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NATIONAL REGISTER

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, styles, materials, and areas of significance, enter only the categories and subcategories listed in the instructions. For additional space use continuation sheets (Form 10-900a). Type all entries.

1. Name of Property

historic name: Glines Canyon Hydroelectric Power Plant
other names/site number: N/A

2. Location

street & number: North end of Lake Mills at Elwha River — [ ] not for publication
city, town: Port Angeles — [x] vicinity
state: Washington — code: WA — county: Clallam — code: 009 — zip code: 98362

3. Classification

Ownership of Property	Category of Property	Number of Resources within Property		
		Contributing	Noncontributing	
[x] private	[ ] building(s)	1		buildings
[ ] public-local	[x] district			sites
[ ] public-State	[ ] site	5		structures
[ ] public-Federal	[ ] structure			objects
	[ ] object	6	0	Total

Name of related multiple property listing: Hydroelectric Power Plants in Washington State

Number of contributing resources previously listed in the National Register: 0

4. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this [X] nomination [ ] request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property [X] meets [ ] does not meet the National Register criteria. [ ] See continuation sheet.

[signature] — October 12, 1988
Signature of certifying official — Date

Washington State Office of Archaeology & Historic Preservation
State or Federal agency and bureau

In my opinion, the property [ ] meets [ ] does not meet the National Register criteria. [ ] See continuation sheet.

Signature of commenting or other official — Date

State or Federal agency and bureau

5. National Park Service Certification

I, hereby, certify that this property is:

- [x] entered in the National Register. — Entered in the National Register — [signature] — 12/15/88
  - [ ] See continuation sheet.
- [ ] determined eligible for the National Register. [ ] See continuation sheet.
- [ ] determined not eligible for the National Register.
- [ ] removed from the National Register.
- [ ] other, (explain:)

Signature of the Keeper — Date of Action

6. Function or Use

Historic Functions (enter categories from instructions)	Current Functions (enter categories from instructions)
INDUSTRY/energy facility	INDUSTRY/energy facility

7. Description

Architectural Classification (enter categories from instructions)

Other/varied-radius single arch dam
Neoclassical

Materials (enter categories from instructions)

foundation concrete
walls concrete
roof
other concrete

Describe present and historic physical appearance.

Located in the northern foothills of the Olympic Mountains, the Glines Canyon Hydroelectric Power Plant is a medium head hydroelectric facility which includes a reinforced concrete arch dam in Glines Canyon (forming a 43,000 acre feet storage reservoir), a concrete powerhouse, and an extensive water conveyance system.[1] The following inventory describes the constituent elements.

THE DAM: The topography of the steep river gorge of Glines Canyon dictated the dimensions of the dam, which is 55 feet wide at its base and 273 feet wide at its crest. Because the crest was almost six times the length of the base, it was necessary to anchor the upper sections of the dam into a heavy gravity abutment block on the east end. The construction of the dam between the steep formidable canyon walls created many engineering challenges. The narrow vertical walls of the canyon site made it necessary to develop a system in which the concrete aggregate could be dropped into place from a vertical height of 75 feet.[2]

The dam, which is a varied-radius single arch design, is particularly adapted to the rock-walled canyon in which it was built. Curved in the upstream direction, the arch dam is structurally more efficient than a straight gravity dam. However, it is not possible to use this design under all conditions because the compressive action of the arch-like form transmits the enormous water load to the abutments. The rock sidewalls of the canyon provide ideal bearing walls for the tremendous lateral thrust of the vault. In addition, the arched structure serves as a gravity dam; as a result it also acts as a vertical cantilever.[3]

The dam consists of a 121 foot long spillway section on the west end which regulates the flow of water by means of five 18 by 20 foot tainter gates. The sluiceway is located 670 feet above the base of the dam on the west end of the structure, and is controlled by a butterfly type gate.

WATER CONVEYANCE SYSTEM: The water, discharged at a maximum rate of 5,200 cfs, is transported to the turbines by means of a pressure tunnel whose intake is located 893 feet below the crest of the dam. As is typical of high or medium head developments, the Glines Canyon intake was built as an independent structure. The intake is connected to a 569 foot long tunnel, driven through solid rock. In cross section, the tunnel is 14 feet wide; the height to the spring line of the arch is 13 feet, and the arch has a rise of four feet. The intake control gate, located 190 feet downstream from the intake at the dam, consists of a shaft with a caterpillar-type mechanism.

[X] See continuation sheet

Approximately 157 feet downstream from the control gate, the tunnel is connected to a 321 foot long, 10 foot diameter, pressure pipe and surge tank. An 11 foot riser pipe connects the penstock to the Johnson differential type surge tank. Because the passage of water through a long pipeline under a medium head can create excessive rises or drops in pressure, it is necessary to provide a mechanism to equalize the pressure variation in the penstock. The surge tank, which acts as an elevated reservoir, serves this purpose. A sudden increase of pressure in the penstock causes the water to rise in a column within the tank, while a sudden decrease in pressure triggers the mechanism to release water from the tank.

The Johnson differential design was claimed to be superior to that of the simple surge tank because an interior riser separated the tank's function as an accelerator or retarder of conduit velocity from its function as a storage tank; this design feature allowed the pressure to be equalized in the conduit more rapidly than in other designs and, consequently, permitted more precise water speed regulation. The 20 foot diameter Glines Canyon tank contains a nine foot diameter interior riser and stands 50 feet high.[4]

The location of the tank conformed to the recommendations of contemporary literature on power plant design which asserted that the system was most efficient when the surge tank was situated as close to the powerhouse as possible. The Glines Canyon tank stands on a bank directly above the powerhouse. At this point the water is diverted into a 158.7 foot long, 11.5 foot diameter steel penstock which drops approximately 80 feet to the turbine casing where the flow is regulated by an 8.5 foot butterfly valve.[5]

TURBINES: The water conveyance system operates a single 17,500 hp Pelton Water Wheel Company hydraulic turbine (225 rpm, 1926) which was originally connected to a 13,333 KVA alternating current, 3 phase, 60 cycle General Electric generator (Type ATB, 660 volts, 1200 KW, 225 rpm). In 1961, the generator was rewound and uprated to 16,500 KVA and 14,850 KW.

An auxiliary 80 hp water wheel was also installed to drive a 26.5 KVA, 220 volt combination motor and generator which furnishes station light and power when the main unit is shut down. When the main unit is in operation, the auxiliary unit is connected to the high voltage station bus and is driven as a motor to operate the oil pump which maintains oil pressure on the Pelton Water Wheel Company governor (Type 7 1/2 gd/691 Serial No., 1925).[6]

POWERHOUSE: A rigidly symmetrical reinforced concrete building houses the equipment. This 40 by 760 foot utilitarian structure is distinguished by a modicum of ornament. The window and door openings are framed by horizontal and vertical projections of concrete. These suggest an attempt to create a monumental scale typical of the Neoclassical structures of the early 20th century. Other elements that draw upon a Neoclassical tradition are the existence of an "attic" story set off by an unadorned entablature, a parapet, and large sash windows. The surface of the reinforced concrete emulates the smooth or polished stone surface characteristic of Neoclassical buildings. A small reinforced concrete structure with similar detailing was built adjacent to the dam.
Contributing Structures: Intake, Gate House, Dam (inc. Spillway), Penstock, Surge Tank
Contributing Buildings: Powerhouse

8. Statement of Significance

Certifying official has considered the significance of this property in relation to other properties:

☐ nationally ☒ statewide ☐ locally

Applicable National Register Criteria ☒ A ☐ B ☒ C ☐ D

Criteria Considerations (Exceptions) ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G

Areas of Significance (enter categories from instructions)	Period of Significance	Significant Dates
Engineering	1926-1938	N/A
Industry		

Cultural Affiliation
N/A

Significant Person
N/A

Architect/Builder
Thebo, Starr, and Anderson

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.

The Glines Canyon Power Plant is historically significant for its association with the evolution of power plant design and contributed to the development of the automation of hydroelectric installations. In addition, as one of the last dams within the state to be constructed solely for the purpose of power generation, it marks the closing of an era which characterized early hydroelectric development within Washington State. It meets the power plant registration requirements established in the Hydroelectric Power Plants in Washington Multiple Property Documentation Form.

HISTORICAL BACKGROUND: In 1926, the Northwestern Power and Light Company began construction of a second hydroelectric facility on the Elwha River to meet growing power load demands of the expanding pulp and paper industry in Port Angeles. Specifically, it was built to furnish power to the Washington Pulp and Paper Company. The completion of the Glines Canyon Plant, which was located seven and one-half miles upstream from the original installation, doubled the company's power generating capacity. Together the hydroelectric facilities on the Elwha River furnished approximately 25,000 KW of power which supplied electricity to the towns of Bremerton, Charleston, Port Angeles, and Port Townsend; in addition, they provided power for the operation of all of the industries on Ediz Hook spit as well as the Bremerton Navy Yard.

When it was completed, the Glines Canyon Plant had the distinction of containing "the largest single water wheel generator unit to be controlled by semi-automatic remote supervisory equipment."[7] The Glines Canyon Plant was part of the mainstream of hydroelectric development in the 1920s, when an increasing number of plants became automated. But, the Glines Canyon installation tested the limits of automated hydroelectric plant design.

As a safety precaution, it was necessary to open the main butterfly valve at the Glines Canyon Plant manually before the automatic equipment would function. Once opened, the butterfly valve was held in position by a solenoid which is "subject to subsequent control by automatic and protective features of the operating equipment." After the valve has opened, a control circuit is completed which releases the generator brakes and triggers the operation of the governor which controls the wheel gate mechanism on the unit itself. When

☒ See continuation sheet

9. Major Bibliographical References

Crown Zellerbach Corporation. More Power to You: 1890-1940. Port Angeles: 1940.
"Glines Canyon Plant Under Supervisory Control," Electrical West, Volume 60, Number 4, April 1, 1928.

☐ See continuation sheet

Previous documentation on file (NPS):
☐ preliminary determination of individual listing (36 CFR 67) has been requested
☐ previously listed in the National Register
☐ previously determined eligible by the National Register
☐ designated a National Historic Landmark
☐ recorded by Historic American Buildings Survey # ______
☐ recorded by Historic American Engineering Record # ______

Primary location of additional data:
☐ State historic preservation office
☐ Other State agency
☐ Federal agency
☐ Local government
☐ University
☐ Other
Specify repository: ______

10. Geographical Data

Acreage of property about 7
Quadrangle Name: Elwha Scale: 1:24000

UTM References

	Zone	Easting	Northing
A	1 0	4 5 5 3 6 0	5 3 1 6 7 8 0
B	1 0	4 5 5 2 8 0	5 3 1 6 5 0 0
C	1 0	4 5 5 4 4 0	5 3 1 6 4 9 0
D	1 0	4 5 5 3 8 0	5 3 1 6 4 6 0

☐ See continuation sheet

Verbal Boundary Description

The nominated property is a rectangular parcel located at the confluence of Lake Mills and the Elwha River with boundaries indicated on the attached sketch map (Scale: 1"= = 60').

☐ See continuation sheet

Boundary Justification

The nominated property includes the dam, water conveyance system and powerhouse historically associated with the Glines Canyon project.

☐ See continuation sheet

11. Form Prepared By

name/title Lisa Soderberg
organization Office of Arch'y & Historic Preservation date October 23, 1986
street & number 111 West 21st Avenue, KL-11 telephone (206) 753-4011
city or town Olympia state Washington zip code 98504

the Glines Canyon generator unit is on line, it is possible to control the load from the Elwha station, seven and one-half miles away; in turn, the generator can be shut down automatically by removing the load from the unit.[8]

The system was also designed so that it could be synchronized from either the Glines Canyon Plant or from the Elwha station. The Elwha operator is able to bring the Glines Canyon Plant into synchronism with the rest of the system by raising or lowering the field voltage and the speed of the unit through the use of "selector type supervisory equipment."

The electricity generated at the Glines Canyon facility is transmitted to the Elwha plant. Three 4,500 KVA General Electric air-cooled transformers were installed in back of the Glines Canyon Power Plant to raise the voltage from 6,600 to 66,000 volts--a voltage at which the current could be transmitted.

Thebo, Starr and Anderson, Inc., of San Francisco designed and built the Glines Canyon Plant under the direction of F.M. Thebo; W.B. McMillan, chief engineer; W.A. Whitmire, superintendent; H.R. Stevens, electrical engineer; and H. Schorer, hydraulic engineer.[9]

The Glines Canyon Project was to be the second of four hydroelectric plants constructed on the Elwha River to provide power for the expanding lumber products industry on the Olympic Peninsula. For numerous reasons, the remaining two power sites were never developed. In 1925-26, the Puget Sound Power and Light Company entered the Olympic Peninsula and purchased segments of the Northwestern Power and Light Company's distribution system and many of its substations. It was not long before the power which provided electricity to the city of Port Angeles was transmitted from a source on the other side of the Hood Canal.

The demand for power to meet the domestic, commercial, and industrial needs of the Olympic Peninsula continued to grow. During the 1930s and 1940s, the Elwha River plants became part of a "power pool" that served the power load demands of the peninsula.[10] However, ultimately, it was not the entrance of the Puget Sound Power and Light Company on the Olympic Peninsula that limited the potential of the power developments on the Elwha River, it was a radical change in the design of hydroelectric installations. During the 1930s, construction began on the enormous federally-funded multiple-purpose dams that made it possible to generate power on a vast regional scale.[11] And in 1949, a large multiple-purpose dam on the Columbia River transmitted power to the Olympic Peninsula by means of high tension lines.

Although construction of the facility represented a significant achievement for the utility, the project provided no mitigation for the serious loss of fish runs, the inundation of wildlife habitat, or the disruption to the tradition cultural and subsistence economy of the Lower Elwha and Jamestown tribes. Any assessment of the historical impact of this plant must recognize the damage inflicted on both the native inhabitants and the natural environment.

[1]"Glines Canyon Plant Under Supervisory Control," Electrical West, Volume 60, Number 4, April 1, 1928, p. 196.
[2]"An Ideal Location for a Dam," Electrical West, May, 1927, p. 269.

[3]Carl W. Condit, American Building, Chicago: The University of Chicago Press, 1982, pp. 163, 265.

[4]"Glines Canyon Plant Under Supervisory Control," op. cit., p. 196; David B. Rushmore, Hydroelectric Power Stations. New York: John Wiley and Sons, Inc., 1923, pp 133-136.

[5]Lamar Lyndon, Hydroelectric Power. New York: McGraw-Hill Book Company, Inc., 1916, pp. 442-444; "Glines Canyon Plant Under Supervisory Control," op. cit., p. 196.

[6]Electrical West, Ibid., p. 198.

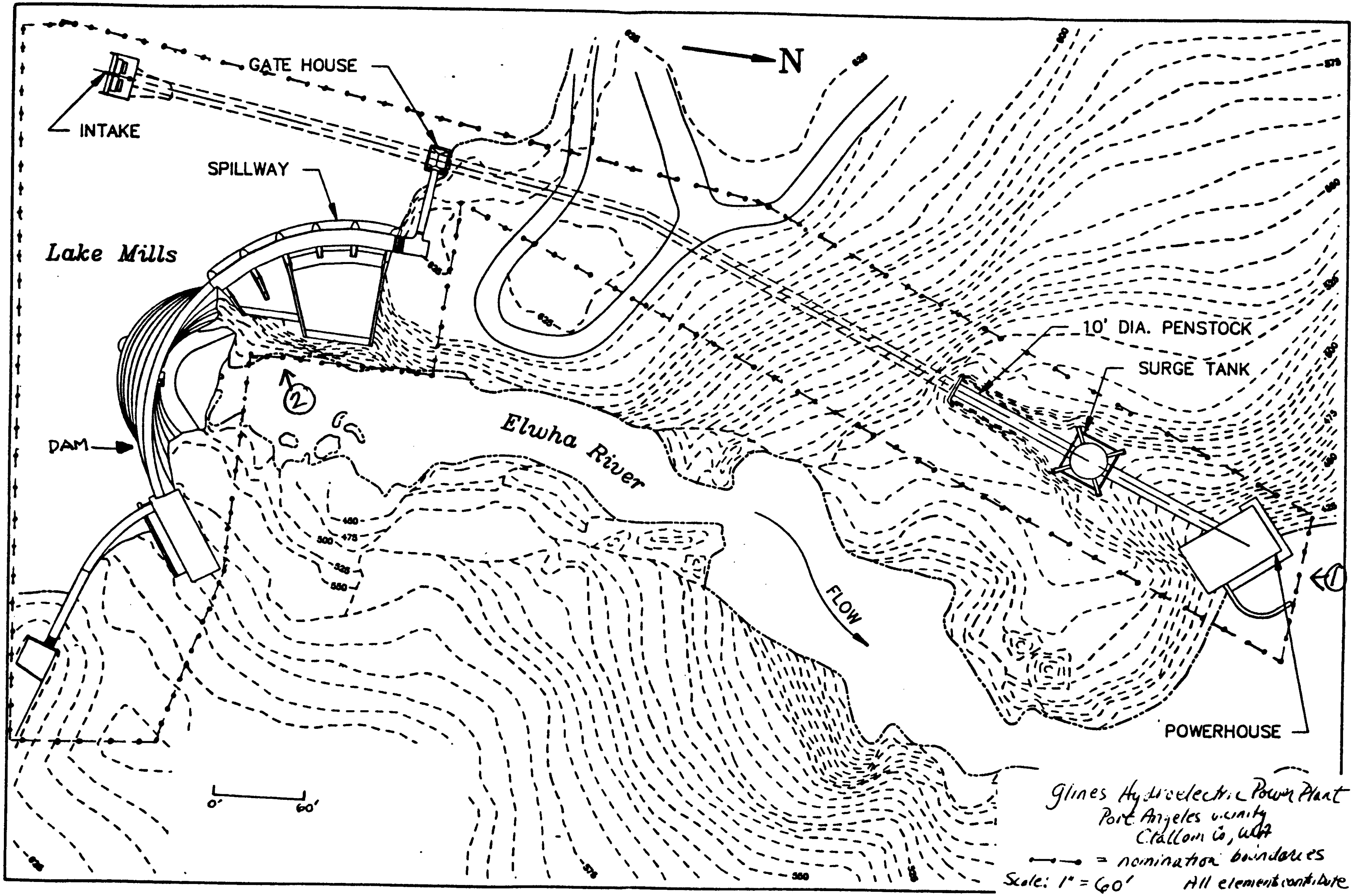
[7]Ibid., p. 196.

[8]Ibid., p. 198.

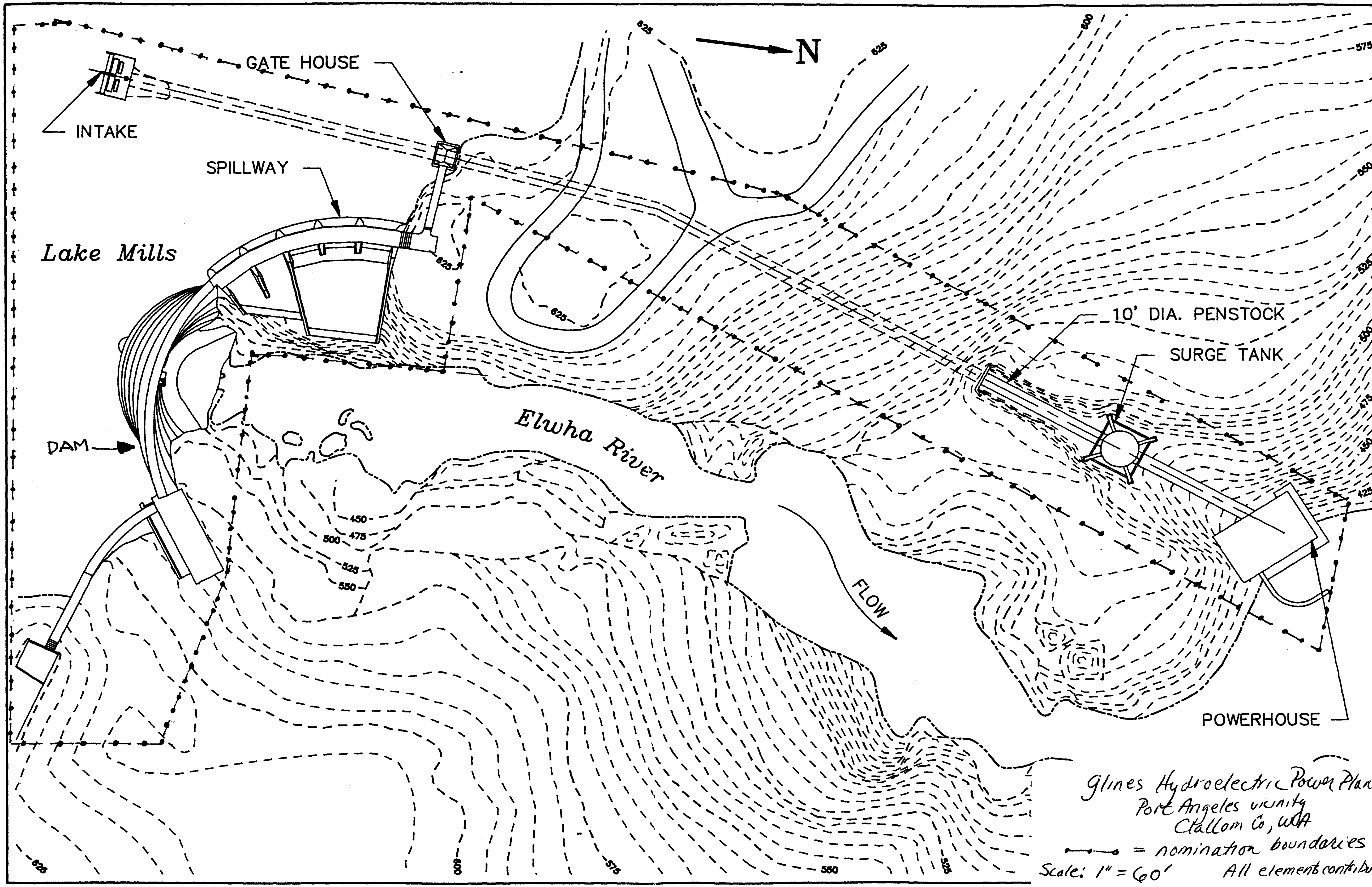
[9]Ibid.

[10]Crown Zellerbach Corporation. More Power To You 1890-1940, 1940.

[11]Condit, op. cit., p. 262.



Glines Hydroelectric Power Plant
Port Angeles vicinity
Clallam Co, WA
•—•—• = nomination boundaries
Scale: 1" = 60' All elements contribute
↗ = photo Key



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