

The Powerless Pump

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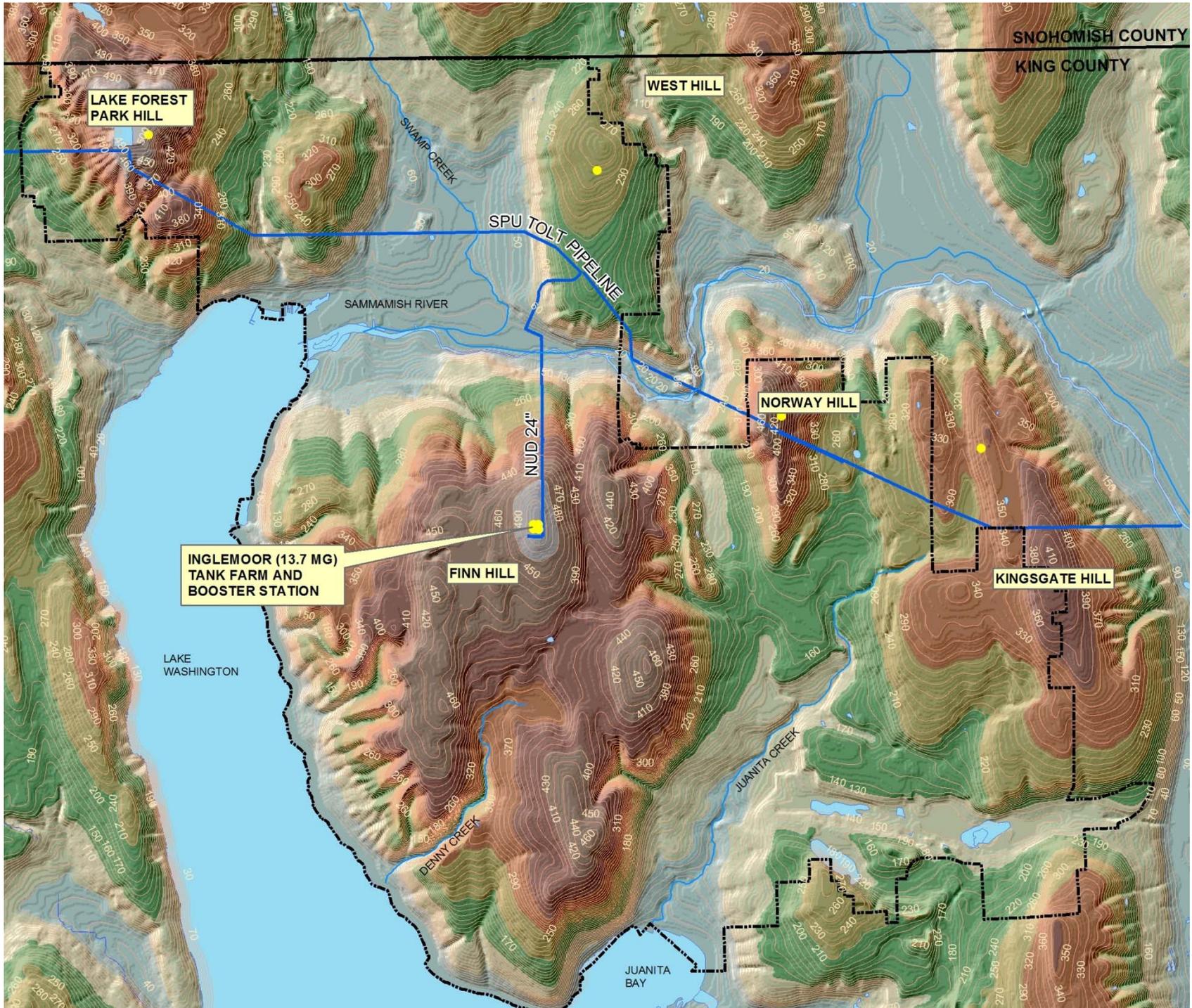


Gray & Osborne, Inc.
CONSULTING ENGINEERS

Project Background

- ▶ Northshore Utility District
 - Located northeast of Seattle on Lake Washington
 - Serves five cities and unincorporated King County.
 - Approximately 19,000 connections and 72,000 people.
- ▶ Purchases 100 percent of its supply from Seattle Public Utilities (SPU)
- ▶ Majority of supply is delivered via the Tolt Pipeline, located in the north part of the District.
- ▶ Approximately 60 percent of customers are served by the Inglemoor Tank Farm, located south of the Sammamish River.





SNOHOMISH COUNTY

KING COUNTY

LAKE FOREST
PARK HILL

WEST HILL

SPU TOLT PIPELINE

SAMMAMISH RIVER

SNUAMP CREEK

NORWAY HILL

INGLEMOOR (13.7 MG)
TANK FARM AND
BOOSTER STATION

FINN HILL

NUD 24"

KINGSGATE HILL

LAKE
WASHINGTON

JUANITA CREEK

DENNY CREEK

JUANITA
BAY

Inglemoor Tank Farm

- ▶ Site has approximately 13.7 MG of storage.
 - 3.0 MG standpipe serves the local pressure zone with an overflow elevation of 601 feet.
 - 10.7 MG of low level storage (537-foot overflow elevation).
- ▶ Site is supplied by a 24-inch supply main that connects directly to the SPU Tolt Pipeline, approximately two miles to the north.
- ▶ Site has a pump station with 9,000 gpm nominal capacity that pumps from low level reservoirs to the standpipe and local zone.



Existing Operation

- ▶ Standpipe sets grade for the site
 - (601' overflow elevation)
- ▶ Pumps operate on fill and draw of the Standpipe.
 - Pump from low level reservoirs (537' overflow elevation) to Standpipe.
 - Also serve to provide turnover in low level reservoirs.
- ▶ Low level reservoirs are supplied on fill and draw from 24-inch supply line from the Tolt Pipeline.
 - Controlled by a 16-inch Cla-Val.
- ▶ If supply pressure from the Tolt is high enough, a 16-inch Cla-Val can supply zone and standpipe directly.
 - District operates this on fill and draw.
 - Does create stagnation in low level reservoirs if over-used.



Site Facilities



Inglemoor Tank Farm



SPU Supply Main

Inglemoor Tank Farm



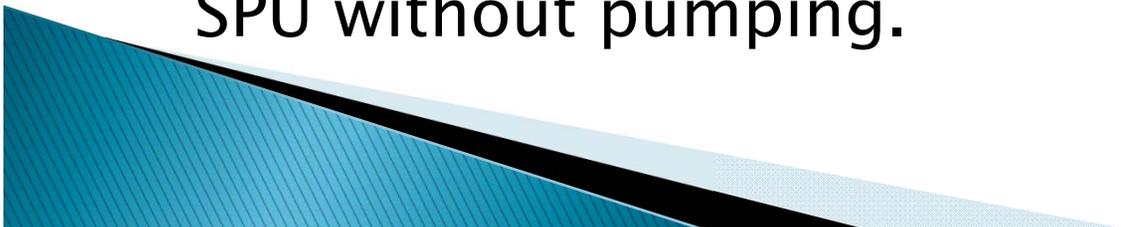
Booster Station



Booster Station

Changing Conditions

- ▶ Historically, SPU could not provide a consistent delivery pressure, especially in summer months, making a large capacity pump station necessary.
- ▶ SPU has made improvements in last decade to stabilize delivery pressure. SPU delivers HGL of approximately 700' most of the year.
 - Tolt Filtration Plant – Created consistent source delivery pressure.
 - Tolt II Pipeline – Lower transmission head loss and improved pressure reliability.
- ▶ Conservation has led to decreasing demands on both SPU regional system and local NUD system.
- ▶ District found it could meet vast majority of demand conditions through direct supply from SPU without pumping.



Problem

- ▶ How to balance water quality concerns in the reservoirs while reducing energy cost?
- ▶ Solution: Cornell Turbine-Pump





How it Works

- ▶ Turbine operates as a centrifugal pump in reverse.
 - High supply head flows through the turbine driving a shaft.
- ▶ Shaft drives a centrifugal pump coupled at the opposite end of the turbine.
- ▶ No motor or any other electrical.
- ▶ Operates similar to a VFD in that there are an infinite number of curves, depending on the operating frequency.
 - Head conditions of the turbine and pump determine operating frequency.

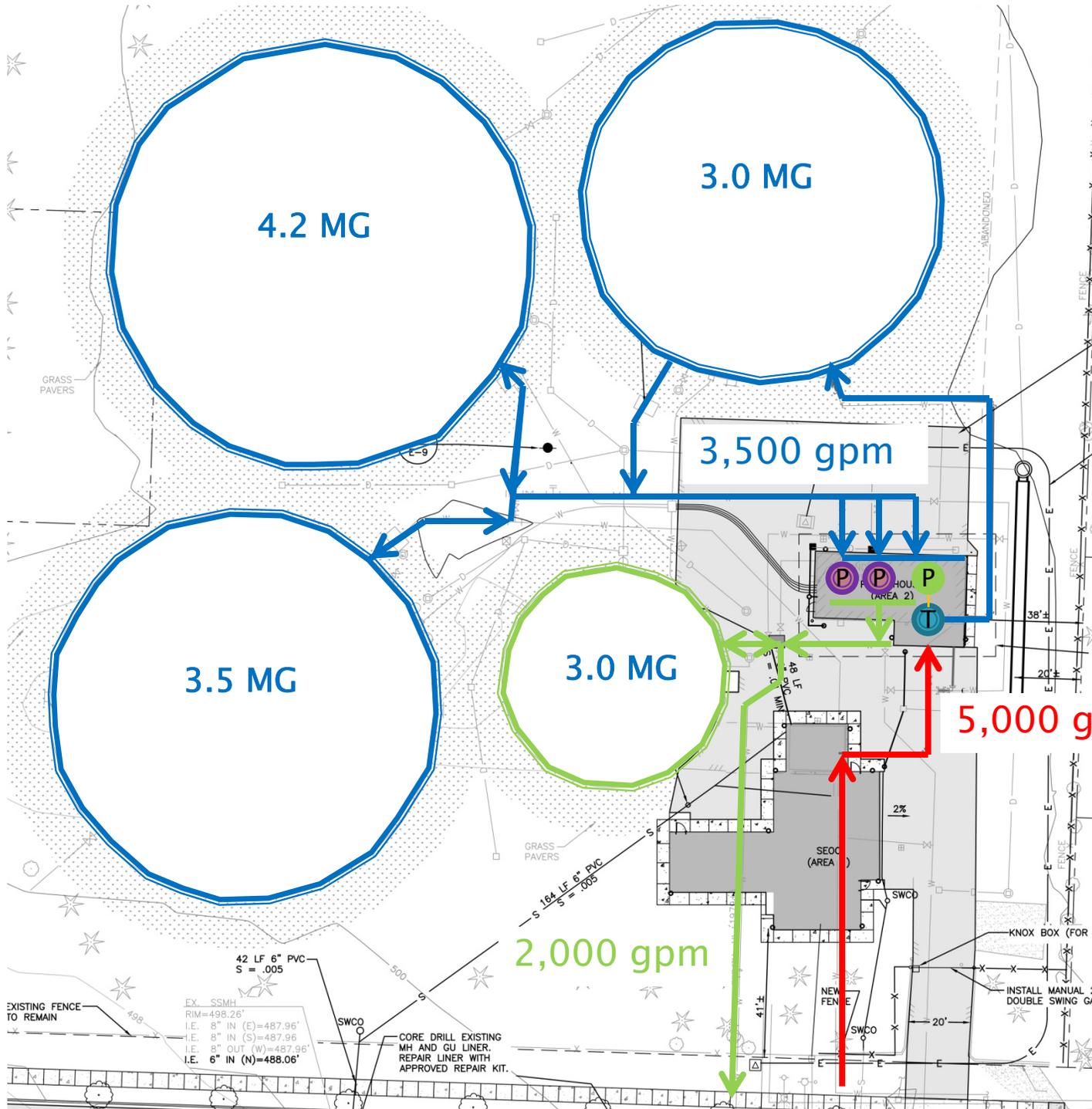


How it Works

- ▶ Supply from SPU diverted to turbine.
- ▶ Turbine design flow rate of approximately 5,000 gpm.
- ▶ Flow through turbine piped to Reservoir No. 1 inlet.
- ▶ Pump is supplied from common reservoir outlet piping.
- ▶ Pump has a design flow rate of approximately 3,500 gpm.
- ▶ Achieves goal of exercising reservoirs and reducing power consumption.
- ▶ Since more flow goes to reservoirs than is pumped to the Standpipe, electric pumps must be used to draw down reservoirs.



Turbine Pump Operation



- HGL - 537
- HGL - 601
- SPU HGL

42 LF 6" PVC
S = .005

EX. SSMH
RIM=498.26'
I.E. 8" IN (E)=487.96'
I.E. 8" IN (S)=487.96'
I.E. 8" OUT (W)=487.96'
I.E. 6" IN (N)=488.06'

EXISTING FENCE TO REMAIN

CORE DRILL EXISTING MH AND GU LINER. REPAIR LINER WITH APPROVED REPAIR KIT.

2,000 gpm

3,500 gpm

5,000 gpm

NEW FENCE

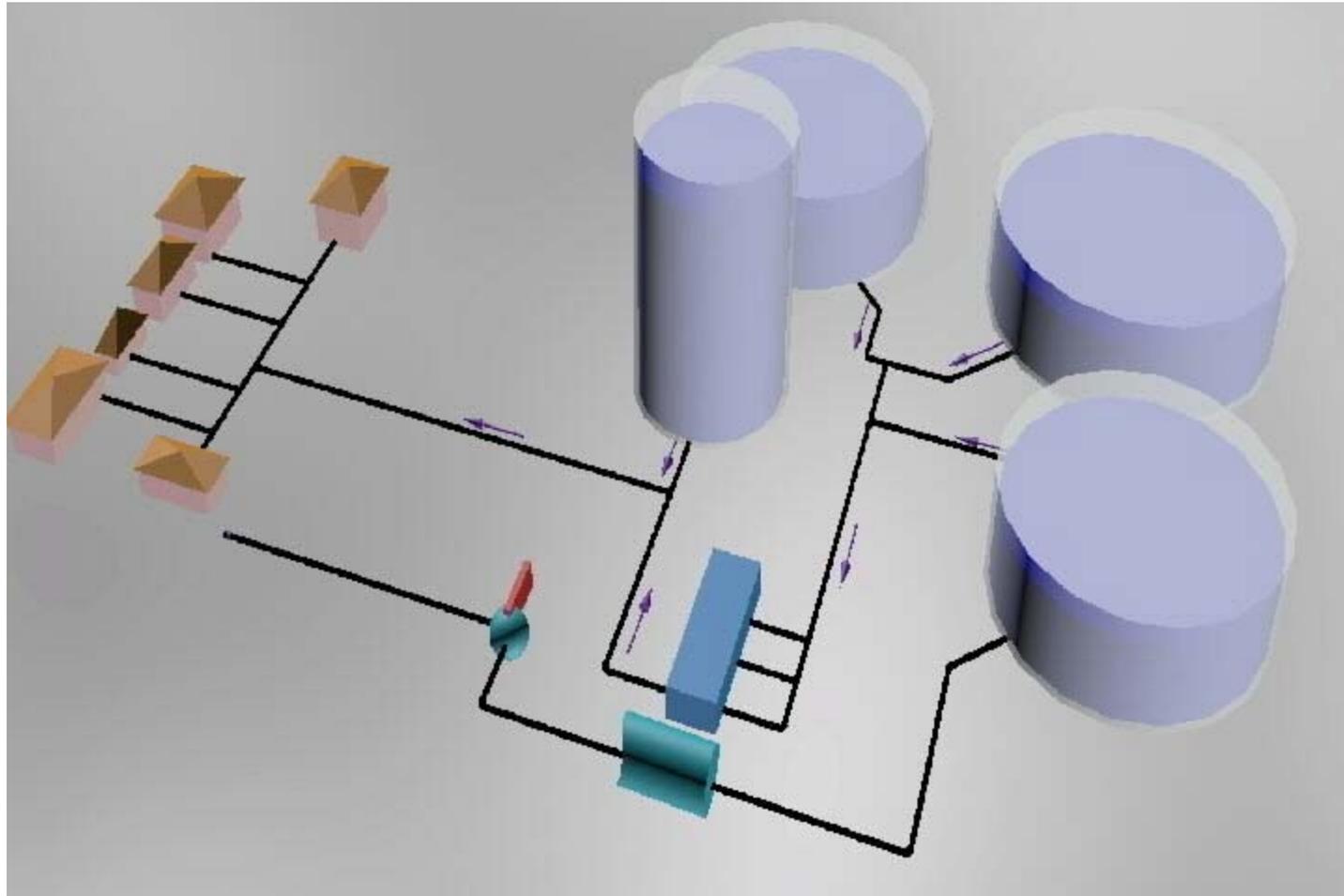
INSTALL MANUAL DOUBLE SWING GA

KNOX BOX (FOR

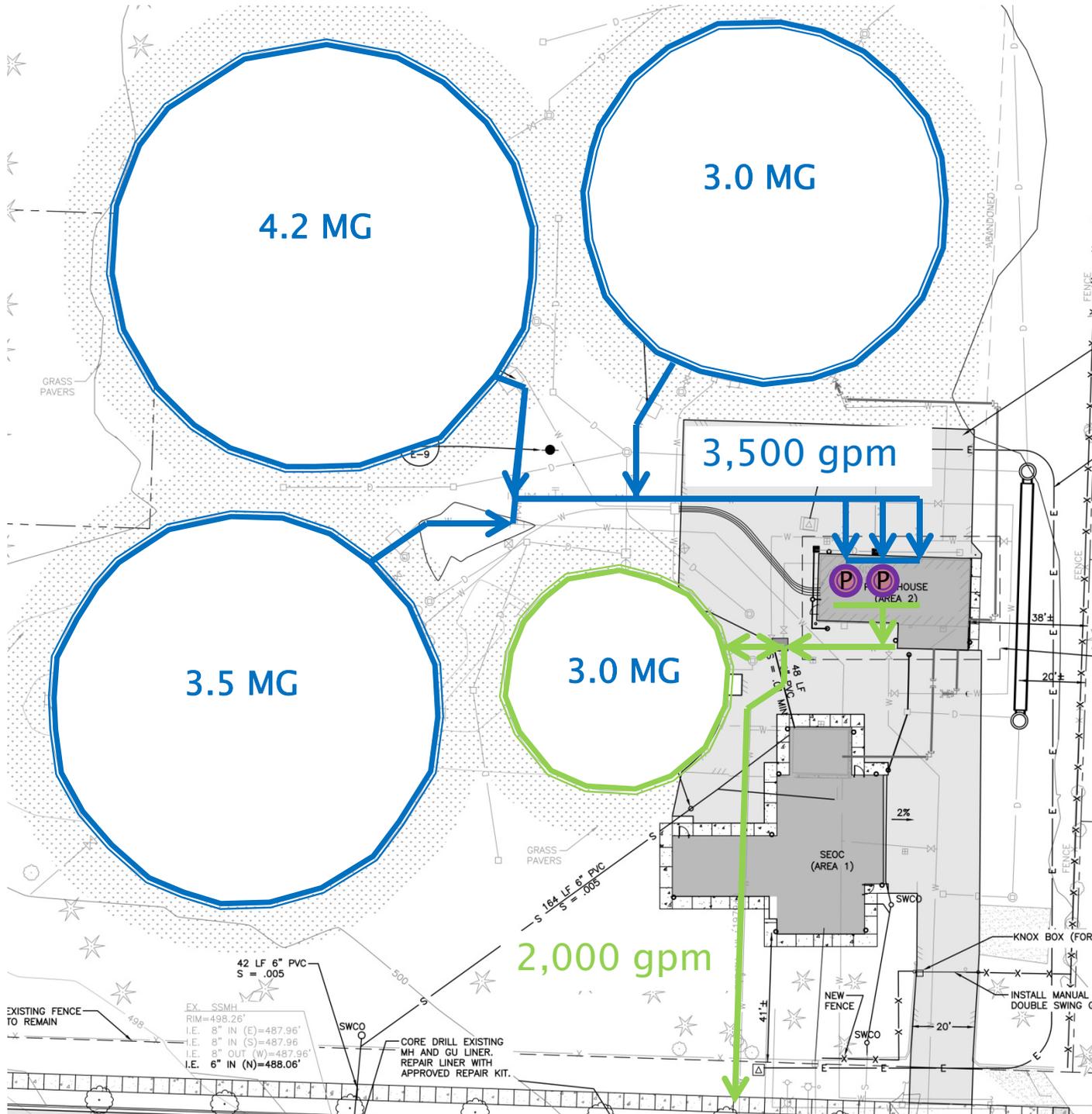
SEOC (AREA)

SWCO

ABANDONED



Reservoir Draw Operation



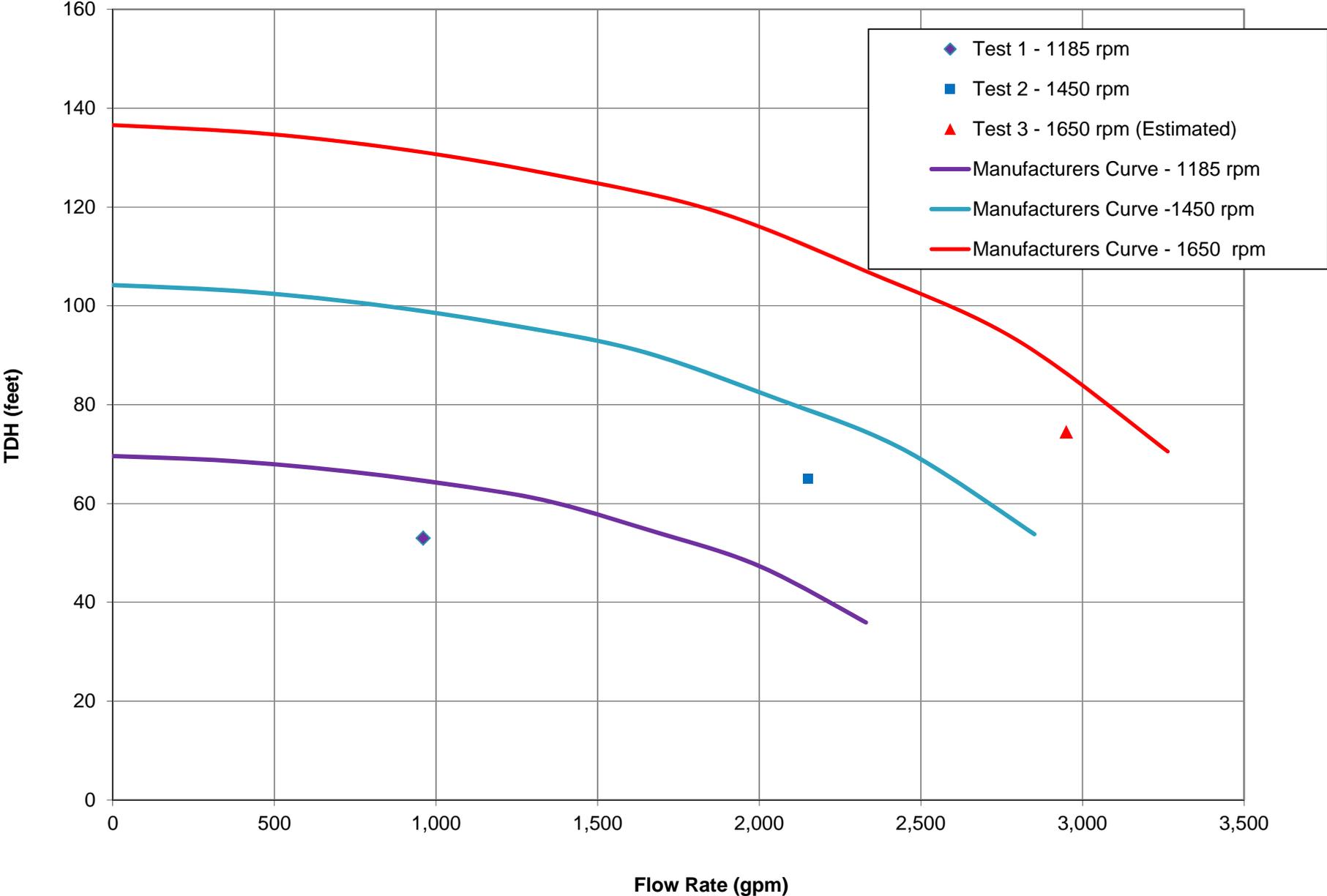
- HGL - 537
- HGL - 601
- SPU HGL

Construction

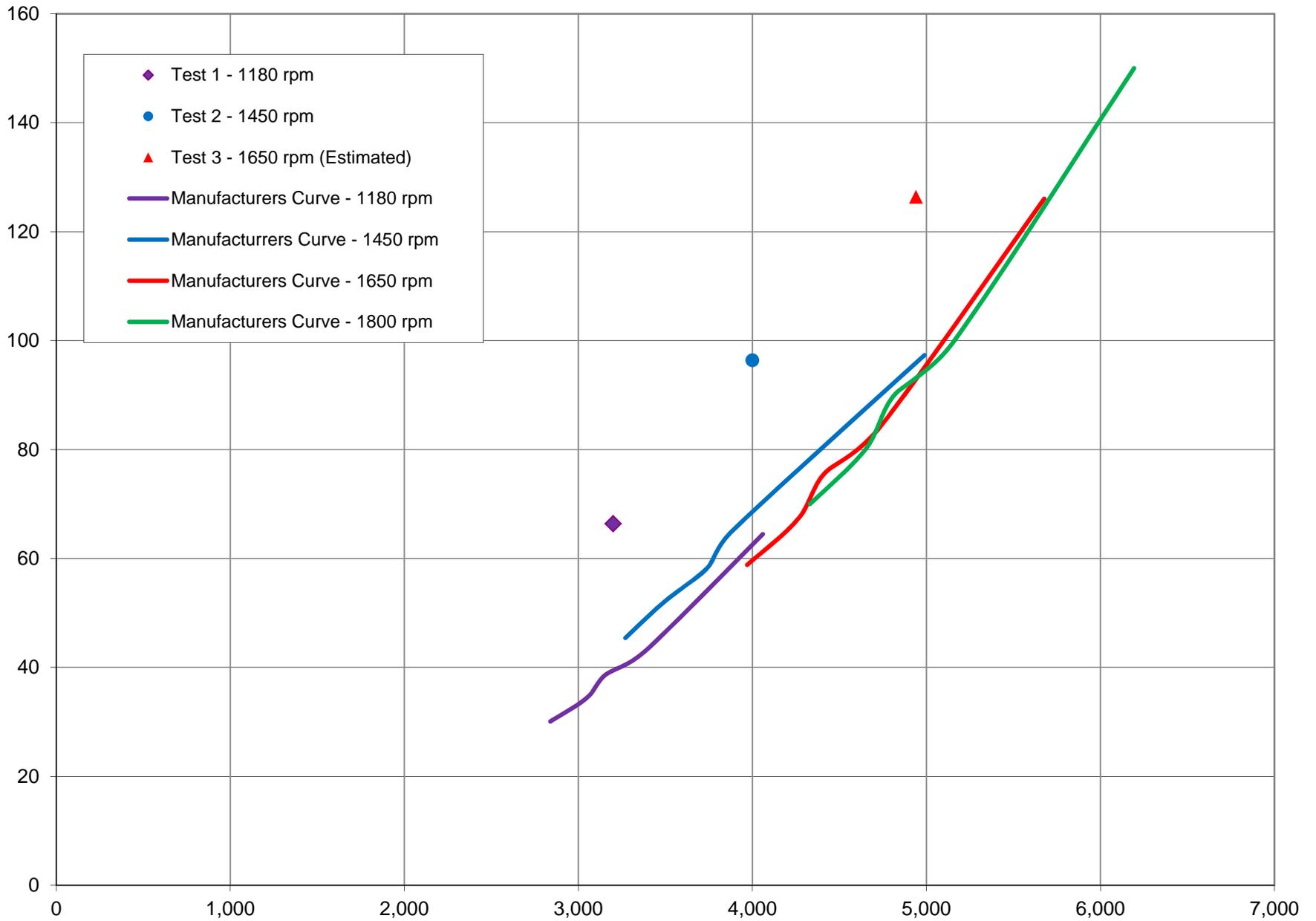
- ▶ Approximately 200 LF of 16-inch and 18-inch site piping and fittings.
- ▶ 16-inch butterfly valve with motor operated actuator.
- ▶ Turbine Pump.
- ▶ Total cost – \$300,000



PUMP CURVE TESTS RESULTS



TURBINE CURVE TEST RESULTS



Project Pay-back

- ▶ Plan to reduce pumping power consumption on site by approximately 660 kWh per day.
- ▶ Annual savings is estimated at approximately \$22,000.
- ▶ Based on \$300,000 cost, pay-back is approximately 14 years.



Conclusions

- ▶ Able to use existing head provided by SPU to District advantage.
- ▶ No FERC licensing issue, utility company involvement, inverters, or any electrical requirements, other than MOV.
- ▶ Unique application, may not be applicable in other locations.
- ▶ District looking at other hydro-turbine opportunities at its other SPU connections.



Questions?



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