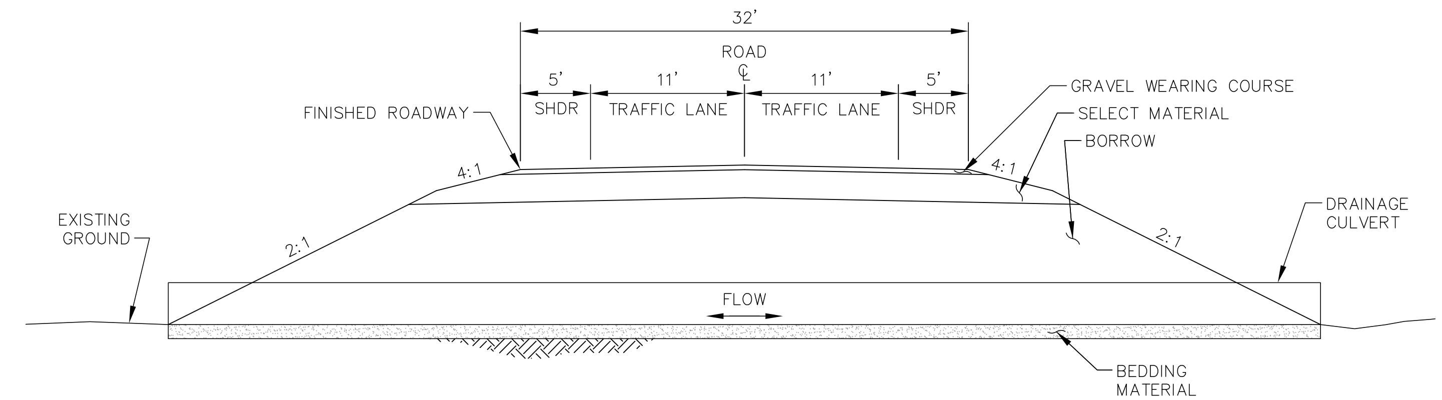
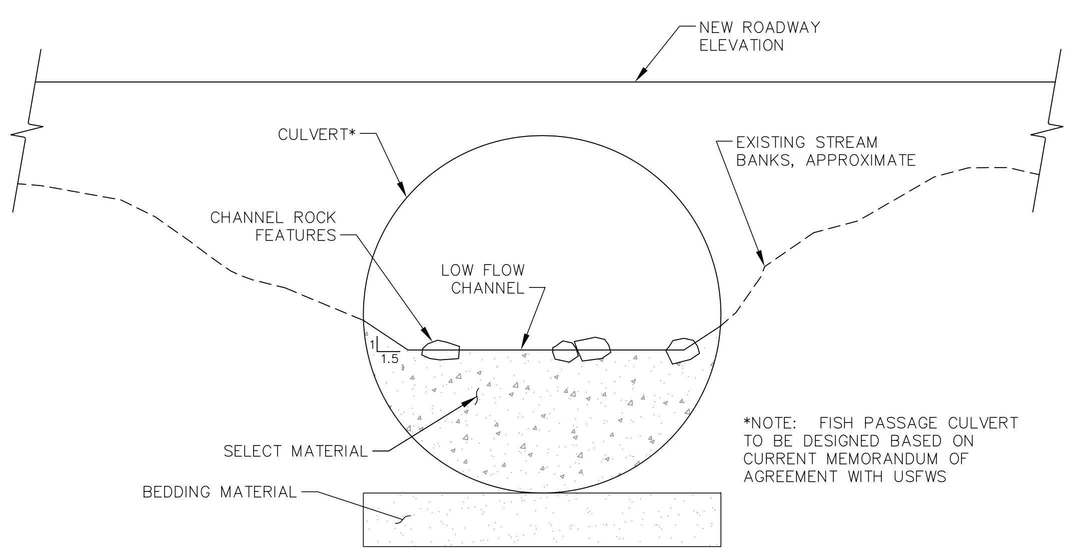
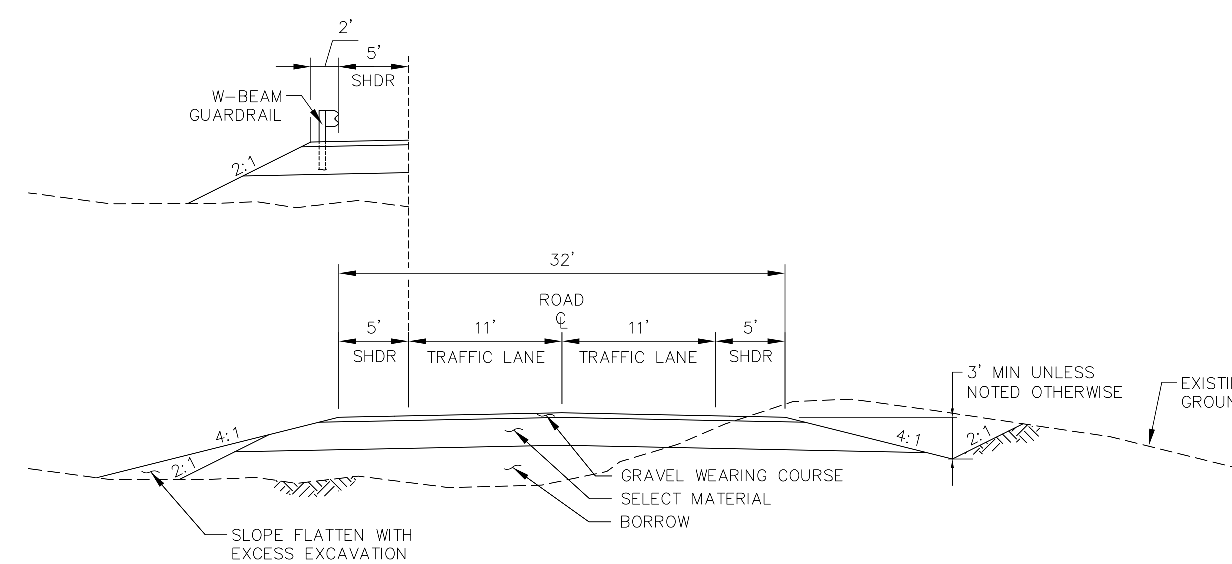


TYPICAL ROAD SECTION W/ DRAINAGE CULVERT



FISH PASSAGE CULVERT CROSS SECTION



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TYPICAL ROAD DETAILS

FIGURE
3.3-6

3.3.1.11.1. Camp-Construction and Permanent Site Facilities

The proposed location of the temporary construction camp will be on the north bank of the Susitna River near Deadman Creek, approximately six mi northeast of the Watana Dam site. The north side of the Susitna River was chosen because most of the construction facilities and the diversion will be on the north, and south-facing slopes can be used for location of the structures. The proposed location is shown in Figure 4.1-1. During design development the temporary construction camp location may be changed within the proposed Project boundary.

Close to, but separated from the dormitory area of the construction camp, will be constructed separate accommodations for management staff from AEA; supervising engineers and construction managers; management staff from the contractors; and guest houses for visiting senior staff. Part of this separate area will remain as the permanent operator housing, but most of it will be demolished, along with the dormitories, at the end of construction. The area will be landscaped. The camp will be grouped around a service core containing recreation facilities, a small store and communal facilities. Facilities such as a fire station and medical facilities will also be part of the camp.

Construction power will be brought in by overhead line from the intertie, along the selected access road route (or the permanent transmission line route) at a voltage of 12.47 kV. Two transformers will be installed at a Watana substation to reduce the line voltage to the desired voltage levels for distribution. Backup generators will be incorporated into the system, located at the construction facilities. Power for the permanent accommodation will be supplied from the station service system after the power plant is in operation, but a standby generator will be incorporated.

The water supply system will provide for potable water and fire protection for the camp and selected contractors' work areas. The principal source of water will be Deadman Creek, with a backup system of wells drawing on ground water. The water will be treated in accordance with the U.S. Environmental Protection Agency's (EPA) primary and secondary requirements, and Drinking Water Standards of the State of Alaska, Department of Environmental Conservation (ADEC).

Telephone and internet communications will be provided during construction via fiber optic cables hung on the same poles as the construction power supply.

A wastewater collection and treatment system will serve the construction camp. One treatment plant will serve all facilities. Gravity flow lines, with lift stations, will be used to collect the wastewater from all of the facilities.

3.3.1.11.2. Contractors Facilities

The on-site contractors facilities will include offices; workshops; tire shops; stores for construction equipment spare parts; stores for permanent materials to be included in the works (both outdoor and climate controlled); fuel and grease storage; and general steel, woodwork, electrical and other workshops.

Space required by the contractors and their suppliers will be located between the main construction camp and the dam. At the railhead, there will also be temporary storage, to allow for scheduling of trucks from the railhead to the site.

3.3.1.11.3. Site Roads

Temporary construction roads will be needed to facilitate construction in and around the dam site. Construction roads will form the basis of the permanent road system, or will be restored with topsoil stored during construction.

3.3.1.11.4. Airstrip

Construction at the site is envisaged to proceed on the basis of 3 weeks on/1 week off (or similar), which will require considerable movement of personnel at the beginning and end of each working week, as well as the daily flow of visitors, food, spare parts, etc., and occasional evacuation of individuals. Previous studies concluded that an airstripcapable of accommodating Boeing 737 and C130 aircraft, as well as helicopters, is required.

At the time of the 1980s studies, an airstrip of a length 6,500 ft was selected because of the required take off length for a 737-200. Subsequent 737 models require a somewhat longer runway of 8,000 ft, and requirements for an increased runway length will be addressed during Project design.

Nine areas were studied for the airstrip and the selected site, based on the criteria mentioned above, as well as FAA criteria for glide paths and the requirements to accommodate the prevailing wind, have resulted in the location shown on Figure 4.1-1. This location selection will be revisited during licensing studies, but the final location will be within the proposed FERC Project Boundary.

3.3.2. Reservoir Data

The Watana Reservoir, at normal operating level of El. 2,000 ftmsl, will be approximately 39 mi long with a maximum width of approximately 2 mi. The total water surface area at normal operating level is approximately 20,000 ac. The minimum reservoir level will be 1,850 ft msl during normal operation, resulting in a maximum drawdown of 150 ft. The reservoir will have a total capacity of 4.3 million ac-ft, of which 2.4 million ac-ft will be active storage.

3.3.3. Turbines and Generators

3.3.3.1. Unit Capacity

The Watana powerhouse will have three generating units, each with a maximum generator output of 282 MVA at a 0.9 power factor corresponding to the maximum normal reservoir level of El.

2,000 ft msl and a corresponding net head of 533 ft. The hydraulic capacity of each turbine will be 4,900 cfs when the reservoir is at El. 2,000 ft msl.

The net head on the plant will vary from 384 ft to approximately 533 ft.

The generator rating has been selected to match with the maximum turbine output of 250 MW under a net head of 533 ft. The generator output is assumed to be 98 percent of the turbine output at full load.

3.3.3.2. Turbines

The turbines will be of the vertical-shaft Francis type with steel spiral casing and a steel lined concrete elbow-type draft tube. The draft tube for each unit will comprise a single water passage with a center pier.

At the design head of 458 ft, the output of the turbine will be 206 MW. For study purposes, the best efficiency (best-gate) output of the turbines has been assumed as 85 percent of the full gate turbine output. Additional studies will be conducted, including electrical system studies, to determine turbine size. The unit size may be as low as 100 MW to ensure Railbelt electrical system reliability.

Each turbine will be provided with a straight-flow type butterfly valve. These guard valves will be located within the powerhouse, just upstream of the turbines.

3.3.3.3. Generators

Each of the three generators in the Watana powerhouse will be of the vertical-shaft type directly connected to a vertical Francis turbine. There will be one three-phase step up transformer per generator. The generators will be connected to the transformers by isolated phase bus through generator circuit breakers.

Each generator will be provided with a high initial response static excitation system. The units will be controlled from the regional energy control center in Anchorage or Fairbanks, with local control facility also provided at a control room on site and from facilities on the powerhouse floor. The units will be designed for black start operation.

The generators will be air-cooled, with a closed circuit air-to-water heat exchanger stator/rotor cooling system.

The generators will be provided with a high initial response type static excitation system supplied with rectified excitation power from transformers connected directly to the generator terminals. The excitation system will be capable of supplying 200 percent of rated excitation field (ceiling voltage) with a generator terminal voltage of 70 percent. The power rectifiers will have a one-third spare capacity to maintain generation even during failure of a complete rectifier module.

3.3.3.4. Governor System

The governor system which controls the generating unit will include a governor actuator and a governor pumping unit. A single separate governing system will be provided for each unit. The governor actuator will be the programmable logic controller (PLC) based digital electronic electric hydraulic type.

3.3.4. Appurtenant Mechanical and Electrical Equipment

Miscellaneous powerhouse mechanical equipment will include:

- Powerhouse Cranes
- Draft Tube Gates
- Draft Tube Bulkhead Crane
- Miscellaneous Cranes and Hoists
- Elevators
- Power Plant Mechanical Service Systems
    - Station Water Systems
    - Fire Protection System
    - Compressed Air Systems
    - Oil Storage and Handling
    - Drainage and Dewatering Systems
    - Heating, Ventilation, and Cooling
    - Service Facilities Mechanical Systems

The mechanical services at the control center will include:

- A heating, ventilation, and air conditioning system for the control room offices and other rooms workers may occupy;
- Domestic water and washroom facilities;
- A fire protection system for the control room; and
- A standby generator that will be located in a separate building or in a gallery adjacent to the access tunnel.

3.3.4.1. Accessory Electrical Equipment

Accessory electrical equipment will include the following:

- Main generator step-up 13.8/230-kV transformers;
- Isolated phase bus connecting the generators and transformers;
- Generator circuit breakers;
- 230-kV lines from the transformer terminals to the switchyard;
- Control systems of the entire hydro plant complex;
- Station service auxiliary AC and DC systems; and
- Other equipment and systems including grounding, lighting system, and communications.

3.3.4.1.1. Transformers and High Voltage Connections

The 3-phase transformers and one spare transformer will be located on the transformer (draft tube) deck, separated by blast walls. The high voltage bushings of the transformers will be connected to overhead transmission lines to the switchyard on the downstream left abutment. The lines will be anchored to the downstream face of the dam.

The isolated phase bus main connections will be located between the generator, generator circuit breaker, and the transformer. Tap-off connections will be made to the surge protection and potential transformer cubicle, excitation transformers, and station service transformers.

The generator circuit breakers will be enclosed SF6 circuit breakers suitable for mounting in line with the generator isolated phase bus ducts.

3.3.4.1.2. Control Systems

A PLC and PC-based Watana Control Room will be located at the power plant and will be linked through the supervisory system to the Dispatch Control Center.

The supervisory control of the entire Alaska Railbelt electrical power system is at the Dispatch Control Center. Independent operator controlled local-manual and local-auto operations will, however, be possible at the Watana power plant for testing/commissioning or during emergencies.

The Control Room at the project will be capable of control completely independent of the Dispatch Control Center in case of system emergencies.

The Watana plant will be capable of "black start” operation in the event of a complete blackout or collapse of the power system. The control systems of the plant will be supplied by a non-interruptible power supply from the station battery (DC) system.

The unit control system will permit the operator to initiate an entire sequence of actions by pushing one button at the control console, provided all preliminary plant conditions have been first checked by the operator, and system security and unit commitment have been cleared through the central dispatch control supervisor.

3.3.4.1.3. Station Service Auxiliary AC and DC Systems

A station service system will be designed to achieve a reliable and economic distribution system for the power plant.

A double ended unit substation switchgear arrangement will be used for providing the 480-V AC power distribution, the turbine-generator, and common station equipment. The switchgear will be provided with an automatic tie system that will automatically switch the 480-V AC service in the event that one of the unit substation main feeders fails. The system will also be automatically backed up with a diesel standby generator system.

A 120/208-V AC distribution system fed from the 480-V AC switchgear will be provided to serve the lighting and small powerhouse loads.

A 125-V DC battery system will be provided to serve the turbine-generator control and automation equipment along with other critical loads. Two station batteries will be provided. Two redundant battery chargers will be provided for each of the batteries. The batteries will be located in a ventilated battery room.

3.3.4.2. Switchyard

A surface switchyard will be sited on the south bank of the Susitna River (Figure 3.3-1). The switchyard station will provide switching for the generator transformer banks and three transmission lines. A breaker-and-a-half bus switching scheme will be provided as shown in the single line electrical diagram in Figure 3.3-7. This arrangement provides the desired switching flexibility and reliability of service required by the adopted system reliability criteria. Disconnecting and grounding switches as well as voltage transformers will be provided for each of the circuits.

3.3.5. Transmission Facilities

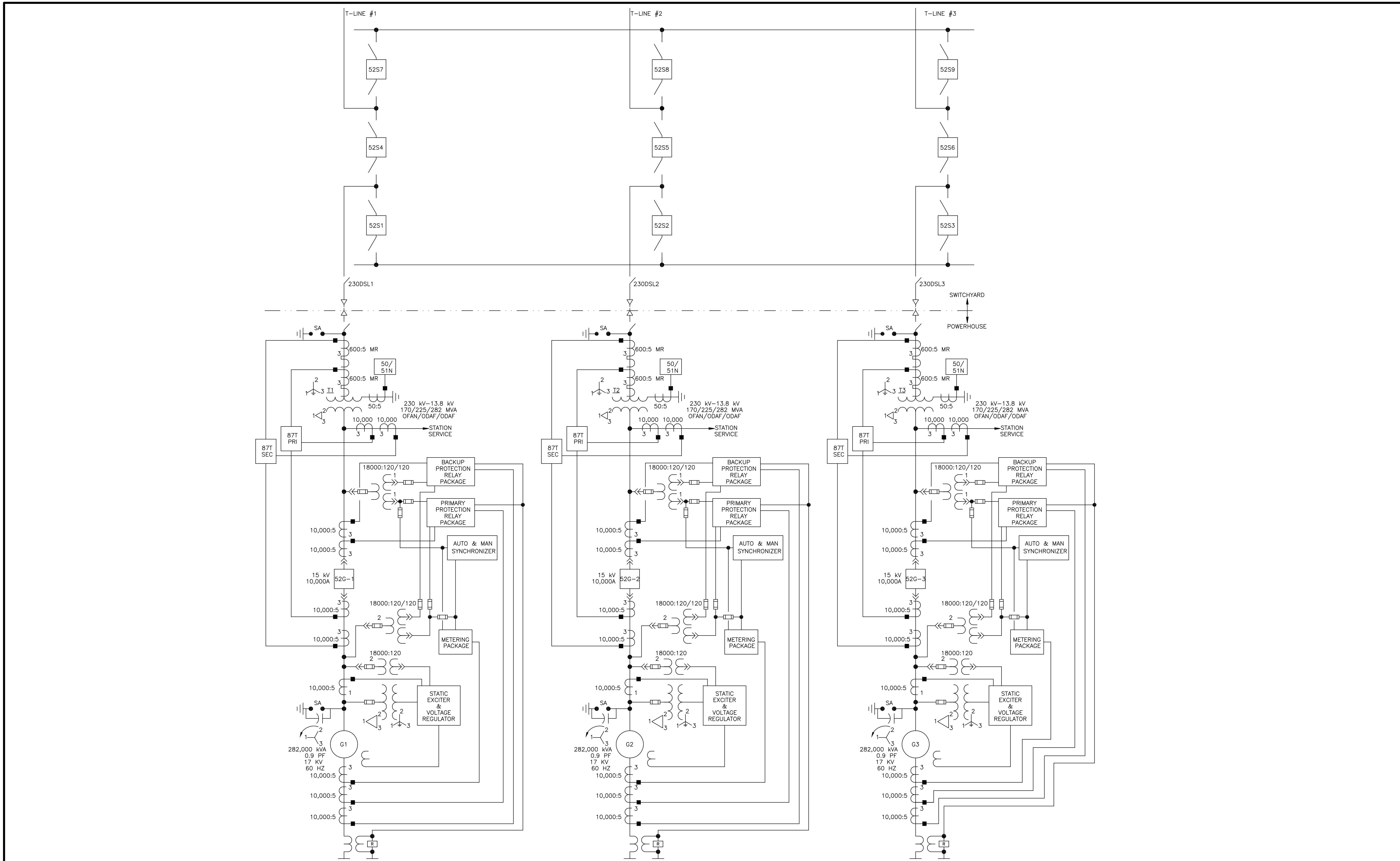
3.3.5.1. Transmission Facilities

The transmission facilities will consist of three overhead transmission lines, switchyards, substations, and a communications system. The interconnection of the primary project transmission line with the existing Alaska Intertie will either be near Chulitna, Gold Creek, or Cantwell, depending on system considerations that will be studied during the License Application preparation. The current plan is either two circuits running west and one north or all three circuits running westward.

3.3.6. Description of Transmission and Interconnection Facilities

3.3.6.1.1. Transmission Corridor

At this time, three corridors are being considered. Two would run generally westward from the dam, one on the north of the Susitna River and one south to connect with the Alaska Intertie near Chulitna and Gold Creek, respectively. The third corridor would run north where it would intersect with the Denali Highway and then follow the highway corridor to a point of interconnection near Cantwell. The transmission facilities are intended to be co-located with the road facilities to the extent possible as described in Section 3.3.6.1.2. The most likely configuration of transmission is described below. The locations of the corridors under study are shown on Figure 3.3-8.



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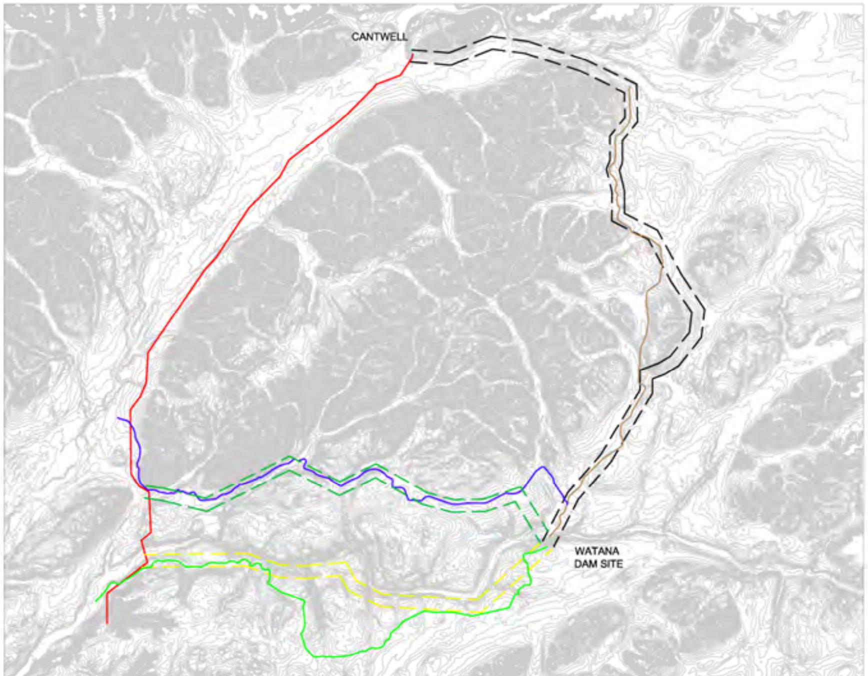
STATE OF ALASKA
ALASKA ENERGY AUTHORITY

SUSITNA-WATANA HYDROELECTRIC PROJECT

ONE LINE DIAGRAM

FIGURE 3.3-7

WATANA OVERVIEW MAP



PROPOSED TRANSMISSION LINE CORRIDORS

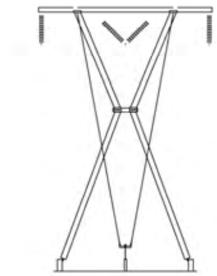
- CHULITNA
- DENALI
- GOLD CREEK

ANCHORAGE- FAIRBANKS INTERTIE

ROAD ALTERNATIVES

- CHULITNA
- DENALI
- GOLD CREEK

CONTOURS-100 FT



X- STRUCTURE TOWER
900 FT SPANS

SINGLE POLE
400 FT SPANS

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STATE OF ALASKA
ALASKA ENERGY AUTHORITY
ALASKA ENERGY AUTHORITY

SUSITNA-WATANA HYDROELECTRIC PROJECT

TRANSMISSION LINE ROUTE
AND TYPICAL DETAILS

FIGURE
3.3-8

3.3.6.1.2. Components

At the Watana site, a 230-kV substation/switchyard will be provided. The generator transformers will be located on the powerhouse draft tube deck. Overhead lines will connect the generator transformers to the 230-kV switchyard. The switching arrangement at the switchyard will be a breaker-and-a-half arrangement which will provide the necessary switching feasibility and reliability.

From Watana, two single-circuit 230-kV lines will be built westward and one northward to the Alaska Intertie and a switching station in Chulitna, Gold Creek or Cantwell. From the Watana substation, the transmission corridors are essentially co-located with the corridors for the access roads except for two specific areas:

1) For the northern westward route (Chulitna Corridor), only the first five mi of the twin 230-kV circuit will not follow the coincident road corridor. The two lines will cross the river from the switchyard (together with the line destined for the northern route) in a northerly direction for two mi, after which the two lines will turn northwesterly to cross Tsusena Creek and three mi later will intersect the Chulitna road corridor. At the extreme westerly end of the corridor, it will widen to facilitate the divergence of the road and the transmission line which will continue to a switching station on the Alaska Intertie.

2) For the southern westward route (Gold Creek Corridor) the double circuit 230-kV lines would not follow the planned road corridor, rather the transmission line can span the rough topography running more parallel to the Susitna River. Near the westerly end of the corridor, both the transmission lines and road can be co-located into one single corridor all the way to Gold Creek where the transmission lines would terminate in a new switching station on the existing Alaska Intertie.

3) For the northern route, the only divergence between the road and transmission line corridor will occur at Deadman Lake, at which location the road will be aligned west of Deadman hill, while the transmission will follow a lower corridor on the east of the hill. Both corridors will rejoin some 9 mi later on the north side of the Deadman hill. At the Denali highway, the northern transmission corridor will turn west and continue along the Denali Highway to the Cantwell switching station.

3.3.6.1.3. Right-of-Way

The right-of-way for the transmission lines within the corridors will consist of a linear strip of land. The width will depend on the number of lines. The transmission rights-of-way will be 200, 300, or 400 ft depending on whether one, two, or three lines run in parallel.

The switching and substations will occupy a total of approximately 16 ac.

Rights-of-way for permanent access to switchyard and substations will be required linking back to the permanent site access road. These rights-of-way will be 100 ft wide.

3.3.6.1.4. Transmission Lines

Access to the transmission line corridors will be:

a) Via unpaved vehicle access track from the permanent access roads at intermittent points along the corridor. The exact location of these tracks will be established in the final design phase.
b) By helicopter, where there is no access road projected.

Within the transmission corridor itself an unpaved vehicle access track 25 ft wide will run along the entire length of the corridor, except at areas such as major river crossings and deep ravines where an access track would not be utilized for the movement of equipment and materials.

The conductor capacity for the lines will be in the range of 1,950 kcmil; this can be provided in several ways. Typical transmission facilities are shown in Figure 3.3-8. Typical of these is a phase bundle consisting of two 954 kcmil "Rail" (45/7) Aluminum Conductor Steel Reinforced (ACSR) or a single 2,156 NCM "Bluebird" (84/17) ACSR conductor, both of which provide comparable levels of corona and radio noise within normally accepted limits. The single “Bluebird" conductor attracts less load under wind or ice loadings and avoids the need to provide the space damper devices required for a bundled phase. The single conductor is stiffer and heavier to handle during stringing operations, although this will tend to be balanced out due to the extra work involved in handling the twin bundle. Selection of the optimum conductor arrangement will be made in final design. The conductor will be specified to have a dull finish treatment to reduce its visibility at a distance.

Two overhead ground wires will be provided the full length of the line. These will consist of 3/8-inch diameter galvanized steel strands. The arrangement will be based on a shielding angle of 15 degrees over the outer phases; this will provide protection against lightning strikes to the line. More refined studies of the lightning performance of the line will be made during final design to confirm the arrangement outlined above.

The transmission structures and foundations that serve to support the conductors and ground wires will be designed for a region where foundation movement due to permafrost and annual freeze-thaw cycling is common. Of the structural solutions that have proved successful in similar conditions, all utilize an arrangement of guy cables to support the structure and depend upon the basic flexibility inherent in guyed structures to resist effects of foundation movement. The guyed “X” design has been selected for use on the Alaska Intertie and is therefore a prime candidate for consideration on the Watana lines.

Structures for larger angle and dead-end applications will be in the form of individual guyed masts, one for each phase. Individual guyed masts will also be used for lengths of line that are judged to be in unusually hazardous locations due to exposure in extremely rugged terrain. All structures will utilize a “weathering” steel which ages over time to create a dark brown appearance which generally has a more pleasing appearance than galvanized steel or aluminum.

Foundations for structures will utilize driven steel piles in unstable soil conditions. In better soils steel grillage foundations will be used and set sufficiently deep to avoid the effects of the freeze-thaw cycle. Rock footings will employ grouted rock anchors with a minimum use of concrete to facilitate winter construction. Foundations for cantilever pole type structures will be large diameter cast-in-place concrete augered piles. Several types of guy anchor will be available for use; they include the screw-in helix type, the grouted bar earth anchor, driven piles and grouted rock anchors. Selection of the most economical solution in any given situation will depend on the site specific constraints including soil type, access problems and expected guy load. Foundation sites will be graded after installation to contour the disturbed surface to suit the existing grades. Tower grounding provisions will depend upon the results of soil electrical resistivity measurements both prior to and during construction. Continuous counterpoise may be required in sections where rock is at or close to the surface; it also may be required in other areas of high soil resistance. The counterpoise will take the form of two galvanized steel wires remaining at a shallow bury parallel to and under the lines. These will be connected to each tower and cross connected between lines in the right-of-way.

3.3.6.1.5. Substations at Interconnection with Alaska Intertie

Construction access to all sites will be over the route of the permanent access provided for each location. Any grading of the sites will be carried out on a balanced cut-and-fill basis wherever possible. Equipment will be supported on reinforced concrete pad-and-column type footings with sufficient depth-of-bury to avoid the active freeze-thaw layer. Backfill immediately around the footings will be granular to avoid frost heave effects.

Light equipment may be placed on spread footings if movements are not a significant factor in operational performance.

The station equipment requirements are determined by the breaker-and-a-half arrangement adopted, for reasons of reliability and security of operation. One and one-half breakers will be needed for each line or transformer circuit termination. The transformer capacities are determined by the load requirements at each substation. Control and metering provisions will cater to the plan for remote operation of all the facilities in normal circumstances. Protective relaying schemes for the 230-kV system will be in accordance with conventional practices, using the general philosophy of dual relaying and the local backup principle.

The station layouts are based on conventional outdoor design with a two-level bus which will result in a relatively low profile. This will assist in limiting the visual impact of the stations and make the most of any available neutral buffers. Although they will be remotely controlled, all stations will be provided with a control building; in larger stations an additional relay building will be provided. A storage building will also be provided for maintenance purposes. Each station will have auxiliary power at 480 V; the normal 480-V AC power will be supplied from the tertiary on the autotransformers or the local utility.

3.4. Proposed Construction and Development Schedule

The Project schedule presented in Figure 3.4-1, allows 12 years for Project development including: FERC licensing, license implementation, design and contracting, construction, demobilization, and site restoration. Several assumptions have been made regarding the times required for the various activities.

The following are the time periods for major components of Project Development:

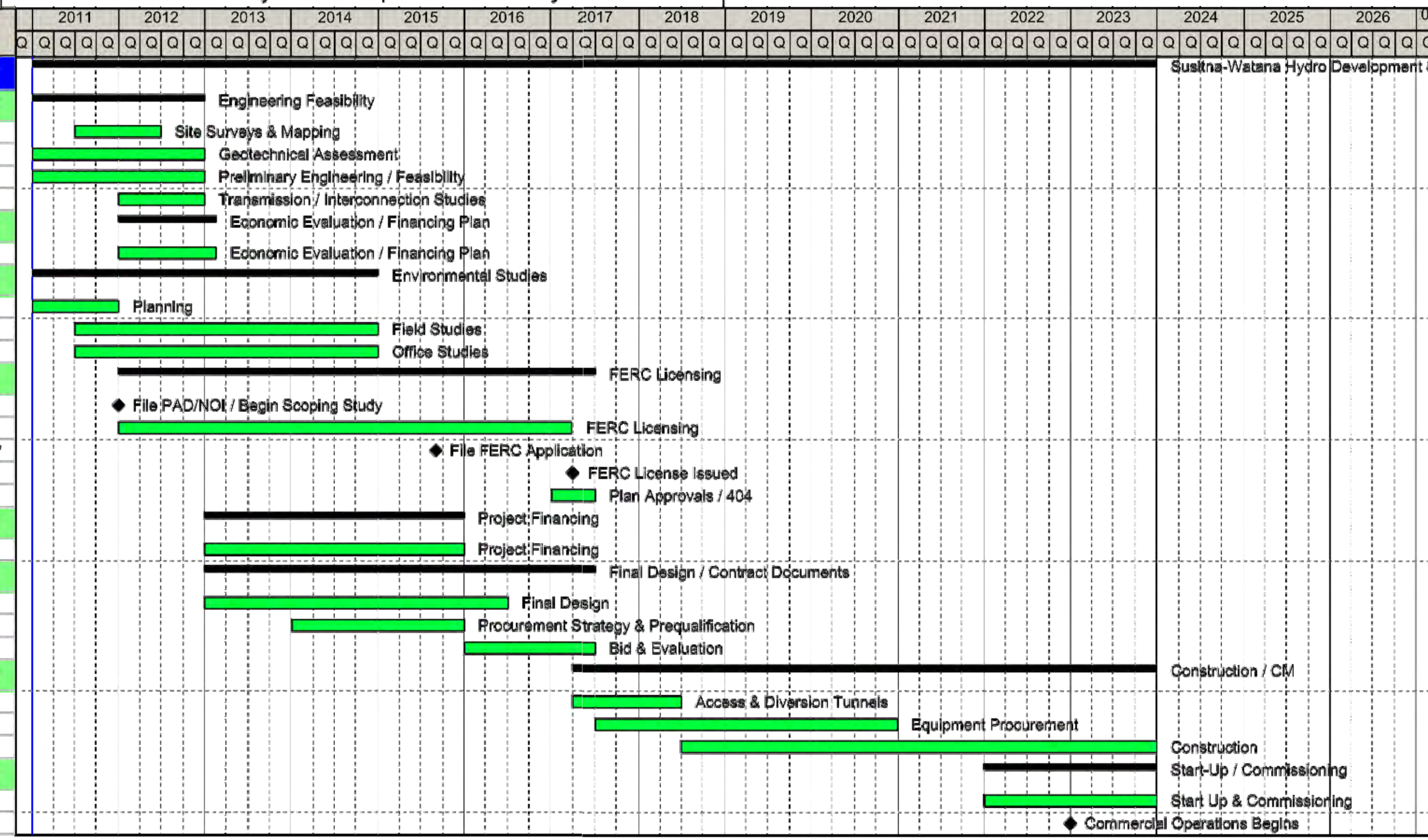
- Total schedule – 12 years, 2012-2023
- Pre-Application studies and related activities 3.5 years
- FERC and Cooperating agencies post-filing activities – approximately 1.5 years.
- Project Construction – 6.5 years
- Reservoir filling – one to two years
- Site Restoration – throughout construction.

Design work would be initiated or completed prior to issuance of the license, so that contracts critical to the schedule (such as access roads and construction support facilities) will be ready to be awarded shortly after issuance of the license and subsequent approvals.

Susitna-Watana Hydro Development Preliminary Schedule

01-Dec-11 16:51

Activity ID	Activity Name	Start	Finish
	Susitna-Watana Hydro Development Schedule	03-Jan-11	29-Dec-23
	Engineering Feasibility	03-Jan-11	31-Dec-12
A1000	Site Surveys & Mapping	01-Jul-11*	29-Jun-12
A1080	Geotechnical Assessment	03-Jan-11*	31-Dec-12
A1090	Preliminary Engineering / Feasibility	03-Jan-11*	31-Dec-12
A1100	Transmission / Interconnection Studies	02-Jan-12*	31-Dec-12
	Economic Evaluation / Financing Plan	02-Jan-12	14-Feb-13
A1010	Economic Evaluation / Financing Plan	02-Jan-12*	14-Feb-13
	Environmental Studies	03-Jan-11	31-Dec-14
A1020	Planning	03-Jan-11*	30-Dec-11
A1110	Field Studies	01-Jul-11*	31-Dec-14
A1120	Office Studies	01-Jul-11*	31-Dec-14
	FERC Licensing	02-Jan-12	30-Jun-17
A1029	File PAD/NOI / Begin Scoping Study		02-Jan-12*
A1030	FERC Licensing	02-Jan-12*	31-Mar-17
A1031	File FERC Application		01-Sep-15*
A1150	FERC License Issued		03-Apr-17*
A1160	Plan Approvals / 404	03-Jan-17*	30-Jun-17
	Project Financing	01-Jan-13	31-Dec-15
A1040	Project Financing	01-Jan-13*	31-Dec-15
	Final Design / Contract Documents	01-Jan-13	30-Jun-17
A1140	Final Design	01-Jan-13*	01-Jul-16
A1141	Procurement Strategy & Prequalification	02-Jan-14*	31-Dec-15
A1145	Bid & Evaluation	01-Jan-16*	30-Jun-17
	Construction / CM	03-Apr-17	29-Dec-23
A1128	Access & Diversion Tunnels	03-Apr-17*	29-Jun-18
A1129	Equipment Procurement	03-Jul-17*	31-Dec-20
A1130	Construction	02-Jul-18*	29-Dec-23
	Start-Up / Commissioning	03-Jan-22	29-Dec-23
A1070	Start Up & Commissioning	03-Jan-22*	29-Dec-23
A1170	Commercial Operations Begins		02-Jan-23*



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SUSITNA-WATANA HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT SCHEDULE

Sheet No.
3.4-1
SHEET OF X

3.5. Project Operations

As noted previously, a final decision on the exact configuration and size of the generating facilities will be made during the licensing studies. The preliminary Project design includes 600 MW installed capacity in 3 units. The current study program and collaboration with utilities will continue to be carried out during the 2012-2013 timeframe to determine the optimum size of the Project and units to meet projected future Railbelt power requirements over the operating life of the Project. Based on those future projections a final project operating plan will be developed for inclusion in the application to FERC for a license.

3.5.1. Proposed Project Operations

During the preparation of this document computer modeling of several potential reservoir operation scenarios has been performed using the preliminary (Base Case) Project configuration as described above in Section 3.3. It is planned that the Project would be operated in a load-following mode such that firm power is maximized during the critical winter months of November through April each year to meet Railbelt utility load requirements. To accomplish this, the reservoir would be drafted annually by an average of about 120 ft; the maximum annual drawdown would be approximately 150 ft, with a probability of occurring about once or twice in 50 years. Flow discharges through the powerhouse under this operating plan would range from a low of zero cfs when the power plant is off line on rare occasions during emergency outages, to a high of about 14,500 cfs during times of maximum power generation. When the power plant is not discharging, instream flow releases would be made through a low-level outlet works in Watana dam.

Daily power generation during the peak winter months would average about 6,000 MWh and powerhouse discharges would average approximately 6,700 cfs during that time. For load following, powerhouse discharges would vary over a 24-hour period in the winter months, typically ranging from a low of 3,000 cfs to a high of 10,000 cfs. For the Base Case operating plan, initial operation model runs have been made using the Case E-VI minimum instream flow criteria developed during the 1980s APA Susitna Hydroelectric Project studies. Those criteria specified a minimum wintertime flow release of 2,000 cfs and a minimum summertime flow release of about 9,000 cfs. Environmental studies will guide the daily range of flow variation permitted.

3.5.1.1. Reservoir Operation and Drawdown

The following description of a potential reservoir operation scenario has been developed using results of initial Base Case operations model runs, and serves as a starting point for further refinements. All information is subject to change as conceptual planning takes place for the Project and the License Application is prepared.

The primary operating objective for the modeling of the Base Case scenario was to maximize firm power generation during the winter months of November through April. Therefore, the model assumes that the reservoir would be drafted to meet those objectives. The maximum annual drawdown to achieve the target is projected to be about 150 ft, although different draw downs will be considered during future conceptual planning studies. Figure 3.5-1 presents the modeled daily reservoir elevations for four selected years (from the available flow records) of operation, including the maximum year (1990), the minimum year (1970), the second minimum year (1974), and the most nearly average year (1986). As indicated, the reservoir can be filled in almost every year, even after reaching the minimum power pool level at El. 1,850 ft msl during the minimum inflow year. Generation requirements were reduced during the minimum year (1970) when the reservoir level was far short of filling in late summer and it would be known that full generation requirements could not be met.

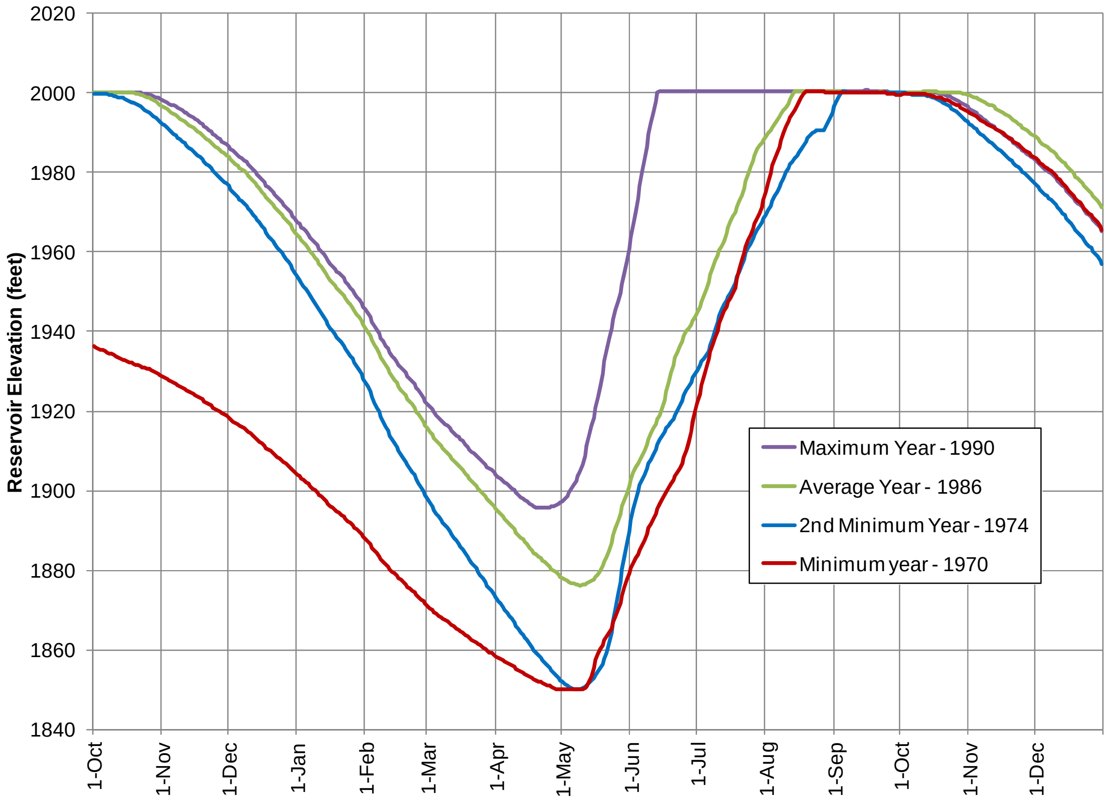


Figure 3.5-1. Daily Reservoir Elevation (ft) for Selected Years

The modeled reservoir fluctuation during the driest period of record is presented on Figure 3.5-2 for illustration purposes

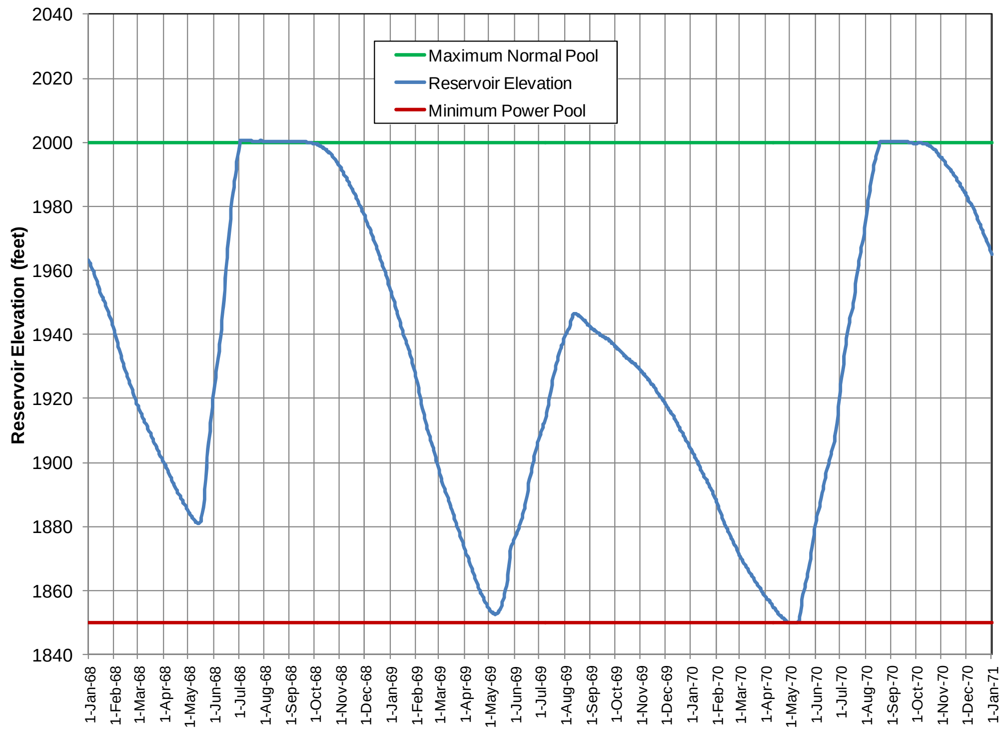


Figure 3.5-2. Reservoir Elevation (ft) for the Driest Period

3.5.1.2. Minimum Flow Releases

Minimum flow requirements in the Susitna River downstream of the Watana Dam have not yet been established. An acceptable flow regime will be determined through the planned licensing studies and through agencies' and other Participants' collaboration.

Similar to the current, natural river flow conditions, after the Project is constructed downstream flows at the project site are expected to vary significantly on a seasonal, weekly, and daily basis. In addition to the flows discharged through the powerhouse for generation purposes, flow augmentation, when required, will also be made by making releases through the low-level outlets if the powerhouse is not operational. A preferred environmental flow regime (designated as Case E-VI) was developed for the previous FERC License Application in 1985 for the larger (1,790 MW) APA Susitna Hydroelectric Project proposal and is presented in Figure 3.5-3 below.

Although no final decision on these recommended flows was made during the 1980s license considerations by FERC, this flow release schedule was considered by the applicant (Alaska Power Authority) as the optimum to meet a variety of downstream requirements, and therefore it has been used for the current operation study runs as the Base Case flow scenario. As shown on Figure 3.5-3 on an average monthly basis, with the Project in place, regulated peak summer flows downstream of Watana Dam at Gold Creek would be reduced and winter flows would be increased in comparison to the natural flow regime. The previously recommended environmental flow regime will be subject to further analysis during the licensing study period.

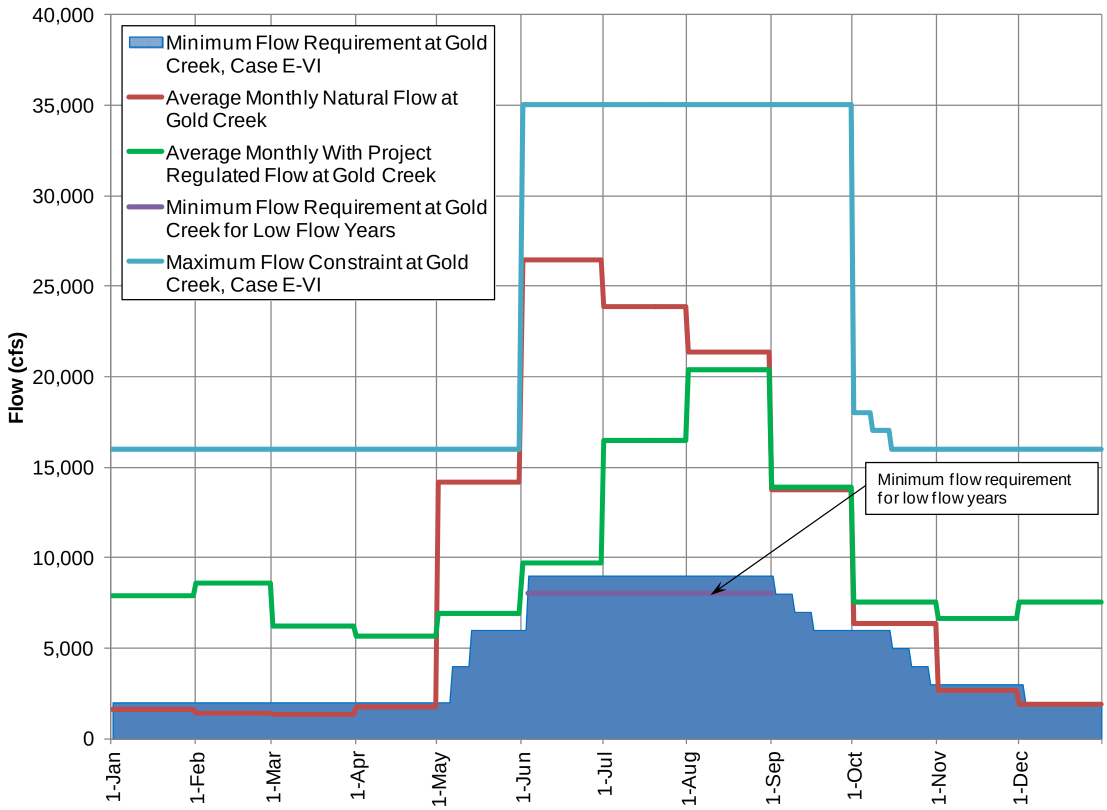


Figure 3.5-3. Average Monthly Natural and Regulated Flows, modeled flows, and 1985 Environmental Flow Schedules at Gold Creek (Case E-VI)

3.5.2. Proposed Project Generation

3.5.2.1. Operational Objectives

The 1985 FERC License Application envisioned the APA Susitna Hydroelectric Project as a load-following project. Under that operating mode there would be variation in powerhouse discharge to meet hourly and daily Railbelt electrical loads, satisfy downstream environmental flow requirements, and prevent spill, therefore optimizing power generation within the constraints of the system. As noted, this mode of operation was used as a premise for the initial Base Case model runs.

For the Base Case model runs, the primary operating objectives of the Project included the following:

- Maximize firm power generation during the months of November through April.
- Generate power as necessary to meet Case E-VI minimum flow requirements at Gold Creek as stated in the 1985 FERC License Application.
- Maximize power generation during the months of May through October without reducing the firm power generation during the November through April period.

- Shape generation according to Railbelt area power requirements, to the extent possible with the other given objectives.

Future operations model runs will examine variations from this Base Case scenario.

3.5.2.2. Future Railbelt Utility Electrical Loads

The Railbelt utilities are comprised of six regulated public utilities: Anchorage Municipal Light & Power (ML&P), Chugach Electric Association (Chugach), Golden Valley Electric Association (GVEA), Homer Electric Association (HEA), Matanuska Electric Association (MEA), and the City of Seward Electric System (SES). The military bases are also currently considering privatizing their utility operations which could add to the load demand. The Railbelt region covers a significant area of the State of Alaska and contains large population centers; it extends from Homer to Fairbanks and includes the major metropolitan areas such as Anchorage and the Mat-Su Valley.

The Railbelt region currently generates about 11 percent of its electric energy needs from renewable sources. This renewable energy principally derives from the Bradley Lake, Cooper Lake and Eklutna hydroelectric projects. The Railbelt Integrated Resources Plan (RIRP), prepared for AEA, assumed future deployment of a combination of large hydroelectric, wind and geothermal resources to achieve the State’s 50 percent renewable energy target. For development of the RIRP, load forecasts were provided by the utilities, and because the RIRP Study has a 50-year planning horizon, load forecast data was extrapolated through 2060.

The tables below present the future projected coincident winter and summer peak demands for the combined system. The coincident peak demand forecasts were developed by combining all of the utilities’ hourly load profiles for 2008 and calculating the 2008 coincident peak demands. The results were compared to the 2008 non-coincident peak demands to develop coincident factors. These factors were applied seasonally to the non-coincident peak demand for both winter and summer months of the study period to develop the resulting coincident peak demand forecasts for the system.

Winter Peak Demand Forecast:

Year	Load (MW)
2011	869.3
2025	927.5
2030	959.0
2040	1,024.1
2050	1,092.0
2060	1,163.0

Source RIRP table 6-1

Summer Peak Demand Forecast:

Year	Load (MW)
2011	668.0
2025	712.7
2030	736.9
2040	786.9
2050	839.1
2060	893.6

Source RIRP table 6-2

Currently, the Railbelt utilities maintain a 30 percent reserve margin above these peak load values. Figure 3.5-4 below is a graph that shows the Railbelt load requirements on a typical winter day.

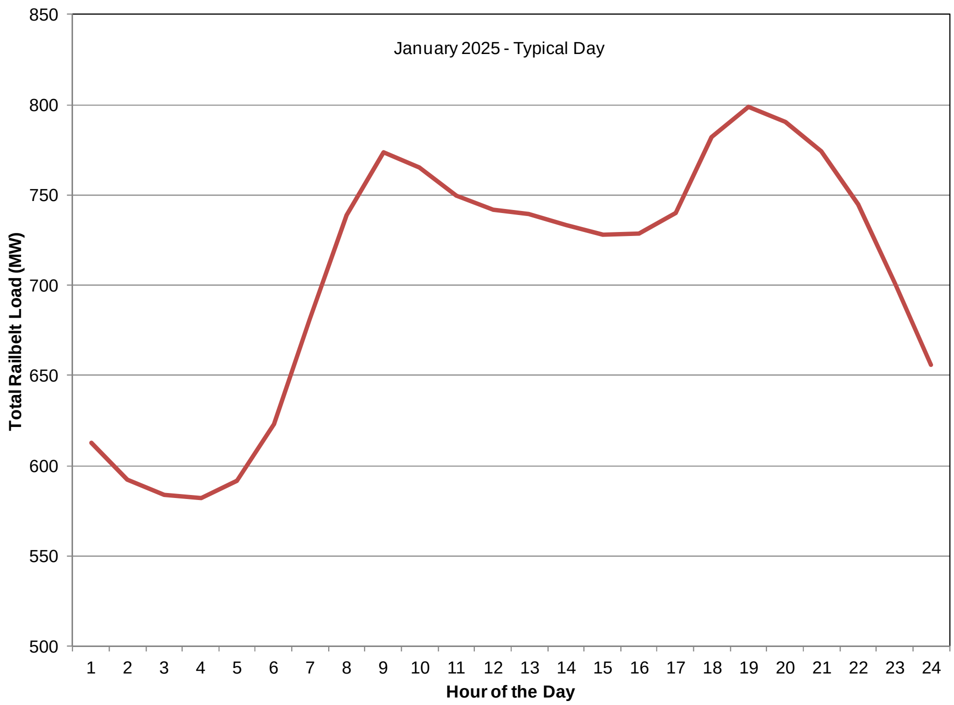
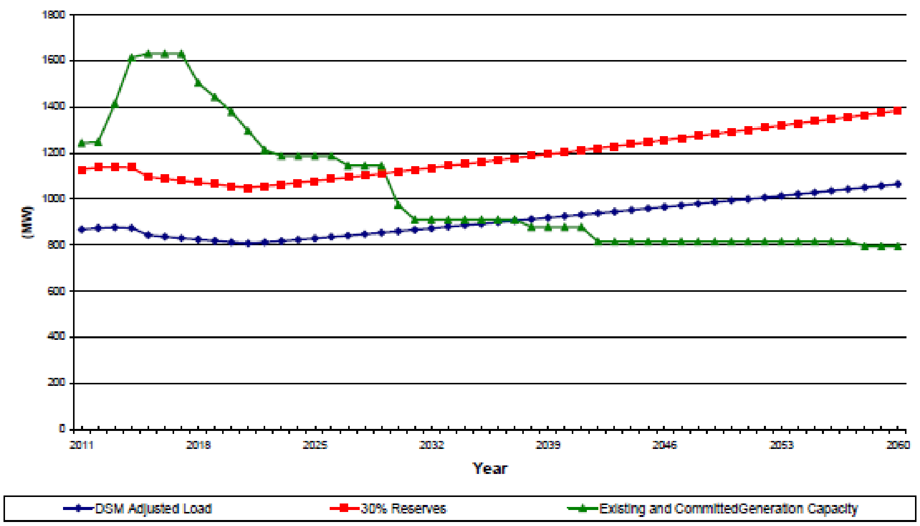


Figure 3.5-4. Railbelt Utilities Typical January Day Load Shape

The following load projection in Figure 3.5-5 (Figure 9-6 from the RIRP) illustrates the scenario used to model the various future supply options and compare total system power costs under a wide variety of underlying assumptions. As indicated, even with Demand Side Management/EE (DSM/EE) reductions, existing resources are only sufficient to meet overall demands, including reserve requirements, until about the year 2029. Without these demand reductions new generating resources will be needed much sooner. As indicated, with DSM/EE reductions, total capacity requirements, including a 30 percent reserve margin allowance, are estimated to be approximately 1,400 MW by the year 2060. This assumes that DSM measures are implemented to reduce demand over that time frame. Without this level of DSM/EE load reductions, total capacity requirements would be about 130 MW higher, totaling about 1,530 MW.

Scenario 1A: Capacity Requirements Including Committed Units with DSM/EE



Source RIRP Figure 9-6

Figure 3.5-5. Projected Railbelt Electrical Demands

3.5.2.3. Power Plant Operation to Meet Future Load Requirements

As noted previously the primary operating objective for modeling the Base Case scenario was to maximize firm power generation during the winter months of November through April. Therefore, the reservoir would be drafted on a daily and seasonal basis to meet those objectives. Using that as an operating objective, Figure 3.5-6 below shows the resulting average power plant generation in megawatt-hours (MWh) for each year of the Base Case simulation model run. The average annual total generation is estimated to be 2,500,000 MWh, which corresponds to an average of 285 MW of continuous power.

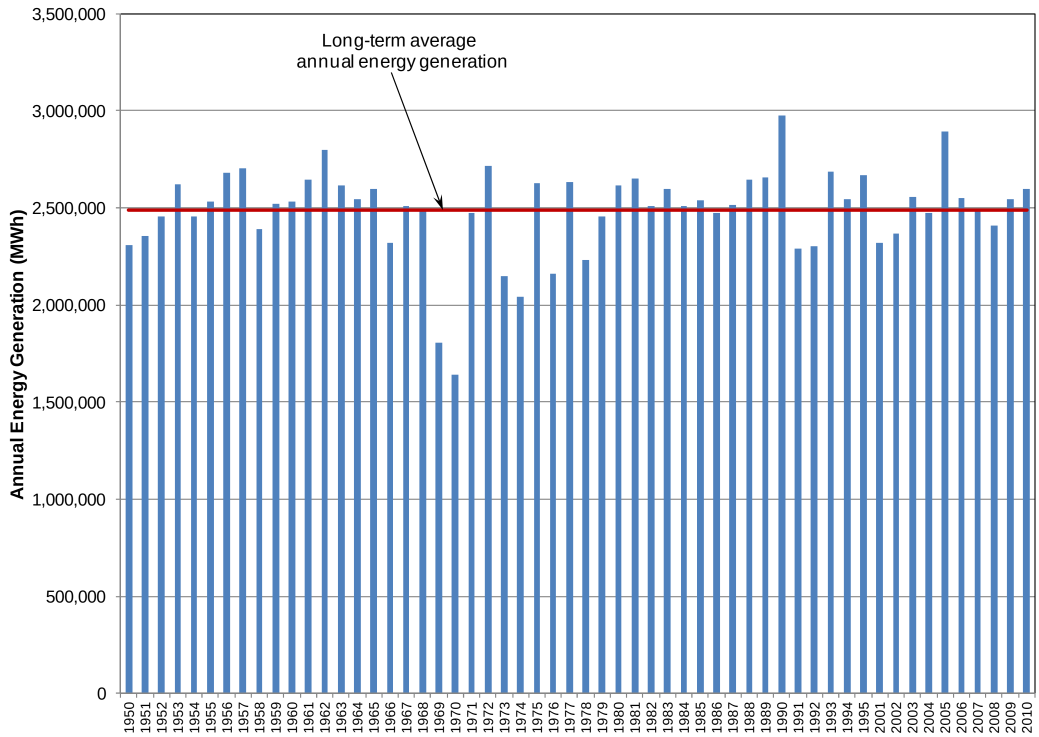


Figure 3.5-6. Annual Average Energy Generation (MWh)

Figure 3.5-7 shows the modeled average monthly distribution of power output based on this mode of operation. Firm power (98 percent reliable) output averages 250 MW during the months of November through April and 223 MW for the entire year, with monthly variations following the Railbelt average power demand shown on Figure 3.5-8. Figure 3.5-8 also shows that the pattern of Railbelt energy demand is completely out of phase with the pattern of reservoir inflows. To reshape the reservoir inflows into a release pattern that is more similar to the power demands, active storage is used for an annual cycle of water storage and withdrawal. With greater active storage, more complete regulation of inflows could be accomplished.

Non-firm power generation would occur mostly during the months of July through September when the powerhouse would generate up to full capacity (600 MW installed in this case) to reduce releasing water through the low-level outlet without generation. Non-firm generation would average about 62 MW annually, or about 22 percent of the total generation. For the entire year, the 223 MW of average firm power plus 62 MW of non-firm power would total 285 MW of average power output, which is equivalent to the 2,500,000 MWh of average annual energy. The Susitna-Watana generation values presented herein assume that all potential generation is usable.

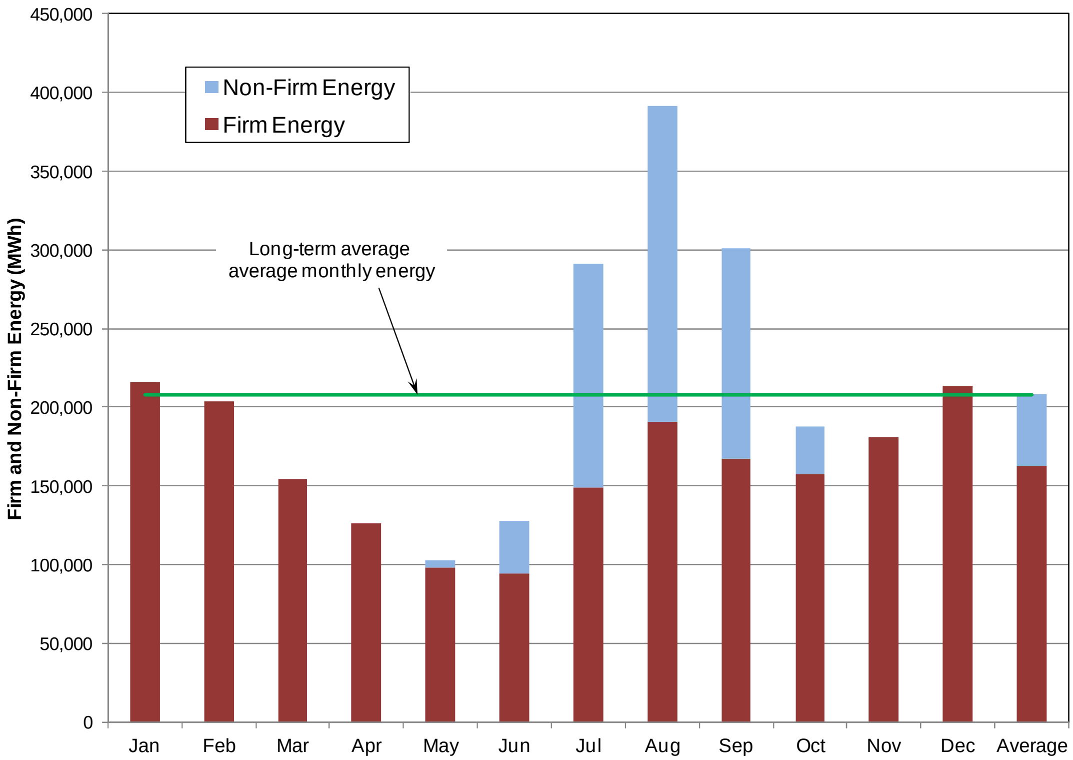


Figure 3.5-7. Monthly Average Energy Generation (MWh)

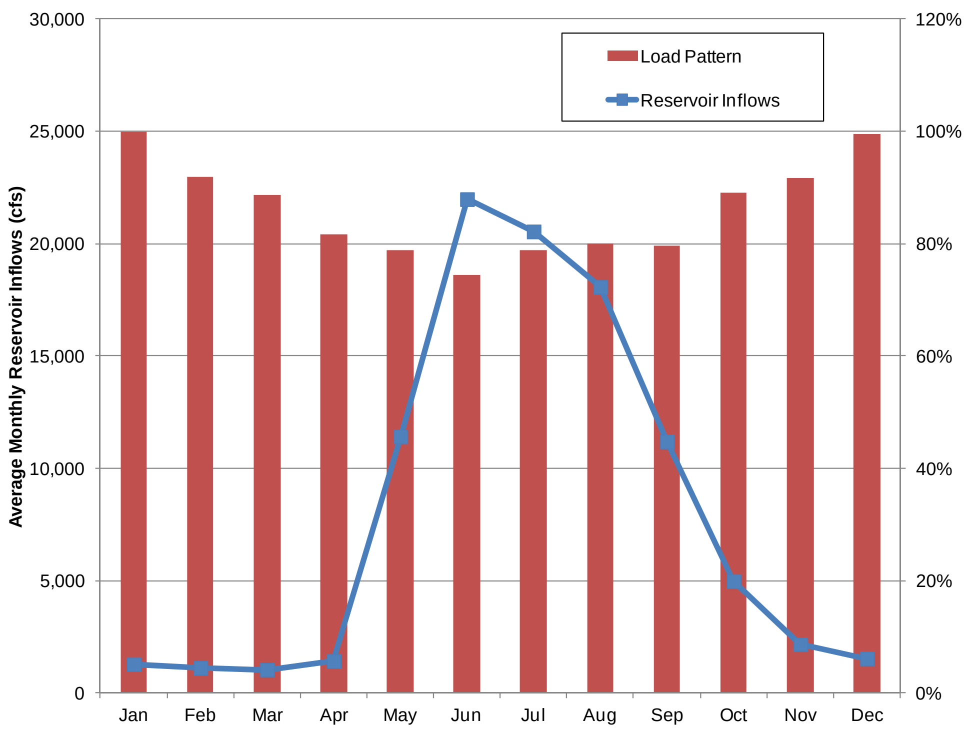


Figure 3.5-8. Railbelt Monthly Energy Demand Pattern Compared with Reservoir Inflow Pattern

Figure 3.5-9 presents the modeled daily power output for selected years - the maximum year (1990), the minimum year (1970) and most nearly average year (1986). These years were selected for illustration based on the annual power generation values. The 98 percent reliability goal essentially means that the firm power objective of 250 MW during the November through April period will not be met during one year in the 56-year period of simulation modeling. Because significantly reducing the firm power objective causes system operating characteristics to be substantially different in 1970 from other years, the second minimum generation year of 1974 is also included in the daily plots for illustration purposes.

On Figure 3.5-9, the minimum year (red line) for 1970 clearly shows the large firm power deficit during most of the November through April period. Note that only one or two lines are visible in places on the plots because the lines at times plot on top of each other. Power peaks at 600 MW (the full plant capacity under this scenario) when the reservoir fills at times during June through October.

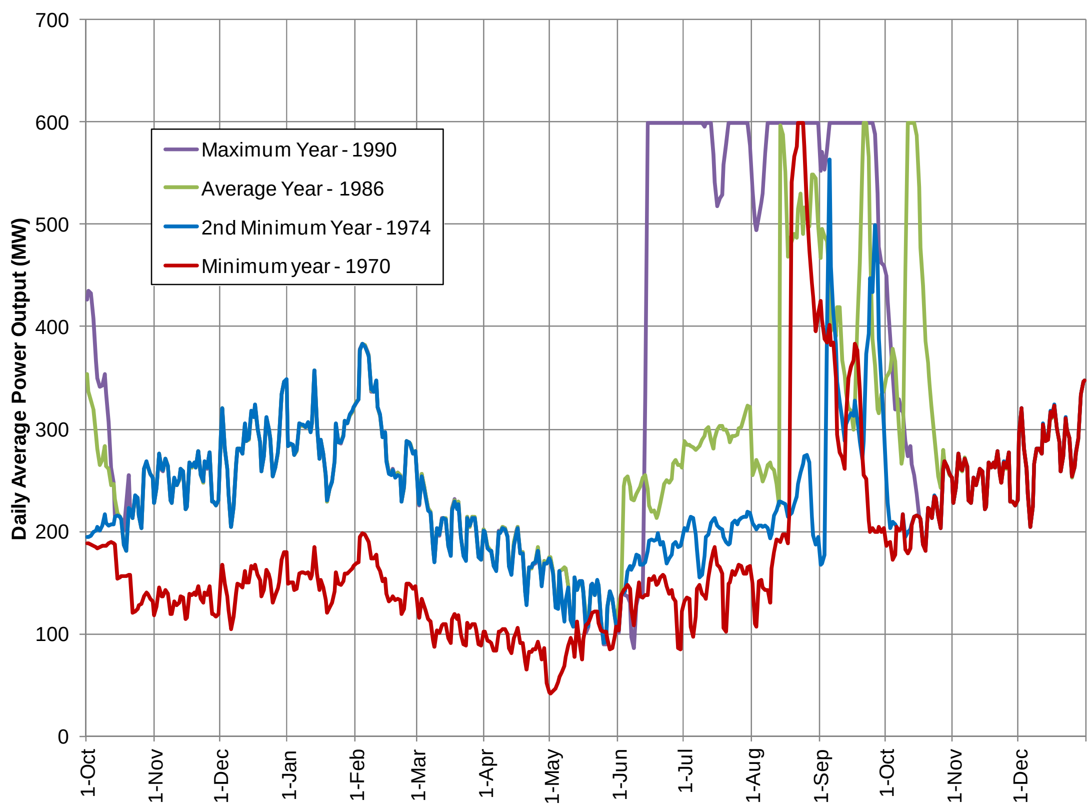


Figure 3.5-9. Daily Power Output (MW) for Selected Years

3.5.2.4. Powerhouse Discharges

Daily powerhouse discharges into the Susitna River for the Base Case model run for selected years are presented on Figure 3.5-10. As modeled, average monthly flows would be increased from the existing natural flows from January through April in response to power demands. The day-to-day flow variation is caused by both seasonal power demand variations and weekday/weekend variations. Although the power demand remains the same in all years, some powerhouse flow variations are caused by variations in local inflow between Watana and Gold Creek while the powerhouse operates to meet the Base Case minimum instream flow schedule in the Susitna River at Gold Creek. The large increases in powerhouse discharges during the June through October period are in response to periods when the powerhouse would be operated at maximum capacity to generate from flow that would otherwise be released through the low-level outlet (i.e. to minimize spill volume and maximize generation). Refinements to this operating scenario will be made as Project development plans progress during future licensing studies.

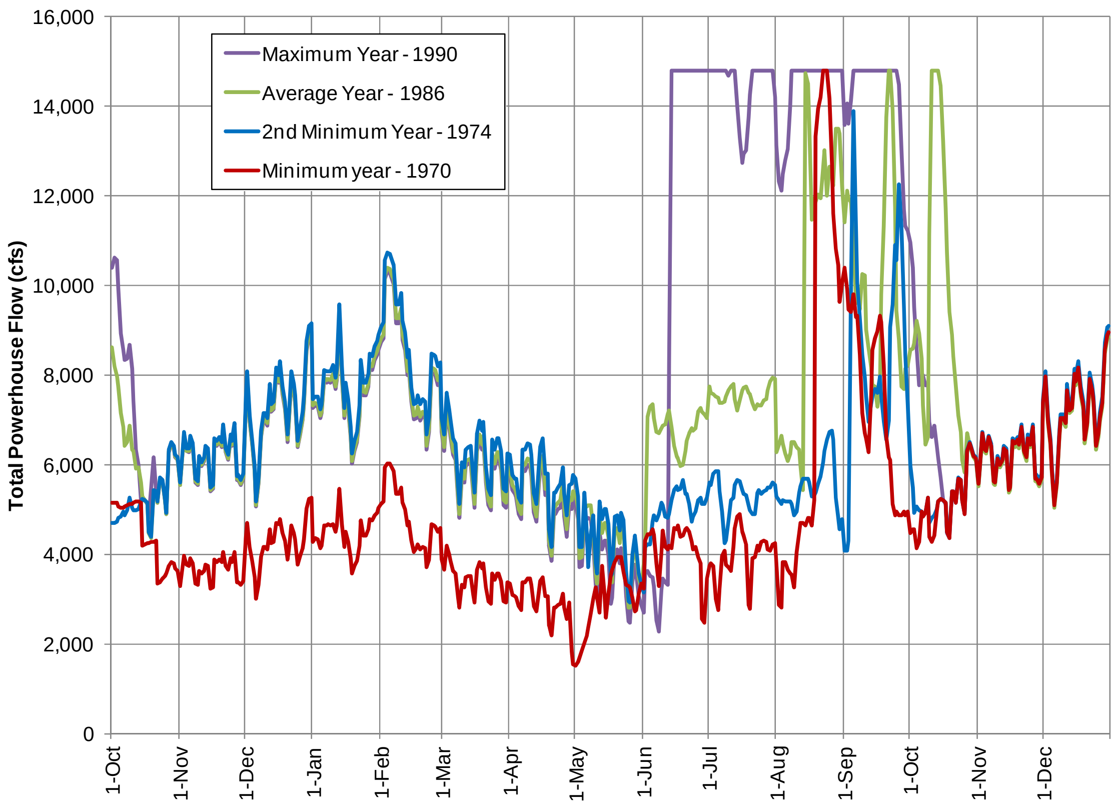


Figure 3.5-10. Daily Powerhouse Discharge for Selected Years

3.5.2.5. Low-Level Outlet Releases

Figure 3.5-11 presents the daily low-level outlet discharges during the four selected years as modeled. Low-level outlet releases occur when the active reservoir storage is full and reservoir inflows exceed the powerhouse operating capacity. During most years, the low-level outlet releases would be zero or of short duration. During the wettest year of 1990, substantial releases would occur from mid-June through September. The average annual flow release would be 738 cfs, which is about 9 percent of the total reservoir inflow. Some low-level outlet releases would occur during about 90 percent of the years, primarily during the months of July through September. It is anticipated that low-level outlet release can be substantially reduced with future refinements in the operating scheme.

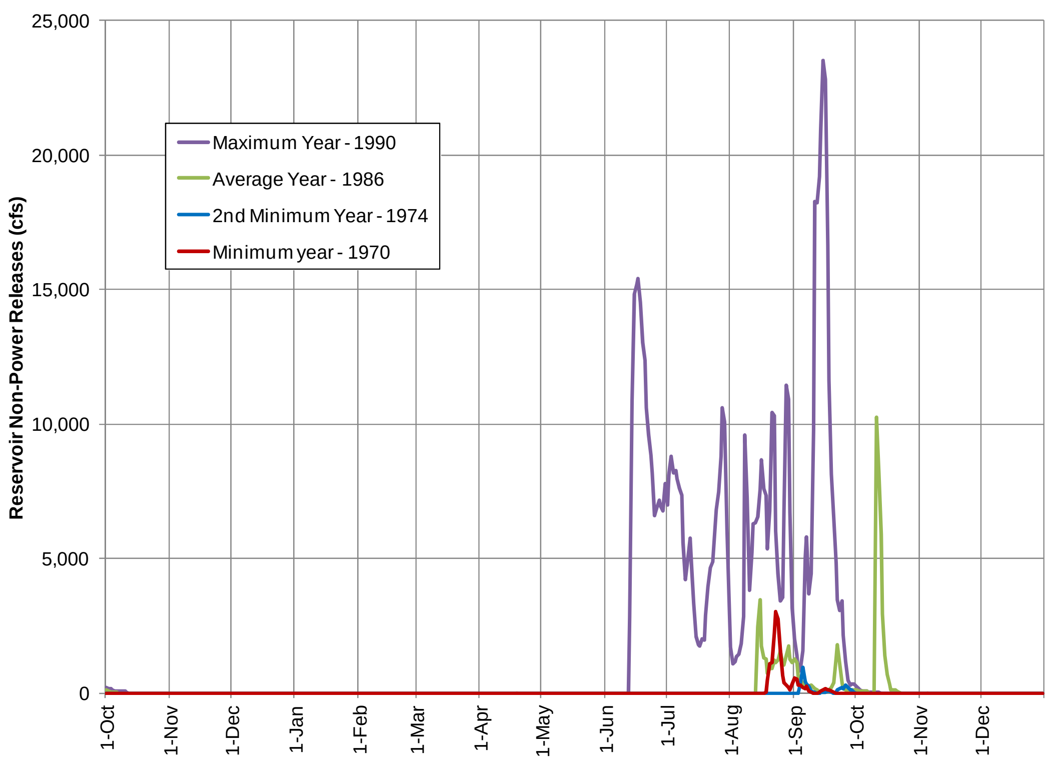


Figure 3.5-11. Daily Outlet Releases at Watana Dam for Selected Years (cfs)

3.5.2.6. Flushing Flows

The need for downstream flushing flows has not yet been determined. If required to protect or enhance downstream resources, these flows would be provided either by making releases through the powerhouse as part of planned power operations, or by releases through the low-level outlet in combination with the powerhouse if powerhouse capacity is insufficient by itself. A proposed plan will be included in the FERC License Application.

3.5.2.7. Flow Ramping Rates

Flow ramping rates have not yet been determined. If restrictions on flow ramping are needed to protect or enhance downstream resources, then hourly powerhouse and/or low-level outlet schedules will be developed and included in the FERC License Application.

3.5.2.8. Downstream Susitna River Flow Changes

Project operations would alter the natural flows of the Susitna River downstream from Watana Dam, with the effects becoming progressively less at greater distances downstream due to tributary inflow, including several major rivers. For about five years during the early 1980s, the USGS operated several streamflow gaging stations concurrently, which provides the opportunity to use recorded streamflow data as the basis to display daily flows at several locations on the Susitna River for both the recorded natural flows and the adjusted "With-Project" flows.

On the following four figures, the natural flows are shown in green and the "With-Project" adjusted flows are shown in red for the Watana Dam site and at the three downstream USGS gaging stations noted above. At the current stage of Project planning, the "With-Project" flows are preliminary and subject to change, but it is useful to get an early approximate look at how flows could be altered on the lower and middle sections of the Susitna River. Further, more detailed modeling and downstream flow analyses will be performed as part of ongoing licensing engineering studies prior to submittal of the FERC License Application.

There are two predominant effects of Project operation on downstream flows in the Susitna River in comparison to the natural pre-Project flows. The first is an increase in the average November through April flows, which corresponds to the period of greatest need for power generation. The second major effect is a reduction in the average flow at the beginning to at least the middle of the snowmelt runoff season from May through July, which is the period when the reservoir would normally be refilled. In the latter part of the high flow season (late August through October), the reservoir would usually be filled and average monthly reservoir releases would be nearly equal to the natural flows. As shown on Figures 3.5-12 and 3.5-13, the difference in the flow regime between Watana and Gold Creek is not great because the difference in drainage areas at the two locations is not great. Moving downstream to Sunshine (Figure 3.5-14), below the confluence with the Chulitna and Talkeetna rivers, the effects of Project operations are much less pronounced. At Susitna Station (Figure 3.5-15), below the confluence with the Yentna and other rivers, the effects of Project operations are further minimized by substantial tributary river inflows.

<u>Watana Dam Site (Figure 3.5-12)</u> – the site is located at RM 184. The drainage area at Watana Dam is 5,180 square mi and the annual average flow is about 8,100 cfs. Although there are no USGS recorded flows at Watana, they can be reliably estimated from recorded flows downstream at Gold Creek (RM 136.5) and upstream at Susitna River near Cantwell gage (RM 223.7).

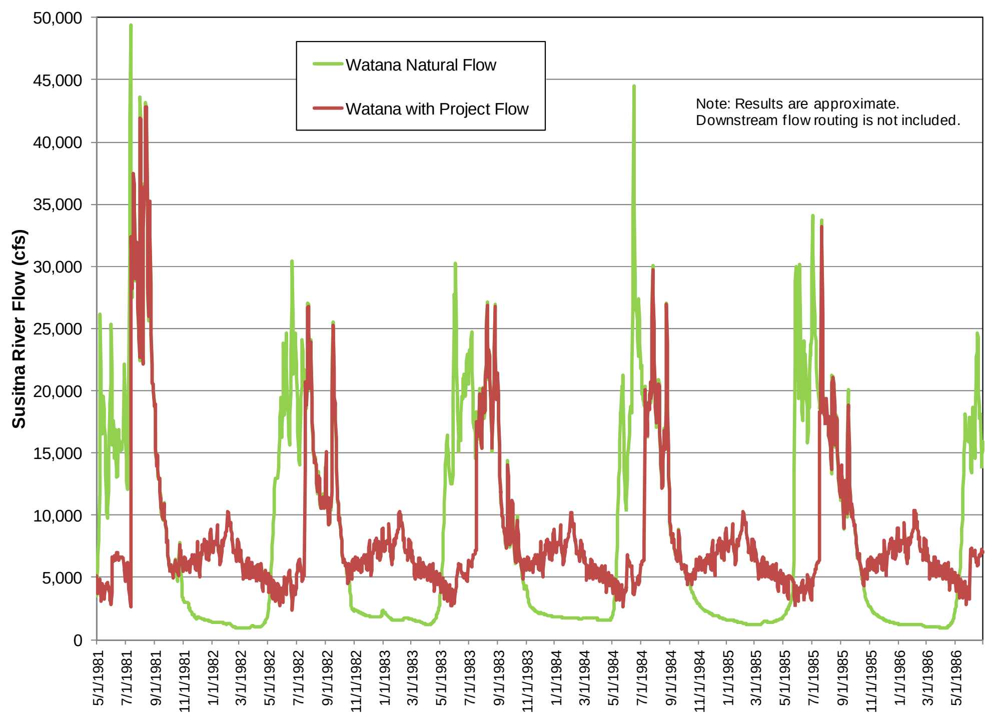


Figure 3.5-12. Natural and With-Project Flows at Watana

<u>Susitna River at Gold Creek (Figure 3.5-13)</u> – this USGS gaging station is located at RM 136.5, which is 47.5 mi downstream from Watana Dam. The drainage area at Gold Creek is 6,160 square mi and the annual average flow is about 9,800 cfs.

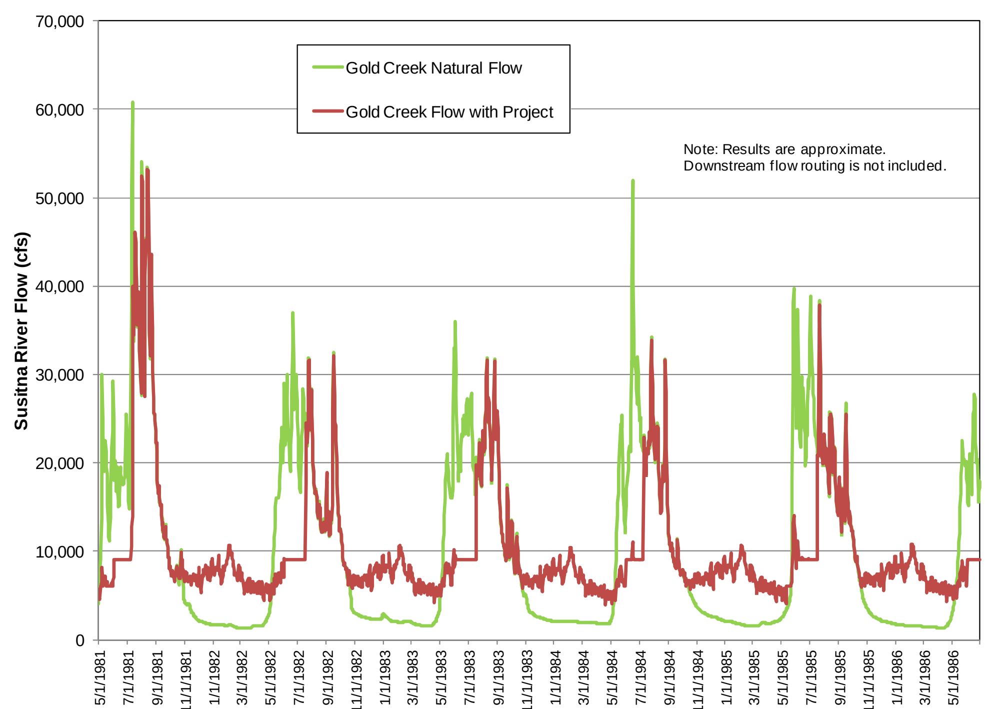


Figure 3.5-13. Natural and With-Project Flows at the Gold Creek USGS Gage

Susitna River at Sunshine (Figure 3.5-14) – this USGS gaging station is located at approximately RM 83.8, more than 10 miles downstream from the confluence of the Susitna River with the Chulitna River (2,570-square mi drainage area) and the Talkeetna River (1,996-square mi drainage area). The drainage area at Sunshine is 11,100 square mi and the annual average flow, based on a short period of record, is about 23,900 cfs.

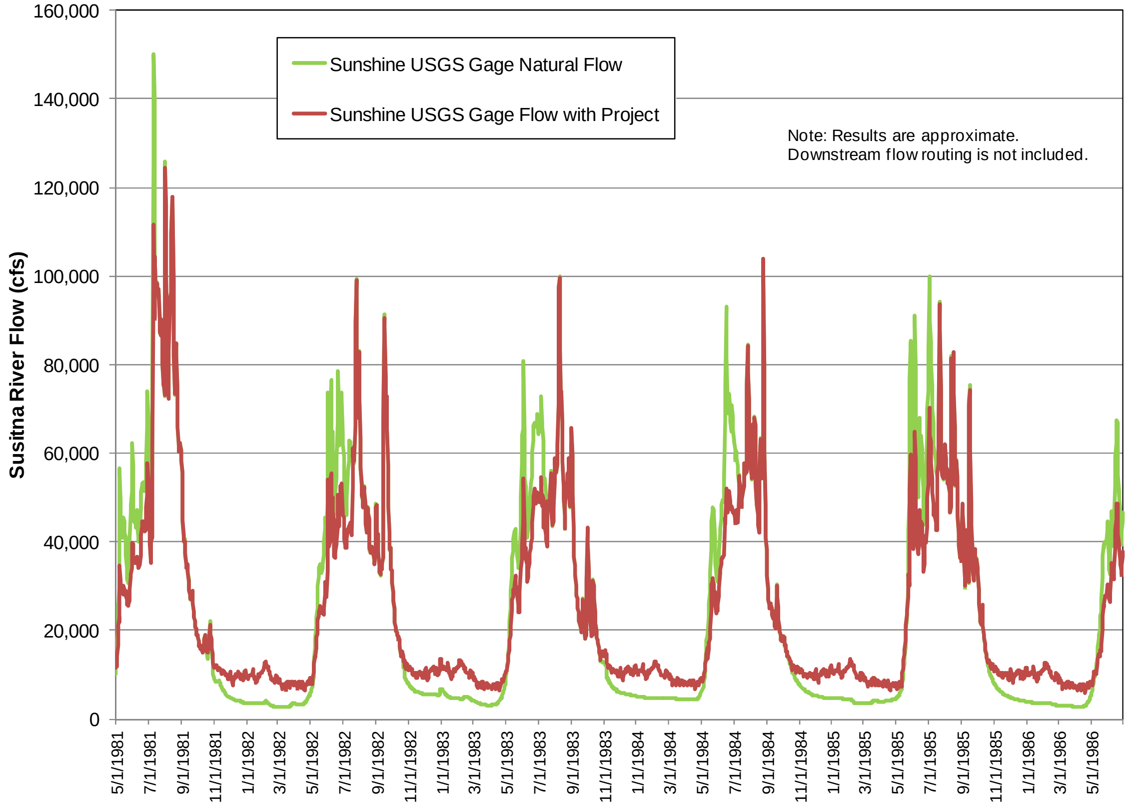


Figure 3.5-14. Natural and With-Project Flows at the Sunshine USGS Gage

Susitna River at Susitna Station (Figure 3.5-15) – this USGS gaging station officially at RM 25.8, is located about 18 mi upstream from Cook Inlet at El. 40 ft msl where it measures the flow of virtually the entire Susitna watershed. Between Sunshine and Susitna Station, the Yentna River, with a drainage area of 6,180 square mi, joins the Susitna River. The total drainage area at Susitna Station is 19,400 square mi and the annual average flow is about 50,400 cfs.

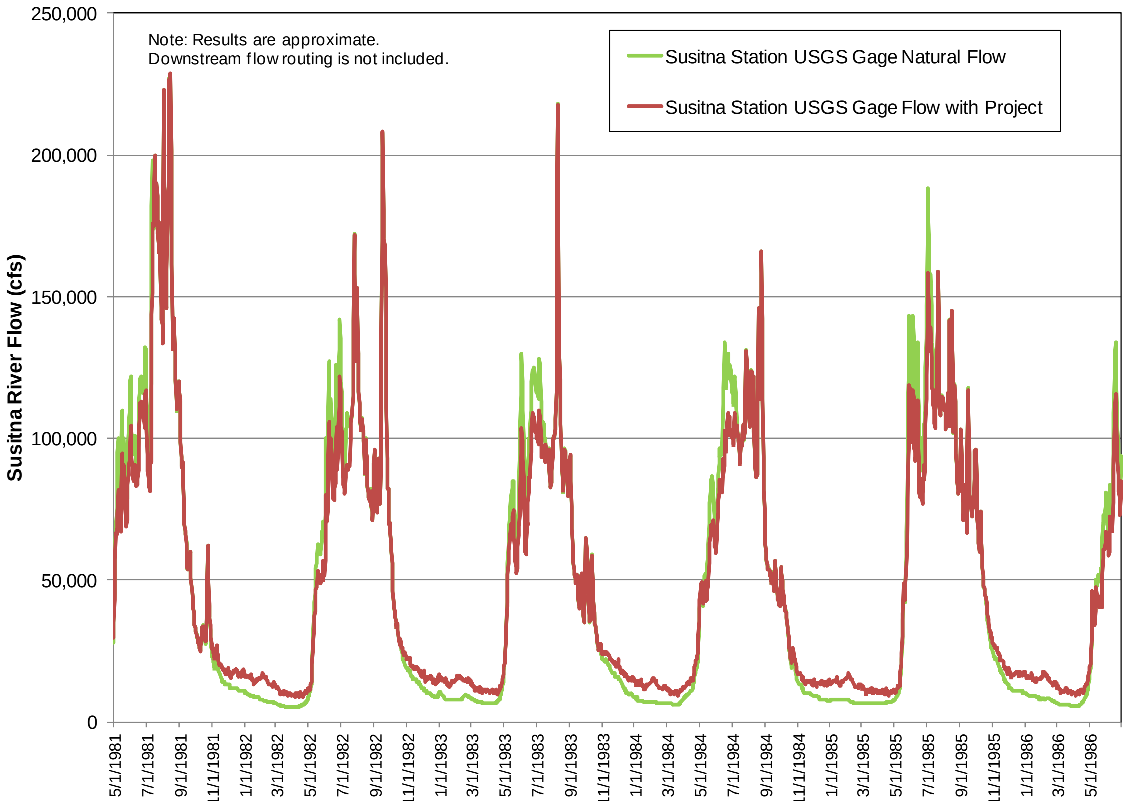


Figure 3.5-15. Natural and With-Project Flows at Susitna Station USGS Gage

3.5.3. Effects of Hydrologic Change

Climate change can significantly modify the expected firm energy from hydroelectric projects like Susitna-Watana due to altered seasonal and annual reservoir inflow regimes. In comparison with projected future temperature changes, future changes in runoff patterns are considered to be much less certain. As part of ongoing licensing studies, available literature will be reviewed with respect to similar rivers with snowmelt dominated runoff under potential climate change scenarios, and site-specific studies will be performed to assess how future climate changes in Alaska might affect long-term Project generation estimates.

Stochastic hydrology techniques can be utilized to evaluate alternative runoff futures for the Watana reservoir under both the historic river flow patterns and under changing climatic conditions in the future. Stochastic hydrology analyses would generate 1,000 traces of equally probable 50-year streamflow data sets for selected alternative future scenarios. This stochastic hydrology will be used by project planners to further quantify firm energy reliability from the Project.

Preliminary hydrology studies conducted to date indicate that there is a trend toward earlier snow and glacier melt runoff in the Susitna River basin probably due to climate warming. As shown on Figure 3.5-16, April is the month that shows the most dramatic trend toward increasing flows. The months of June (Figure 3.5-17), July, and August, have historic trends toward decreasing average flows. The net effect is that historic annual flows have shown essentially no trend toward either increasing or decreasing flows, as shown on Figure 3.5-18.

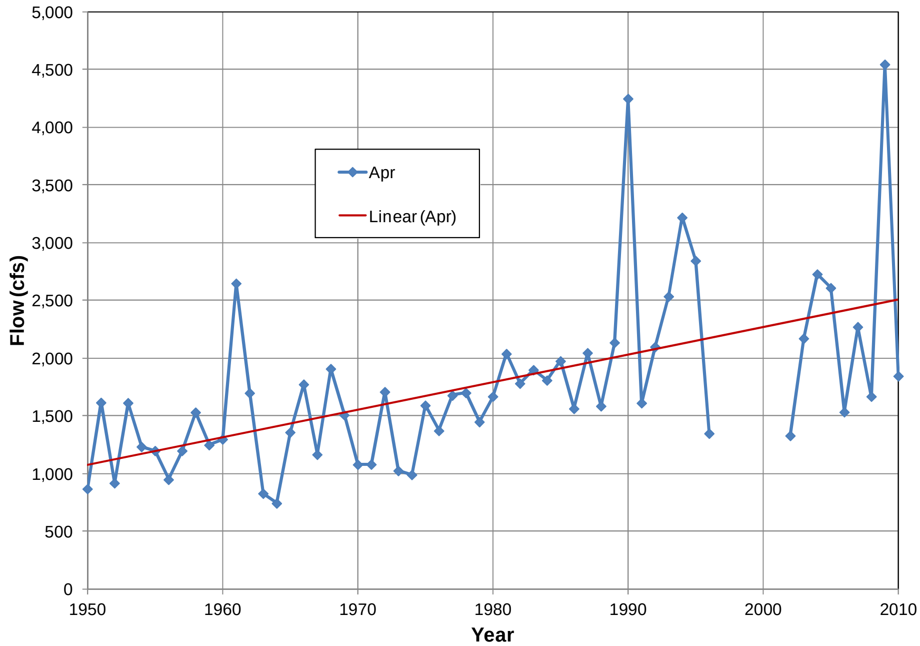


Figure 3.5-16: April Recorded Flows (cfs) – Susitna River at Gold Creek

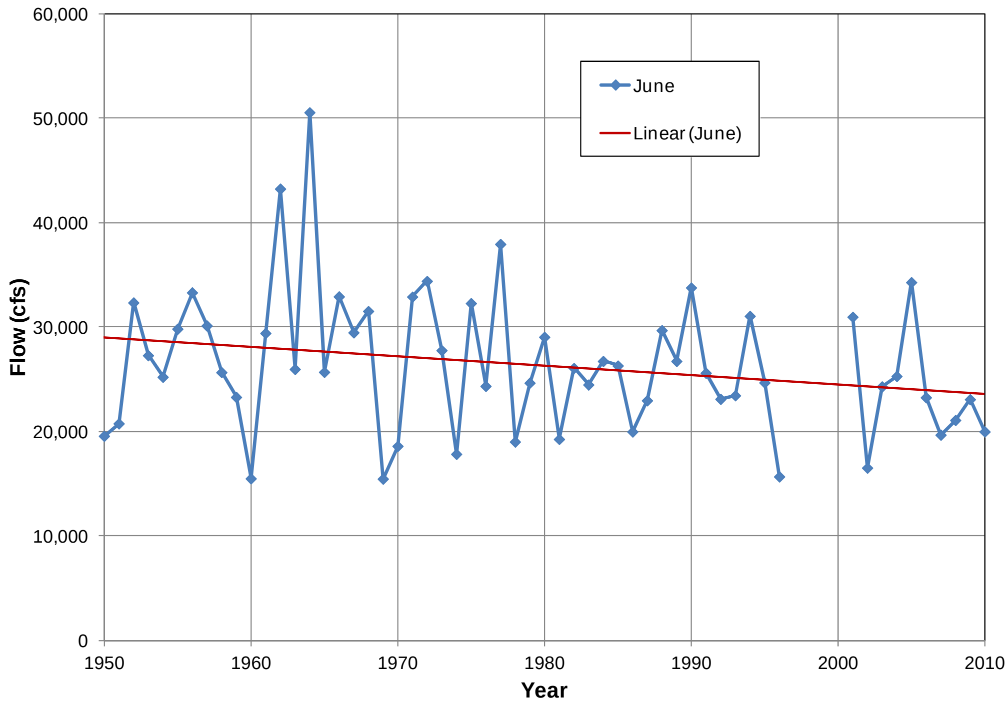


Figure 3.5-17: June Recorded Flows (cfs) – Susitna River at Gold Creek

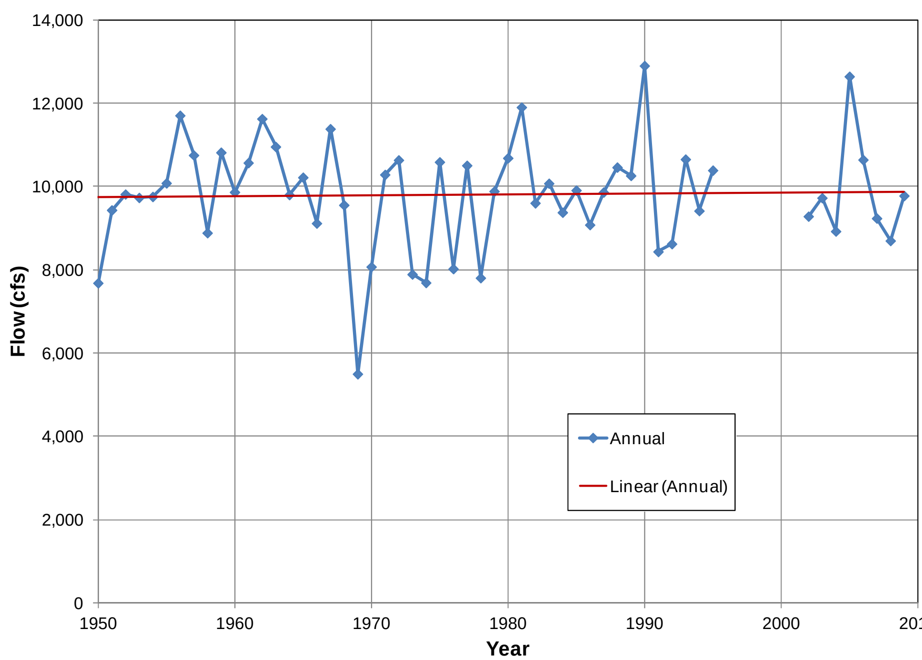


Figure 3.5-18: Annual Recorded Flows (cfs) – Susitna River at Gold Creek

Figure 3.5-19 shows the historic average monthly flows at the USGS gage at Gold Creek (1949 – 2011) along with a projection of the trends in monthly flows to the year 2050. The 2050 projected flows also show no net change on an annual basis compared to the historic annual flows.

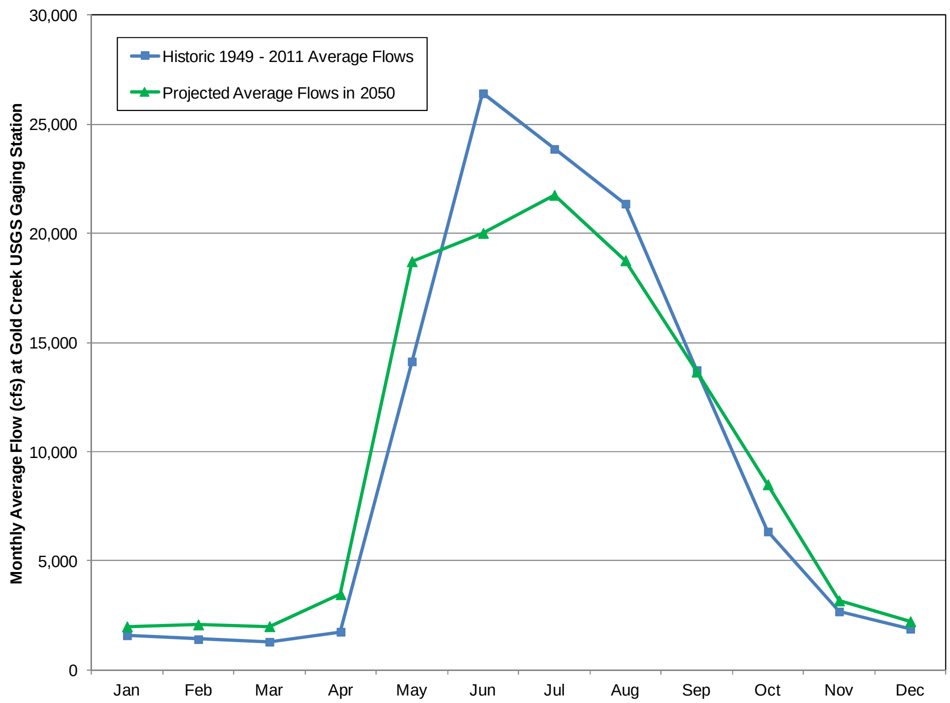


Figure 3.5-19: April Recorded Flows (cfs) – Susitna River at Gold Creek

The Intergovernmental Panel on Climate Change (IPCC) has published an authoritative global study of the effects of climate change. Starting with an ensemble of 23 Atmosphere-Ocean General Circulation Models (AOGCMs) and multiple alternative emission scenarios, the IPCC developed worldwide simulation model projections of changes in temperature, precipitation, evaporation, runoff, and other parameters. Projections of temperature changes all indicated temperature increases worldwide, but runoff projections showed both areas of increasing runoff and decreasing runoff. As shown on Figure 3.5-20, simulation model projections indicate increased Susitna River basin runoff in the coming decades (IPCC 2007). These projections are based on the SRES A1B emission scenario and show the change in average annual runoff for the 2080-2099 period relative to 1980-1999. The regions are stippled on Figure 3.5-20 where at least 80 percent of the models agree on the sign of the mean change. This means that the Susitna watershed is in a region that is projected to have among the highest average annual increases in runoff worldwide, with a high degree of agreement among the models that the change in runoff will be an increase. Reading Figure 3.5-20 for the Susitna watershed and converting the units, it translates to about a 10 percent increase in average annual runoff by 2050.

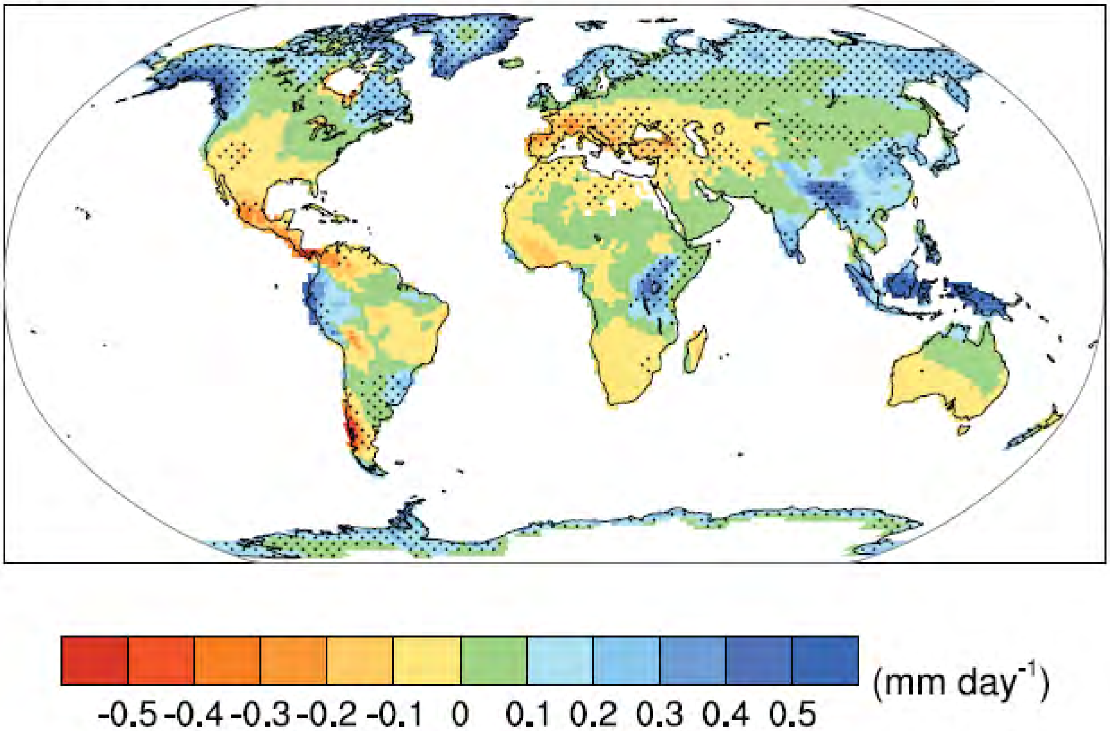


Figure 3.5-20: Change in Annual Mean Runoff (mm/day) for the Period 2080 – 2099 Relative to 1980 – 1999 (Source: IPCC 2007)

Section 4.4.1.2.4 presents further information regarding considerations of climate change. If increased average runoff does occur, it would be expected that there will be a net positive effect (increase) in Susitna-Watana Project annual and firm power generation over time.