GOLDENDALE ENERGY STORAGE HYDROELECTRIC PROJECT

Federal Energy Regulatory Commission Project No. 14861

Klickitat County, Washington

FINAL LICENSE APPLICATION
Exhibit A: Description of the Project

For:

FFP Project 101, LLC

June 2020

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Acronyms and Abbreviations

AF	acre-feet
Applicant	FFP Project 101, LLC
BPA	Bonneville Power Administration
cfs	cubic feet per second
CGA	Columbia Gorge Aluminum
KPUD	Public Utility District No. 1 of Klickitat County, Washington
kV	kilovolt
MW	megawatt
MWh	megawatt-hour
TID	Turlock Irrigation District
U.S.	United States

1.0 PROPOSED LOCATION AND FACILITIES

The following exhibit discusses the proposed Goldendale Energy Storage Project No. 14861 (Project) to be located near Goldendale, Washington, in Klickitat County, Washington, and Sherman County, Oregon. The proposed Project will be a new energy storage facility proposed by FFP Project 101, LLC (the Applicant).

1.1 Site Description

A proposed FERC Project Boundary is shown in Figure 1.1-1, and encompasses all land necessary for access or control in order to construct and operate the Project and provide a possible Project "footprint" area where environmental and engineering studies are being undertaken. The Project is primarily located in Klickitat County, Washington. The Project Boundary aerially spans the Columbia River into Oregon, and contains an area in Sherman County where the transmission line will be located. Representative site photographs are provided in Appendix A.

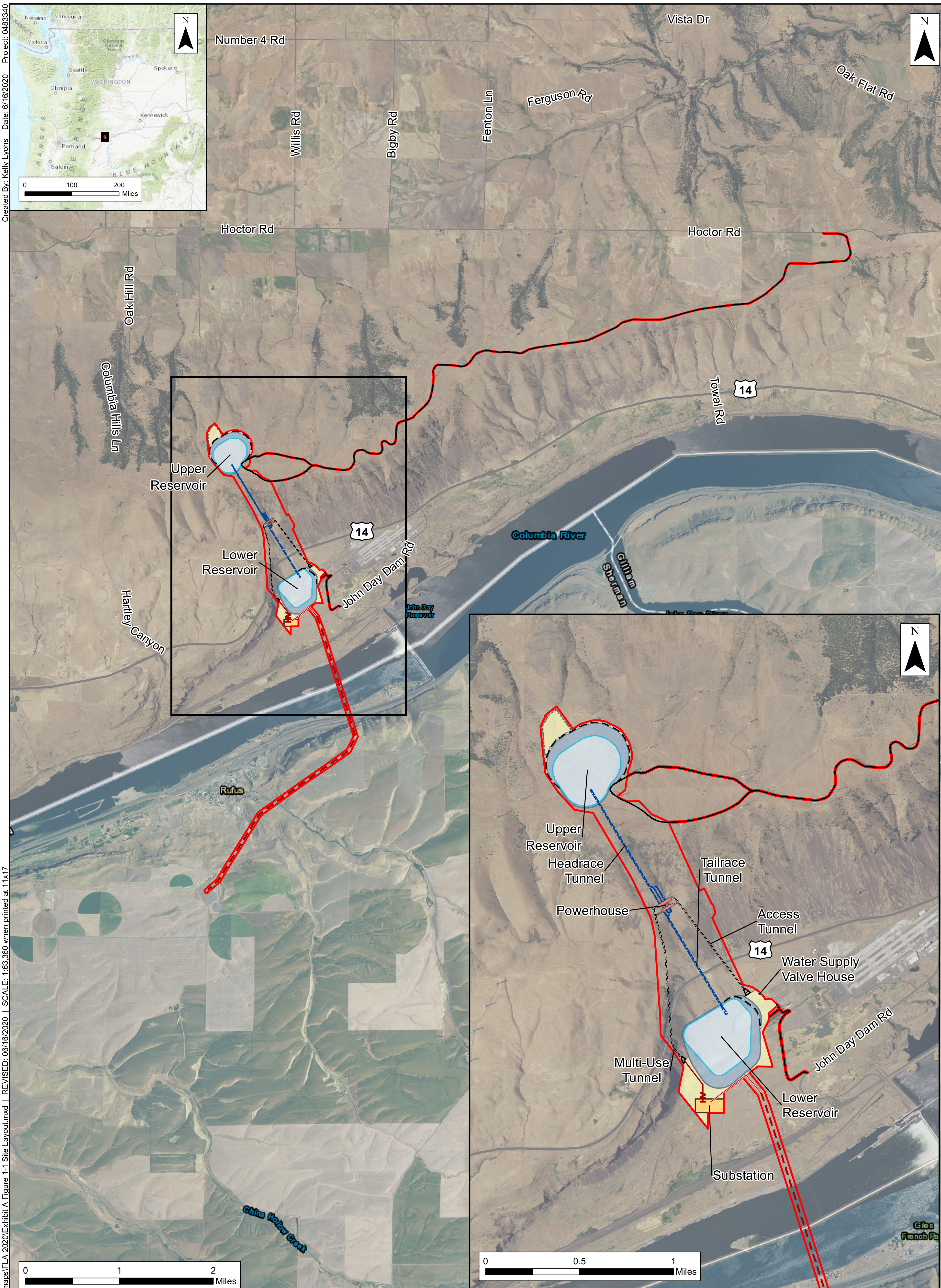
1.1.1 Land Ownership

The proposed Project Boundary encompasses approximately 681.6 acres of mostly private lands owned by NSC Smelter, LLC. All Project land disturbance will occur either on private lands or within an existing utility right-of-way owned by Bonneville Power Administration (BPA). Washington Department of Transportation lands in the Project Boundary will be crossed underground by the Project's tunnels. Washington Department of Natural Resources lands will be crossed only by the existing access road to the upper reservoir. United States (U.S.) Army Corps of Engineers, BNSF, and private lands will be crossed by the Project's aerial transmission line within BPA's existing transmission right-of-way. Table 1.1-1 provides the ownership breakdown of area within the proposed Project Boundary.

Table 1.1-1: Land Owners within the Proposed Project Boundary

Name	Area (Acres)	Area (Percent of Total)
NSC Smelter, LLC	529.6	78%
Department of Transportation	23.6	3.5%
Department of Natural Resources	1.8	<0.5%
BPA right-of-way (Washington)		
Private Lands	19.1	3%
BNSF Railway Co	1.9	<0.5%
U.S. Government (USACE)	17.1	2.5%
Columbia River	6.5	1%
BPA right-of-way (Oregon)		
Private Lands	73.2	11%
U.S. Government (USACE)	1.0	0%
Columbia River	7.8	1%
Total	*681.6*	*100%*

BPA = Bonneville Power Administration; USACE = U.S. Army Corps of Engineers



Legend

- Project Boundary

Proposed Infrastructure

- Access Road
- High Voltage Cable
- Transmission Line
- Transmission Co-Located with Existing BPA ROW
- Existing Access Road
- Reservoir
- Reservoir Berm Outer Slope
- Laydown Area
- Powerhouse
- Substation
- Water Supply Valve House
- Access Tunnel
- Access Tunnel Portal
- Headrace/Tailrace Tunnel

Figure 1.1-1
Proposed Site Layout
Final License Application
Goldendale Energy Storage Project
FFP Project 101, LLC
Goldendale, WA

Environmental Resources Management
www.erm.com
ERM

Created By: Kelly Lyons Date: 6/16/2020 Project: 0483340

FILE: M:\Projects\Goldendale Energy Storage Project\maps\FLA 2020\Exhibit A Figure 1-1 Site Layout.mxd | REVISED: 06/16/2020 | SCALE: 1:63,360 when printed at 11x17

Source: Esri - World Topographic Map; NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

1.2 Existing Facilities

The Project will be a newly licensed facility, and there are no other existing hydroelectric facilities within the Project Boundary.

Existing facilities within the proposed Project Boundary include:

- The lower reservoir is proposed to be located at an area known as the West Side Surface Impoundment, which is an area associated with the Columbia Gorge Aluminum (CGA) smelter that was capped and closed in 2005 in compliance with applicable environmental laws. The impoundment has tested as having non-hazardous and non-dangerous material; however, this area will be characterized further prior to being excavated as part of the construction of the lower reservoir. Because the material is unsuitable fill, it will be excavated and properly disposed of pursuant to full characterization in collaboration with the Washington Department of Ecology.
- Washington State Route 14 (Lewis and Clark Highway). Project tunnels will be constructed underneath the highway and will not interact or interfere with highway operations.
- Existing private roads. A private road from its intersection with John Day Dam Road will be used to access the lower reservoir. A private road from its intersection with Hoctor Road will be used to access the upper reservoir.
- One wind turbine owned by Turlock Irrigation District (TID) is inside the Project Boundary but is unrelated to the Project and will not be affected by the Project. The wind turbine is located immediately above the subsurface headrace tunnel and appears to be within the Project Boundary, but should be considered excluded based on its vertical separation from the headrace tunnel.
- Two power distribution lines of unknown voltage within the Project Boundary, supported by single pole structures and H-frame wood towers. A new 5,600-foot-long alignment for both lines around the south side of the lower reservoir would require the relocation of five to six wooden H-frame towers and nine to ten single-pole structures. The voltages of the relocated lines would remain the same.

The Applicant's intent is to avoid impact on the operations and output of TID's turbines from the drilling and vibrations associated with construction of the pumped storage plant and upper reservoir. In consultation with the TID, the Applicant and the final design engineer will take the following steps during final design and construction of the upper reservoir arrangement:

- Develop a detailed map of existing utilities, including the underground 34.5 kilovolt (kV) distribution system that interconnects all wind turbines to facilitate avoidance of those facilities.
- If necessary, potentially refine portions of the footprint of the upper reservoir to avoid or minimize impacts of existing underground wind farm utilities.

- Develop detailed contractor requirements related to maximum construction vibrations associated with construction of the upper reservoir and vertical shaft.
- Develop a construction vibration monitoring program, including definition of vibration criteria, to ensure no damage to those existing wind farm facilities and no interruptions to their operation.

1.3 Proposed Project Facilities

As illustrated in Figure 1.1-1, the proposed Project will consist of an off-stream, closed-loop pumped-storage project with an upper and lower reservoir with over 2,400 feet of maximum gross head that involve no river or stream impoundments, allowing for relatively small water conveyances. Other features include an underground water conveyance tunnel, underground powerhouse and transformer caverns, 115 and 500 kV transmission line(s), a substation/switchyard, and other appurtenant facilities. Table 1.3-1 shows a summary of the basic Project features.

Table 1.3-1: Project Features Summary

Project Characteristics	
Approximate Installed Capacity	1,200 MW
Assumed Number of Units (Variable Speed)	3 x 400 MW units
Assumed Average Gross Static Head	2,360 feet
Assumed Usable Storage Volume	7,100 AF
Approximate Energy Storage	14,745 MWh
Approximate Hours of Storage @ 1,200 MW	12 hours
Underground Powerhouse	
Rated Head (Gross)	2,360 feet
Max Flow Generating Mode	8,280 cfs
Max Flow Pumping Mode	6,700 cfs

AF = acre-feet; cfs = cubic feet per second; MW = megawatt; MWh = megawatt-hour

Initial fill water and periodic make-up water will be purchased from Public Utility District No. 1 of Klickitat County (KPUD) using a KPUD-owned conveyance system and existing water right.

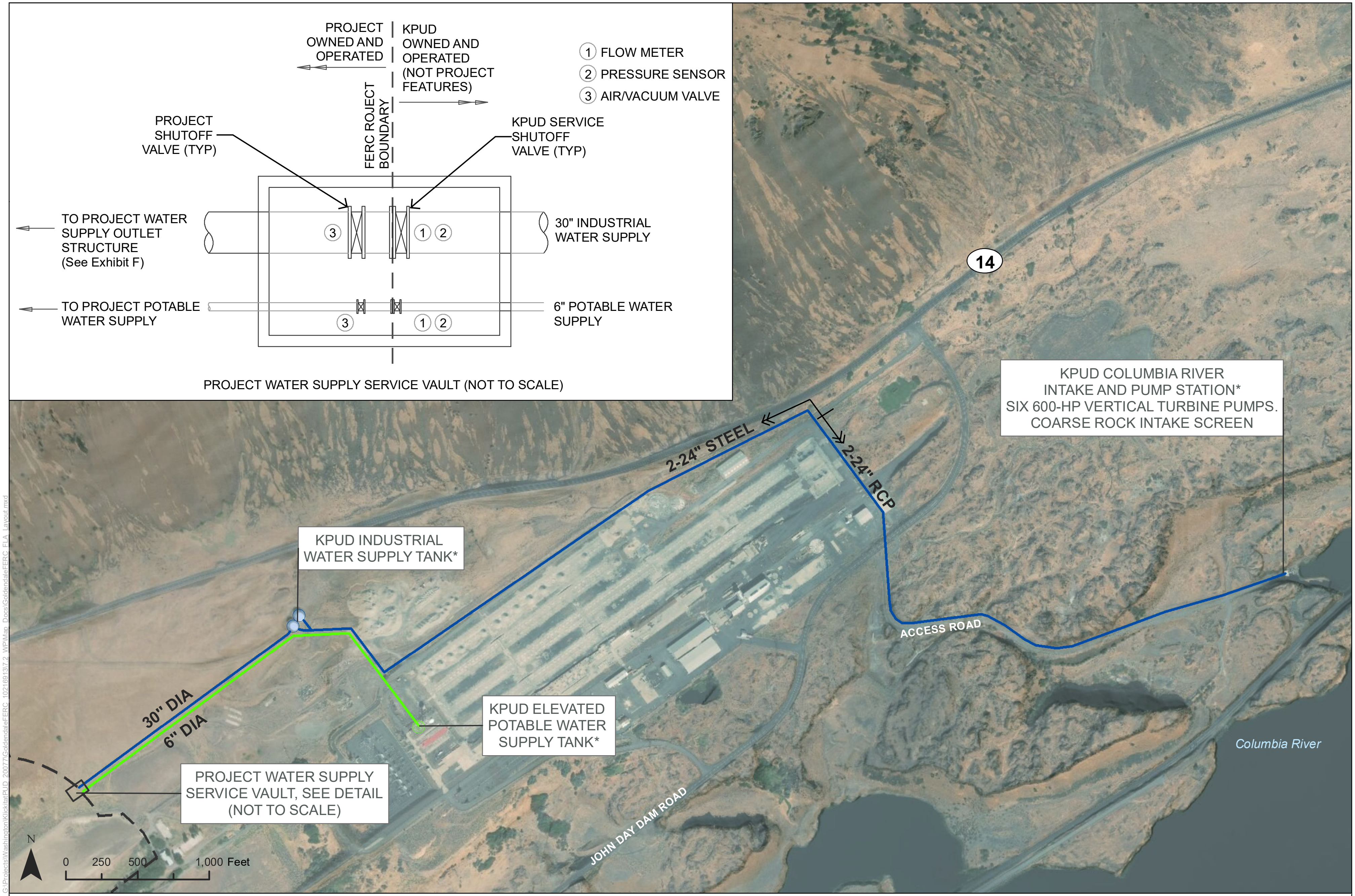
The proposed Project will consist of the following new facilities:

- Upper and lower reservoirs, sized to provide approximately 7,100 acre-feet (AF) of usable storage volume by combination of limited excavation of the reservoirs with construction of concrete face rockfill dams;
- Upper reservoir ungated vertical intake concrete structure with a hood to prevent vortex formation;
- Lower reservoir horizontal intake concrete structure, including vertical steel slide gates to allow isolation of tailrace tunnel from lower reservoir;

- Water conveyance system, including:
  - One 29-foot diameter concrete-lined vertical shaft;
  - One 29-foot diameter concrete-lined headrace tunnel;
  - Three 15-foot diameter steel-lined penstock tunnels;
  - Three 20-foot diameter steel-lined draft tube tunnels, each including a bonneted slide gate to allow isolation of pump-turbines from lower reservoir; and
  - One 30-foot diameter concrete lined-tailrace tunnel;
- Underground power house and appurtenant equipment; and
- Transmission interconnection to BPA's John Day Substation.

The Project will utilize variable-speed, pump-turbine generator units and provide balancing services and renewable energy flexible capacity to utilities in the Pacific Northwest and potentially California to decarbonize the electric power system cost-effectively. Reservoirs will be entirely on private land without aquatic impacts to the Columbia River or associated riparian habitats.

Water for the Project will be leased from KPUD, who owns an existing water right and conveyance system adjacent to the proposed Project. Figure 1.1-2 shows KPUD's industrial water conveyance system, including the intake and pumping facilities on the Columbia River, the alignment of the buried piping to two water storage tanks, and a buried 30-inch diameter conduit from the storage tanks that terminates with a water service shut-off valve in a water supply service vault on the Project Boundary. Figure 1.1-2 also includes description of KPUD's potable water supply system that will serve the Project.



FERC Project Boundary
Industrial Water Supply Line
Potable Water Supply Line
* *Not a project feature*

KPUD WATER SYSTEM AND PROJECT WATER SUPPLY SCHEMATIC

FIGURE 1.1-2

Klickitat PUD
Goldendale FERC FLA

The Project's lower reservoir area is located on lands that previously housed the CGA smelter (also known as Harvey Aluminum, Martin Marietta Aluminum, Commonwealth Aluminum, or Goldendale Aluminum). This facility was a primary aluminum reduction smelter that generally operated from 1969 to 2003, with a few periods when the plant shut down or had limited operation.

1.4 New Dams and Reservoirs

Preliminary embankment dam volumes were estimated using three-dimensional CAD software. All dams were assumed to be concrete-faced rockfill structures with a crest width of 25 feet, side slopes of 1.5H:1V,[1] 10 feet of freeboard, and 20 feet of foundation preparation (undercut). Material take-off estimates were calculated for each dam structure assuming a crest elevation 10 feet higher than the maximum reservoir elevation. Table 1.4-1 is a summary of estimated dam, reservoir, and embankment features.

Table 1.4-1: Dams, Reservoirs, and Embankments

Lower Reservoir Embankment	
Type	Concrete-faced rockfill embankment
Height	Approximately 205 feet (max)
Length	Approximately 6,100 feet (max)
Crest Elevation	590 feet
Fill volume	6,700,000 CYs
Lower Reservoir	
Surface Area at Maximum Pool	Approximately 63 acres
Active Storage Capacity	7,100 AF and 14,745 MWh
Maximum Normal Pool Elevation	580 feet
Upper Reservoir Embankment	
Type	Concrete-faced rockfill embankment
Height	Approximately 175 feet (max)
Length	Approximately 8,000 feet (max)
Crest Elevation	2,950 feet
Upper Reservoir	
Surface Area at Maximum Pool	Approximately 61 acres
Active Storage Capacity	7,100 AF and 14,745 MWh
Maximum Normal Pool Elevation	2,940 feet

AF = acre-feet; cfs = cubic feet per second; CY = cubic yard; MW = megawatt; MWh = megawatt-hour

In addition to the features included Table 1.4-1 above, other features that will be evaluated during the final design include (but are not limited to) low-level outlet size and location (if required), reservoir liner type, and freeboard. The final arrangement of Project features will be based on required studies of topography, geology, hydrology seismic hazard consideration, functional requirements, and appearance.

[1] The slope ratio (H:V) formula is H:V, where HD is the horizontal distance and VD is the vertical distance.

1.5 Project Design Alternatives

Three preliminary energy storage Project arrangement alternatives were compared in an early study to evaluate the cost-benefit of various reservoir sizes. These alternatives all represent a total generating capacity of 1,200 megawatts (MW), which is considered most appropriate for the site and market conditions. The objective of this alternative evaluation was to select one of the alternatives for refinement into the preferred general arrangement presented in this license application.

- **Alternative 1**: Active storage of 7,100 AF allowing for approximately 12 hours of continuous run time at full generating output of approximately 1,200 MW. This alternative is presented in Figure 1.5-1.
- **Alternative 2**: Active storage of 11,800 AF allowing for approximately 20 hours of continuous run time at full generating output of approximately 1,200 MW. This alternative is presented in Figure 1.5-2.
- **Alternative 3**: Active storage of 4,800 AF allowing for approximately 8 hours of continuous run time at full generating output of approximately 1,200 MW. This alternative is presented in Figure 1.5-3.

Figure 1.5-4 shows the Project profile that is representative of all the above alternatives. Any inconsistencies in Project arrangement and Project Boundary to the Project description and arrangement presented in the exhibits of this license application are due to the preliminary nature of the evaluated alternatives.

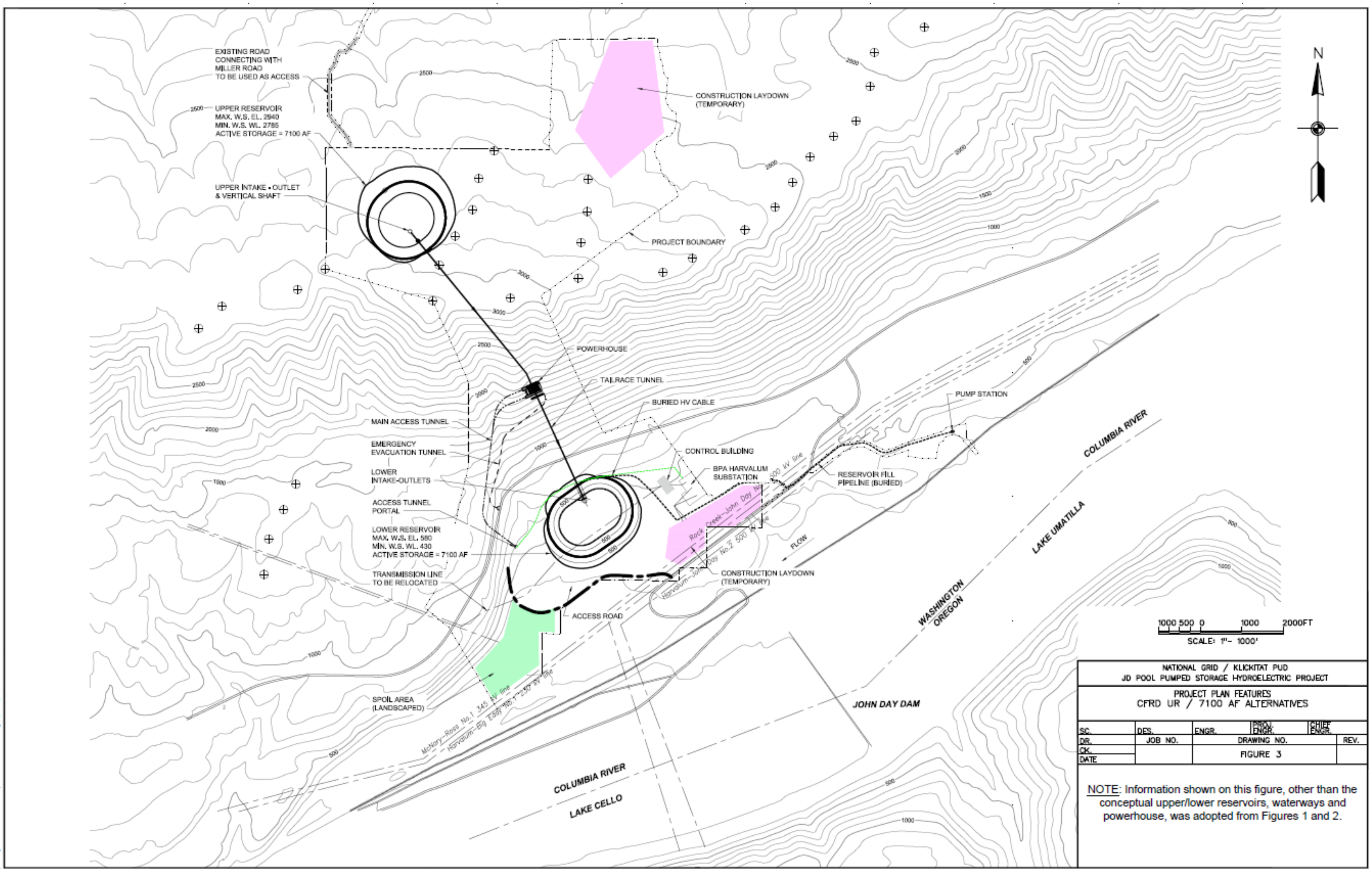


Figure 1.5-1: Goldendale Energy Storage Project General Arrangement—Alternative 1—Plan

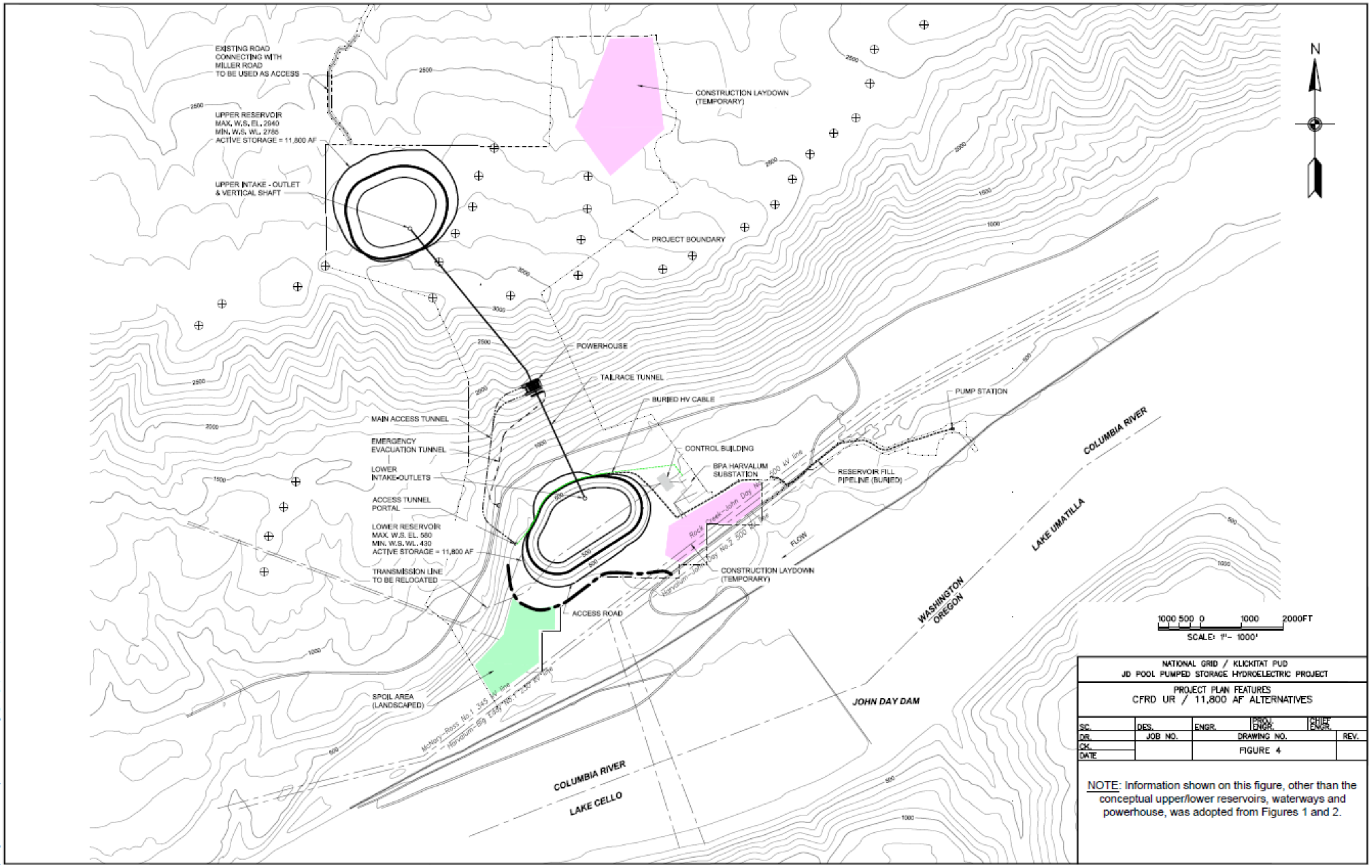


Figure 1.5-2: Goldendale Energy Storage Project General Arrangement—Alternative 2—Plan

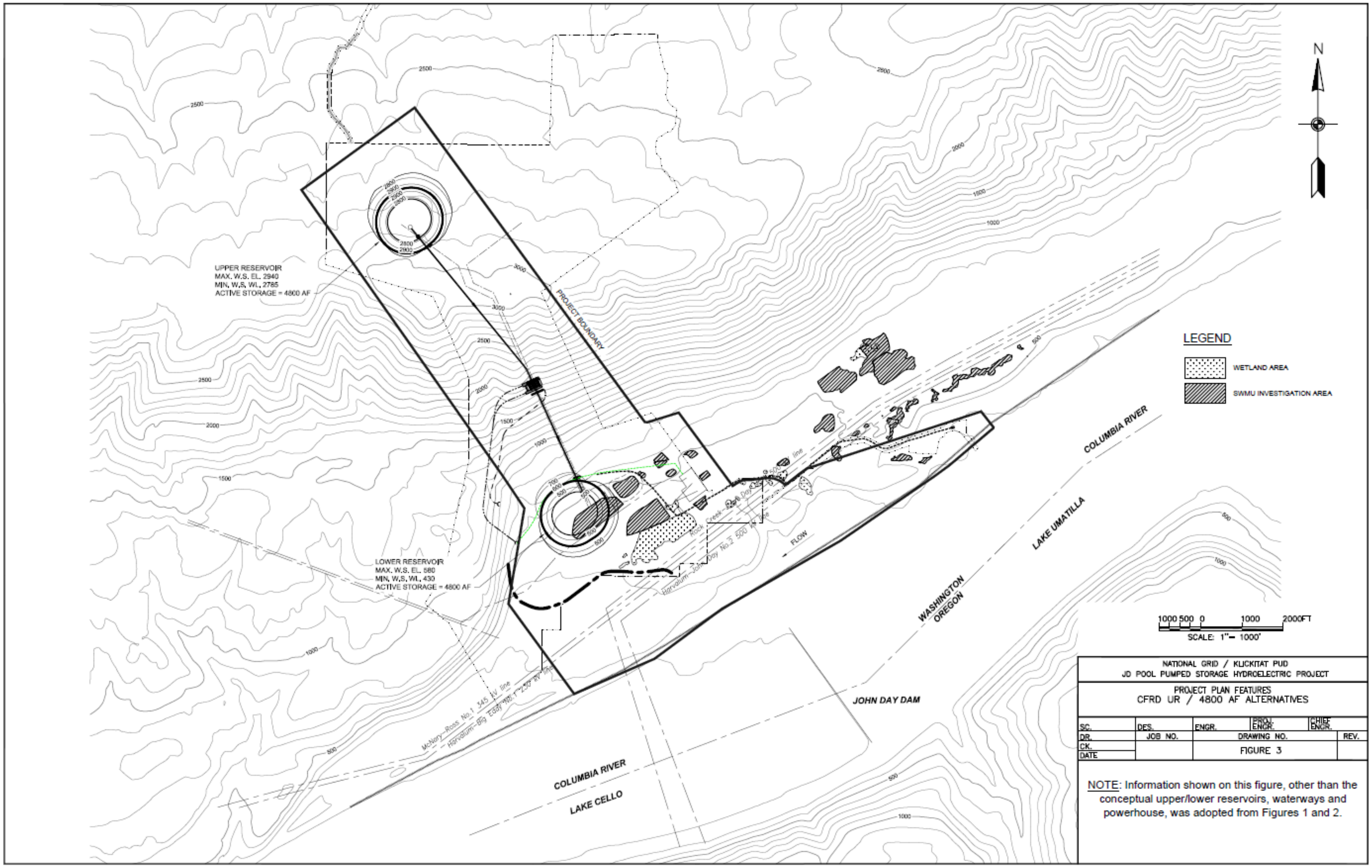


Figure 1.5-3: Goldendale Energy Storage Project General Arrangement—Alternative 3—Plan

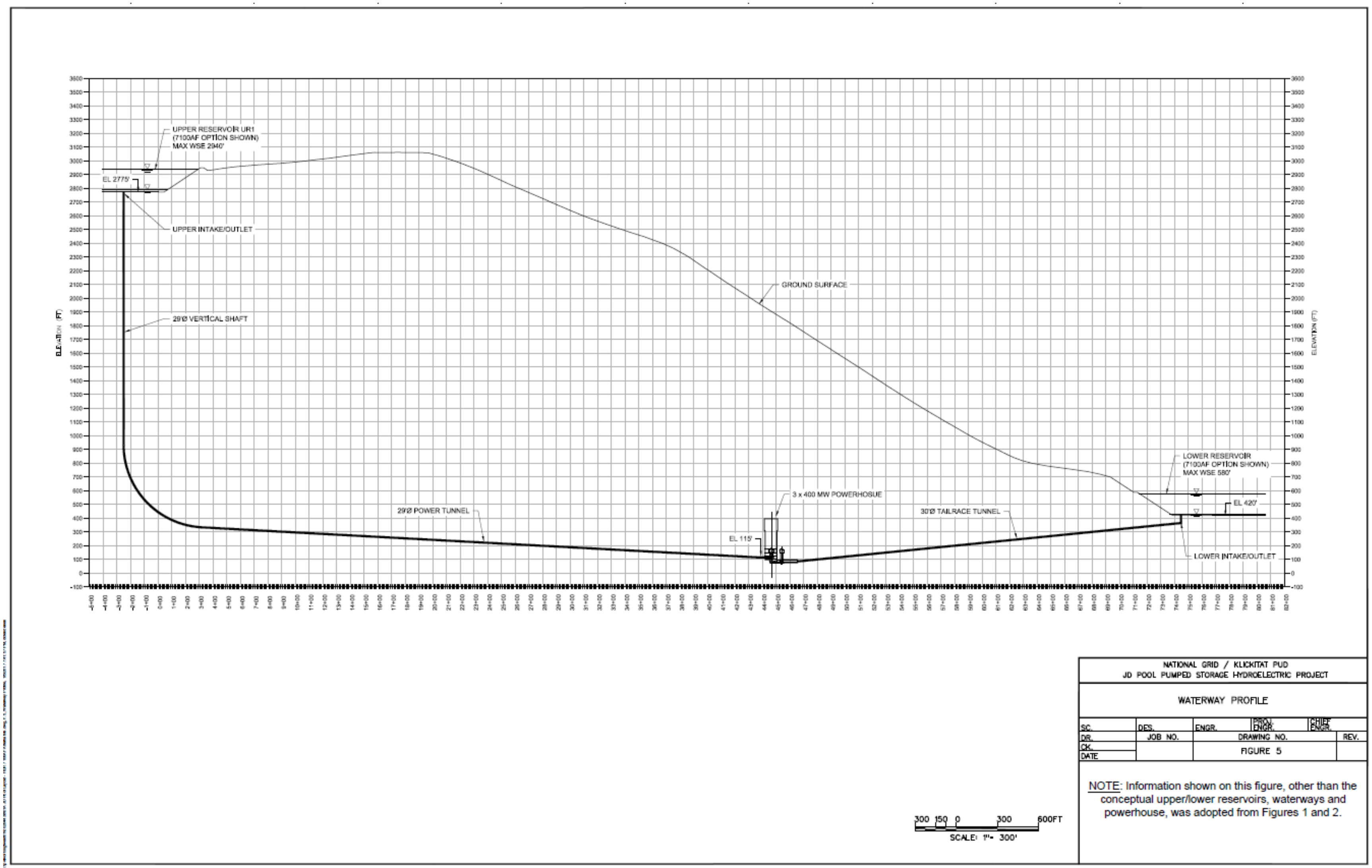


Figure 1.5-4: Goldendale Energy Storage Project General Arrangement—Typical Profile

1.5.1 Selected Alternative Arrangement

Based on the results of the alternative evaluation described above, the Project team selected Alternative 1 (Figure 1.5-1) with an active storage size of 7,100 AF of water representing an energy storage capacity of approximately 14,745 megawatt-hours (MWh), or 12 hours of operation at 1,200 MW of power generation. This selected Project size will balance the regional need for capacity while still providing sufficient storage capacity to facilitate load shifting and energy arbitrage.

Alternative 1 was subsequently further refined into the Project description and exhibits presented in this original license application, including a revised and refined proposed Project Boundary, to which all studies and surveys performed for this license application were bound.

2.0 DESIGN OF WATER MANAGEMENT

A nominal (minimal) reservoir dewatering system was assumed necessary to facilitate reservoir construction. The reservoirs will be lined to prevent seepage/leakage.

There is no contributing drainage basin other than the reservoirs themselves, and both upper and lower reservoirs were assumed to contain identical active storage volumes. In the extremely unlikely event of an overpumping scenario, the water level in the lower reservoir will quickly result in a lack of water for the pumps, which, consequently, will shut off and limit any overpumping to a very small volume. For these reasons, it is assumed that a spillway will not be required at either the upper or the lower reservoir. In addition, the lower reservoir will be sized to also contain, in addition to the active storage volume, the dead storage of the upper reservoir and the volume of water within the conveyance system.

3.0 TURBINES, GENERATORS, AND POWERHOUSE

The rated (average) gross head of the Project is 2,360 feet, and the estimated maximum generating discharge is 8,280 cubic feet per second. The rated total installed capacity is 1,200 MW (3 × 400 MW). The Project will utilize Francis-type variable-speed, pump-turbine units with an overall cycle efficiency for pumping and generating of approximately 80 percent and a power factor of 0.9. The estimated annual generation for 8 hours a day, 7 days a week is 3,500 gigawatt-hours. Economic modeling, cost-benefit analysis, system need, and market will determine the final optimal size and configuration.

The powerhouse will be located underground between the upper and lower reservoirs in order to minimize the rock cover needed for tunnels. The location will be largely dictated by maximum unit centerline elevation (submergence below minimum normal lower reservoir level), geological characteristics, construction constraints and cost-related preferences associated with tunneling, and an acceptable hydraulic layout and configuration of the water conveyance tunnels. The powerhouse cavern dimensions will be approximately 450 feet long by 80 feet wide (0.83 acre) by 150 feet high. Intermediate step-up transformers (18/115 kV) will be housed in a separate transformer gallery cavern adjacent to the underground powerhouse. The step-up transformer cavern dimensions will be approximately 350 feet long by 60 feet wide (0.48 acre) by 60 feet high. The same cavern may also house the draft tube gates. Table 3-1 shows estimated design features of the underground water conductors and penstock.

Table 3-1: Underground Water Conductors and Penstock Details

Water Conveyance Segment	Approximate Length (feet)	Assumed Finished Shape	Lining Type	Internal Diameter (feet)
Vertical shaft	2,200	Circular	Concrete	29
High pressure tunnel	3,300	Circular	Concrete	29
High pressure manifold tunnel	200	Circular	Concrete	22
Unit penstocks	600	Circular	Steel/concrete	15
Draft tube tunnel	200	Circular	Steel	20
Low pressure tunnel	200	Circular	Concrete	26
Tailrace tunnel	3,200	Circular	Concrete	30

4.0 TRANSMISSION LINES

High voltage (115 kV) transmission lines will be routed from the transformer gallery in a combined access and transmission tunnel to an outdoor 115/500 kV substation and switchyard near the lower reservoir, from which a 500-kV transmission line will be routed to the interconnection location. The outdoor 115/500 kV substation/ switchyard size will be approximately 800 feet by 400 feet (7.3 acres).

The location, number of circuits, voltage, and configuration of the proposed Project's interconnection with the regional electric utility network will be finalized in conjunction with BPAs transmission planning group. Based on BPAs 2017 Feasibility Study for the proposed Project, the John Day Substation is the preferred connection point for interconnection into BPA's transmission system. Additional details will be developed during the design phase of the proposed Project.

5.0 OTHER FEATURES

The embankments forming the upper and lower reservoirs will include instrumentation such as movement monuments, extensometers, and piezometers (as well as other instrumentation) to monitor the performance of the structures at all times. General access along the toe of both the upper and lower embankments will facilitate periodic inspections and monitoring of equipment.

6.0 PROPOSED PROJECT CAPACITY AND PRODUCTION POTENTIAL

The powerhouse is planned to include three reversible, variable speed pump/turbine motor/generator units, each having a rated generating capacity of 400 MW for a total installed rated capacity of 1,200 MW. As a closed-loop pumped storage plant, the plant capacity (1,200 MW) will be dependable capacity. The upper reservoir will be capable of storing approximately 14,745 MWh of energy. The rated (average) gross head of the Project is 2,360 feet and the estimated maximum discharge is 8,280 cubic feet per second. Economic modeling, cost-benefit analysis, system need, and market will determine the optimal size and configuration for Project operations. The estimated annual generation for 8 hours a day, 7 days a week is 3,500 gigawatt-hours.