

APPENDIX C

City of Santa Rosa – Pump Replacement Evaluation at
Stations S14 and S13 TM – July 9, 2013

TECHNICAL MEMORANDUM

DATE: July 9, 2013 Project No.: 405-02-11-31

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SUBJECT: City of Santa Rosa – Pump Replacement Evaluation at Stations S14 and S13

This technical memorandum (TM) summarizes West Yost Associates (West Yost) hydraulic evaluation of the City of Santa Rosa's (City) Pressure Zones R14 and R13, as it relates to the replacement of pumps at Stations S14 and S13. The City is planning to replace the two large 700 gallon per minute (gpm) pumps at Station S14 in order to meet the minimum required 1,500 gpm fire flow demand in this high fire severity zone (PZ R14). The City requested that West Yost develop system curves for Station S14 to assist in pump selection. Because PZ R14 is supplied from Pressure Zone R13 (PZ R13), the City also requested West Yost develop system curves for Station S13.

HYDRAULIC EVALUATION AND PUMP PERFORMANCE REQUIREMENTS

The most efficient method of developing a system curve for Station S14 and Station S13 is to run the City's existing water system hydraulic model under both current and projected future demand scenarios. The hydraulic evaluation was performed using the City's updated water model developed in 2007. Analyzing the water system under a range of operating conditions quickly provides the various operational conditions which must be met by the new pumps, creating a selection envelope for suitable pumps. The following sections discuss hydraulic model assumptions and methods used to establish pump performance requirements.

Pump Performance Requirements

Station S14 and Station 13 were evaluated using the City's updated water model under existing system and future system demands. For each system condition, the pump station was modeled under both maximum head and minimum head conditions to develop system curves that bracket anticipated pump operation. Assumptions for the maximum and minimum head conditions, and fire flow conditions, are tabulated in Table 1.

Table 1. Hydraulic Conditions for Pump Curve Development^(a,b)

Hydraulic Conditions	Station S14	Station S13
Maximum Head Conditions	<ul style="list-style-type: none"> • Existing and Future Average Day Demand (ADD) Conditions • Low Reservoir Level at Station R13 (12.8 feet or 40% full; 819.8 feet hydraulic grade line (HGL)) • High Reservoir Level at Station R14 (24 feet or 100% full; 1024.5 feet HGL) • S13 Station Offline 	<ul style="list-style-type: none"> • Existing and Future ADD Conditions • Low Reservoir Level at SCWA Annadel Tank 1 (24 feet or 50% full; 545 feet HGL) • Low Reservoir Level at SCWA Annadel Tank 2 (35.17 feet or 73% full; 551.17 feet HGL) • High Reservoir Level at Station R13 (32 feet or 100% full; 839 feet HGL) • S12 Station Offline • S14 Station Offline • Sonoma County Booster Pump Offline
Minimum Head Conditions	<ul style="list-style-type: none"> • Existing and Future Peak Hour Demand (PHD) Conditions • High Reservoir Level at Station R13 (32 feet or 100% full; 839 feet HGL) • Low Reservoir Level at Station R14 (9.6 feet or 40% full; 1010.1 feet HGL) • S13 Station Offline 	<ul style="list-style-type: none"> • Existing and Future PHD Conditions • High Reservoir Level at SCWA Annadel Tank 1 (34.28 feet or 71% full; 555.28 feet HGL) • High Reservoir Level at SCWA Annadel Tank 2 (45.53 feet or 95% full; 561.53 feet HGL) • Low Reservoir Level at Station R13 (12.8 feet or 40% full; 819.8 feet HGL) • S12 Station Offline • One Pump at S14 Station Online Producing 716 gpm • Sonoma County Booster Pump Offline
Fire Flow Condition	<ul style="list-style-type: none"> • Existing and Future Maximum Day Demand (MDD) Conditions • 1,500 gpm fire flow demand • Low Reservoir Level at Station R14 (9.6 feet or 40% full; 1010.1 feet HGL) • High Reservoir Level at Station R13 (32 feet or 100% full; 839 feet HGL) • S13 Station Offline 	<ul style="list-style-type: none"> • Existing and Future MDD Conditions • 1,500 gpm fire flow demand • High Reservoir Level at SCWA Annadel Tank 1 (34.28 feet or 71% full; 555.28 feet HGL) • High Reservoir Level at SCWA Annadel Tank 2 (45.53 feet or 95% full; 561.53 feet HGL) • Low Reservoir Level at Station R13 (12.8 feet or 40% full; 819.8 feet HGL) • S12 Station Offline • One Pump at S14 Station Online Producing 626 gpm • Sonoma County Booster Pump Offline

^(a) City's reservoir levels were based on July 2007 SCADA data.

^(b) SCWA's reservoir levels were based on August and September 2007 SCADA data.

System Curves

To develop the system curves, all pumps at Stations S14 and S13 were closed, and flows were taken out at the suction side of the pump station and injected at the discharge side of the pump station. Minor losses for pump station piping were not included in the model.

Station S14

Figure 1 presents the system curves for Station S14. Because existing and future demands in PZ R14 are smaller than the fire flow demand requirement for this pressure zone, the pumps should be selected and designed for maximum day demand plus fire flow demand conditions. Table 2 summarizes the system operational conditions at Station S14 used to bracket the system conditions shown previously on Figure 1.

After developing the system curves, for illustrative purposes only, West Yost used the Goulds manufacture pump selection applicator to identify two 800 gpm Goulds pump curves that operate within the given system curve conditions for Station S14. Figures 2 and 3 illustrate how these Goulds pump curves would meet the system curve requirements for Station S14.

Station S13

System curves for Station S13 are presented on Figure 4. Similar to PZ R14, the existing and future demands in PZ R13 are smaller than the fire flow demand requirement; therefore, the pump station should be selected and designed to be able to supply the maximum day demand plus fire flow demand conditions. In addition, because Station S13 also supplies water to Station S14, Station S13 should have the capacity to deliver 1,500 gpm of fire flow demand to Station S14 during a fire flow event in PZ R14. Table 3 presents the system operational conditions at Station S13 used to bracket the system conditions shown on Figure 4.

After developing system curves for Station S13, again for illustrative purposes only, West Yost also looked into providing example pump curves from the Goulds manufacture pump selection applicator to identify two 800 gpm example pump curves that can operate within the given system curve conditions for Station S13. Figures 5 and 6 illustrate how these Goulds pump curves would meet the system curve requirements for Station S13.

Table 2. Pump Station S14 System Curve Bracketing Conditions

Flow, gpm	Maximum Head Requirement (Existing ADD) ^(a)			Minimum Head Requirement (Future PHD) ^(b)			Fire Flow (Existing System MDDFF) ^(c)		
	Suction Pressure, psi	Discharge Pressure, psi	Total Dynamic Head, ft	Suction Pressure, psi	Discharge Pressure, psi	Total Dynamic Head, ft	Suction Pressure, psi	Discharge Pressure, psi	Total Dynamic Head, ft
0	6	94	205	14	87	170			
100	6	94	205	14	88	171			
200	5	95	206	14	88	172			
300	5	95	208	13	89	173			
400	5	96	210	13	89	175			
500	5	97	212	13	90	177			
600	5	98	215	13	91	179			
700	5	100	219	13	92	183			
800	5	102	223	13	93	186			
900	5	103	227	13	95	190			
1,000	5	105	232	12	96	194			
1,100	4	107	238	12	98	199			
1,200	4	110	243	12	100	204			
1,300	4	112	250	12	103	210			
1,400	4	115	256	11	105	216			
1,500	4	118	263	11	108	223	12	128	268

Discharge pressures above 100 psi are shown in red.

Notes:

^(a) Conditions / Assumptions for Existing System ADD Scenario:

- R13 Average Day Demand = 10 gpm
- R14 Average Day Demand = 16.3 gpm
- Reservoir R13 Minimum Operating Level = 12.8 feet (819.8 feet HGL)
- Reservoir R14 Maximum Operating Level = 24 feet (1024.5 feet HGL)
- S13 Pump Station Offline

^(b) Conditions / Assumptions for Future System PHD Scenario:

- R13 Peak Hour Demand = 396.8 gpm
- R14 Peak Hour Demand = 517.1 gpm
- Reservoir R13 Maximum Operating Level = 32 feet (839 feet HGL)
- Reservoir R14 Minimum Operating Level = 9.6 feet (1010.1 feet HGL)
- S13 Pump Station Offline

^(c) Conditions / Assumptions for Existing System MDDFF Scenario:

- R14 Maximum Day Demand = 32.5 gpm
- Fire Flow Demand = 1,500 gpm (2.16 mgd)
- Reservoir R13 Maximum Operating Level = 32 feet (839 feet HGL)
- Reservoir R14 Minimum Operating Level = 9.6 feet (1010.1 feet HGL)
- S13 Pump Station Offline

Table 3. Pump Station S13 System Curve Bracketing Conditions

Flow, gpm	Maximum Head Requirement (Existing ADD) ^(a)			Minimum Head Requirement (Future PHD) ^(b)			Fire Flow (Future System MDDFF) ^(c)		
	Suction Pressure, psi	Discharge Pressure, psi	Total Dynamic Head, ft	Suction Pressure, psi	Discharge Pressure, psi	Total Dynamic Head, ft	Suction Pressure, psi	Discharge Pressure, psi	Total Dynamic Head, ft
0	33	160	293	35	150	267			
100	33	160	294	34	151	269			
200	32	160	295	34	151	270			
300	32	161	297	34	151	272			
400	32	161	299	33	152	273			
500	31	162	301	33	152	275			
600	31	163	304	32	153	278			
700	31	163	307	32	153	281			
800	30	164	310	31	154	284			
900	30	166	314	30	155	287			
1,000	29	167	318	30	156	291			
1,100	29	168	322	29	157	295			
1,200	28	170	327	28	158	299			
1,300	27	171	332	28	159	304			
1,400	27	173	338	27	161	309			
1,500	26	175	344	26	162	315	29	160	303

Discharge pressures above 150 psi are shown in red.

Notes:

^(a) Conditions / Assumptions for Existing System ADD Scenario:

- R13 Average Day Demand = 10 gpm
- SCWA Minimum Operating Level - Annadel Tank 1 = 24 feet (545 feet HGL)
- SCWA Minimum Operating Level - Annadel Tank 2 = 35.17 feet (551.17 feet HGL)
- Reservoir R13 Maximum Operating Level = 32 feet (839 feet HGL)
- S12 Pump Station Offline
- S14 Pump Station Offline
- Sonoma County Booster Pump Offline

^(b) Conditions / Assumptions for Future System PHD Scenario:

- R13 Peak Hour Demand = 396.8 gpm
- SCWA Maximum Operating Level - Annadel Tank 1 = 34.28 feet (555.28 feet HGL)
- SCWA Maximum Operating Level - Annadel Tank 2 = 45.53 feet (561.53 feet HGL)
- Reservoir R14 Minimum Operating Level = 9.6 feet (1010.1 feet HGL)
- Reservoir R13 Minimum Operating Level = 12.8 feet (819.8 feet HGL)
- S12 Pump Station Offline
- One pump at S14 Online (724 gpm)
- Sonoma County Booster Pump Offline

^(c) Conditions / Assumptions for Future System MDDFF Scenario:

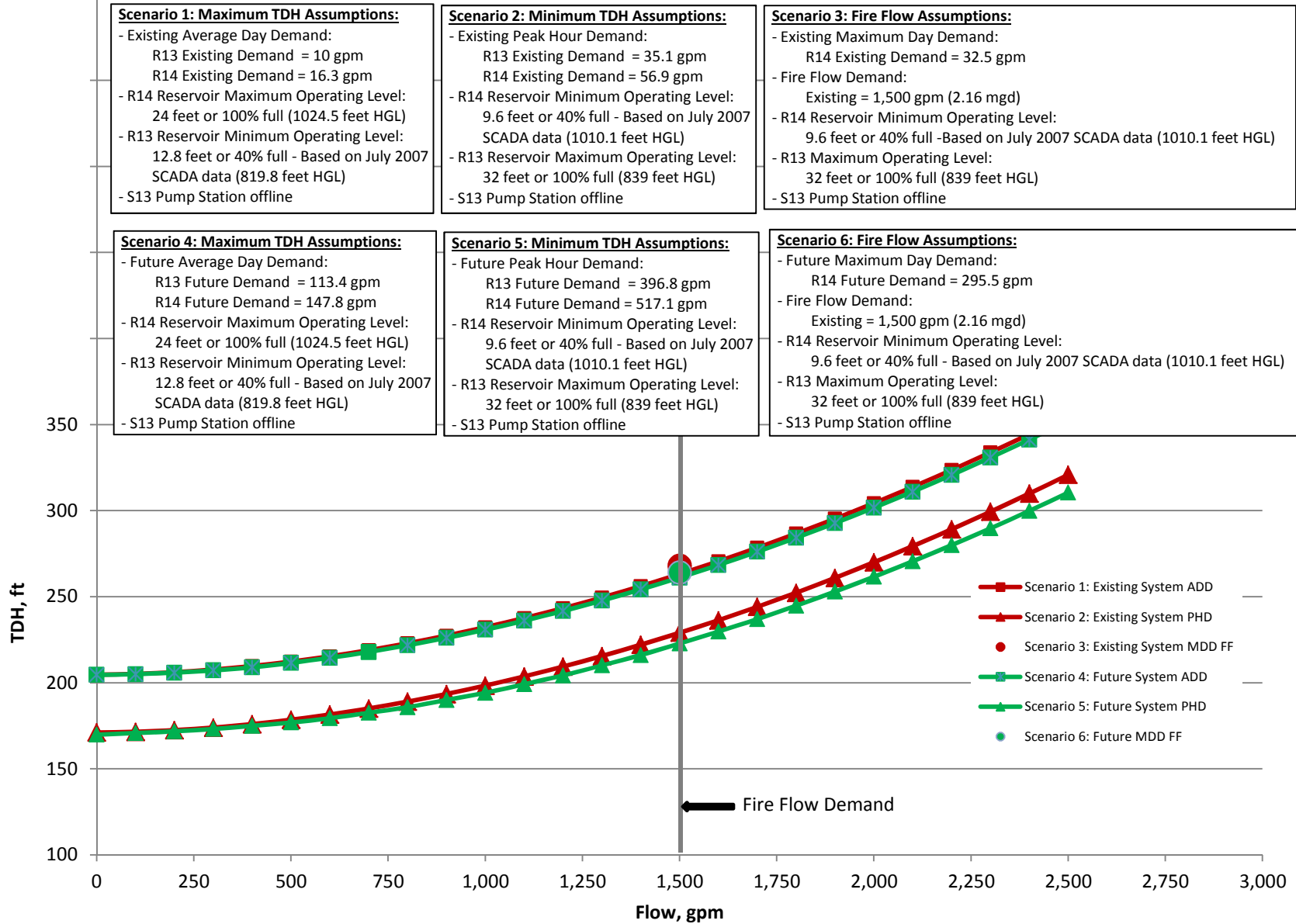
- R13 Maximum Day Demand = 226.8 gpm
- Fire Flow Demand = 1,500 gpm (2.16 mgd)
- SCWA Maximum Operating Level - Annadel Tank 1 = 34.28 feet (555.28 feet HGL)
- SCWA Maximum Operating Level - Annadel Tank 2 = 45.53 feet (561.53 feet HGL)
- Reservoir R14 Minimum Operating Level = 9.6 feet (1010.1 feet HGL)
- Reservoir R13 Minimum Operating Level = 12.8 feet (819.8 feet HGL)
- S12 Pump Station Offline
- One pump at S14 Online (721 gpm)
- Sonoma County Booster Pump Offline

FINDINGS AND RECOMMENDATIONS

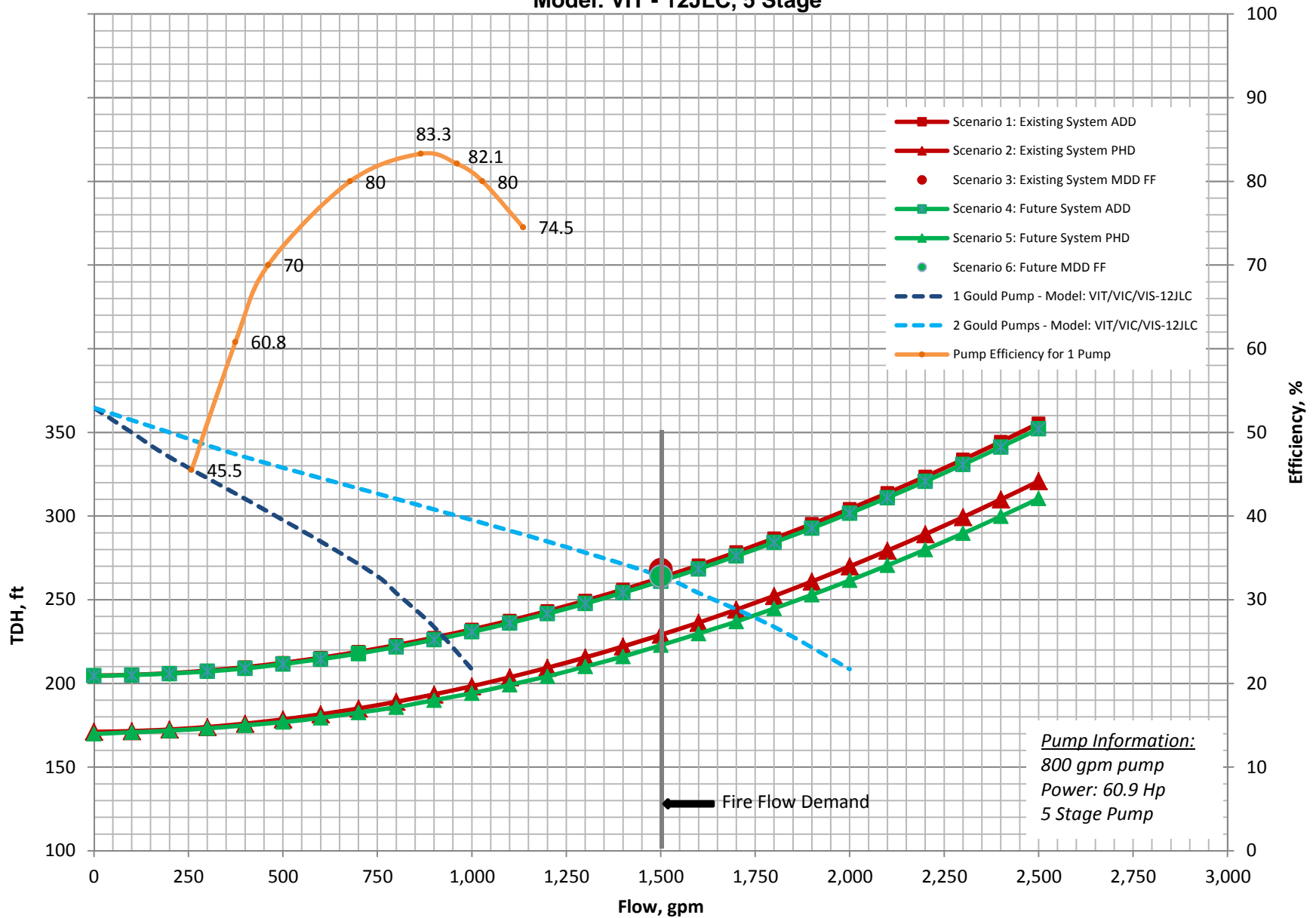
In summary, the results for these hydraulic evaluations indicate that each proposed pump at Station S14 and Station S13 would need to be sized at a minimum of 800 gpm design flow to meet fire flow requirements. A total of two identical, large pumps will be required to meet the total design capacity requirement.

Based on the hydraulic evaluation of the system curve, the two system conditions that bracket the pump selection are the existing system ADD and the future system PHD conditions. Note that for the existing system MDD plus fire flow conditions at Station S14, the total dynamic head at 1,500 gpm falls above the upper bracket. For Station S13, the future system MDD plus fire flow conditions falls below the lower bracket. The pumps selected for Stations S14 and S13 will need to meet the range of system conditions shown on Figures 1 and 4, respectively.

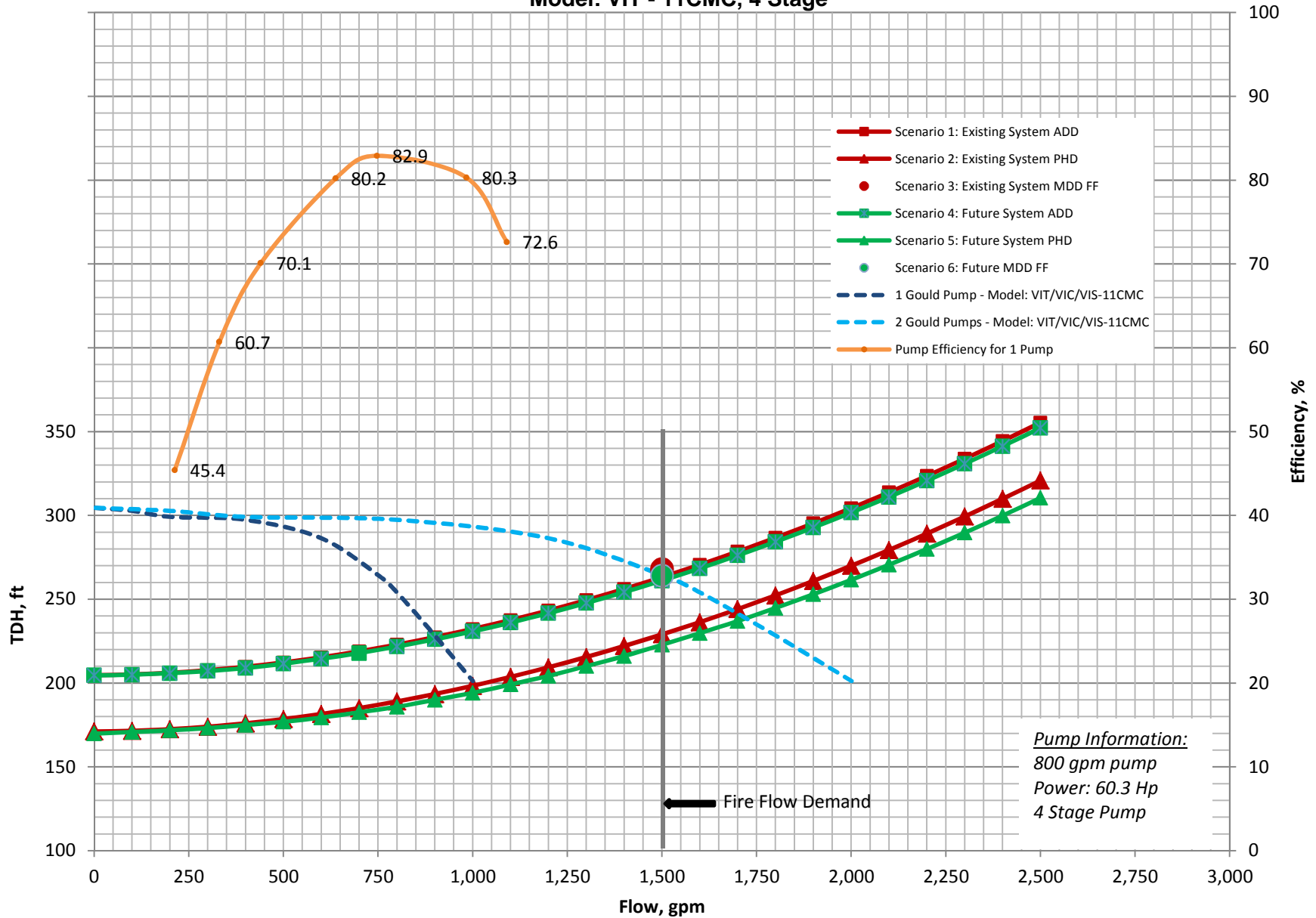
Figure 1. Pump Station S14 System Curves



**Figure 2. Example of Available Pump Curve from Goulds
Model: VIT - 12JLC, 5 Stage**

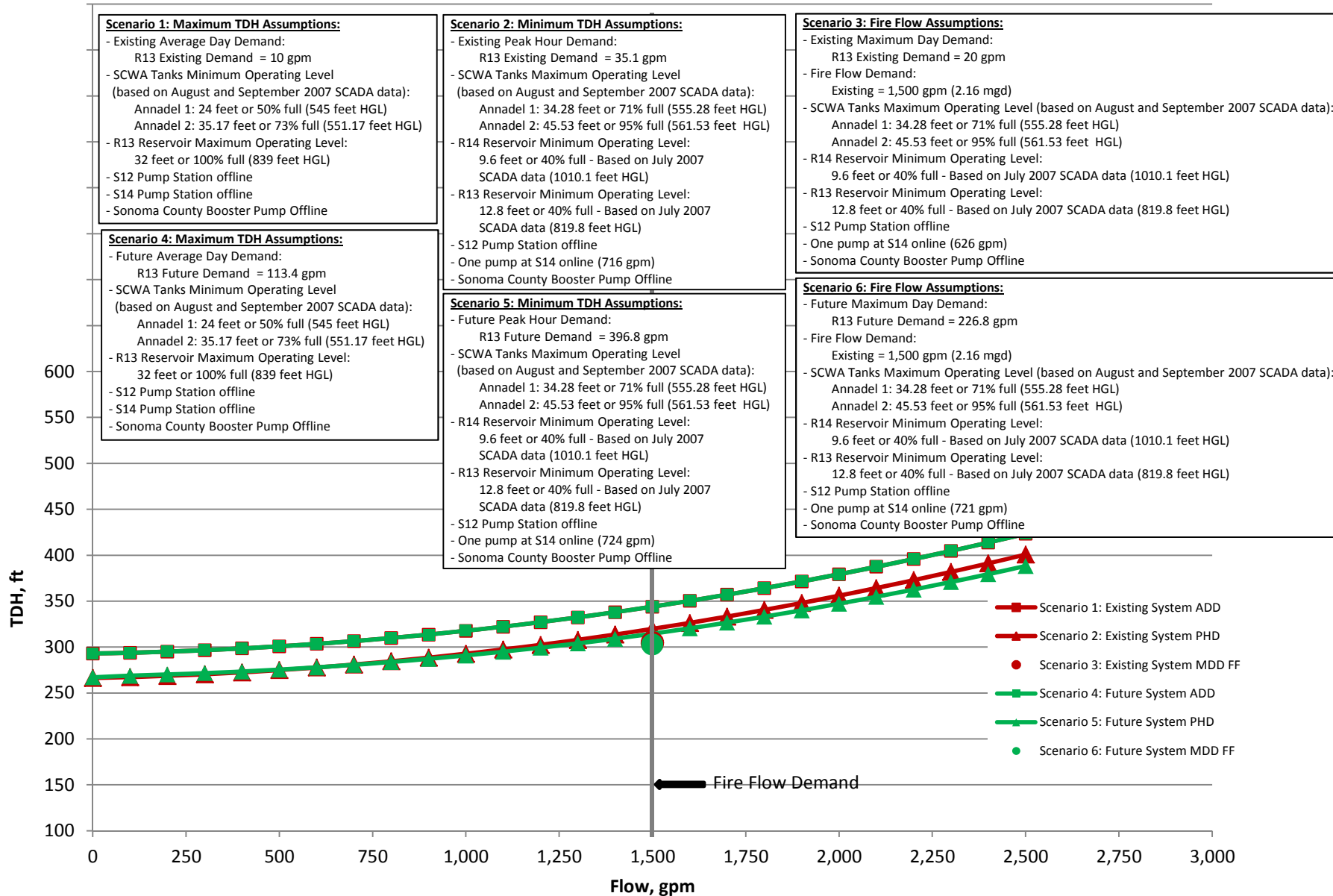


**Figure 3. Example of Available Pump Curve from Goulds
Model: VIT - 11CMC, 4 Stage**

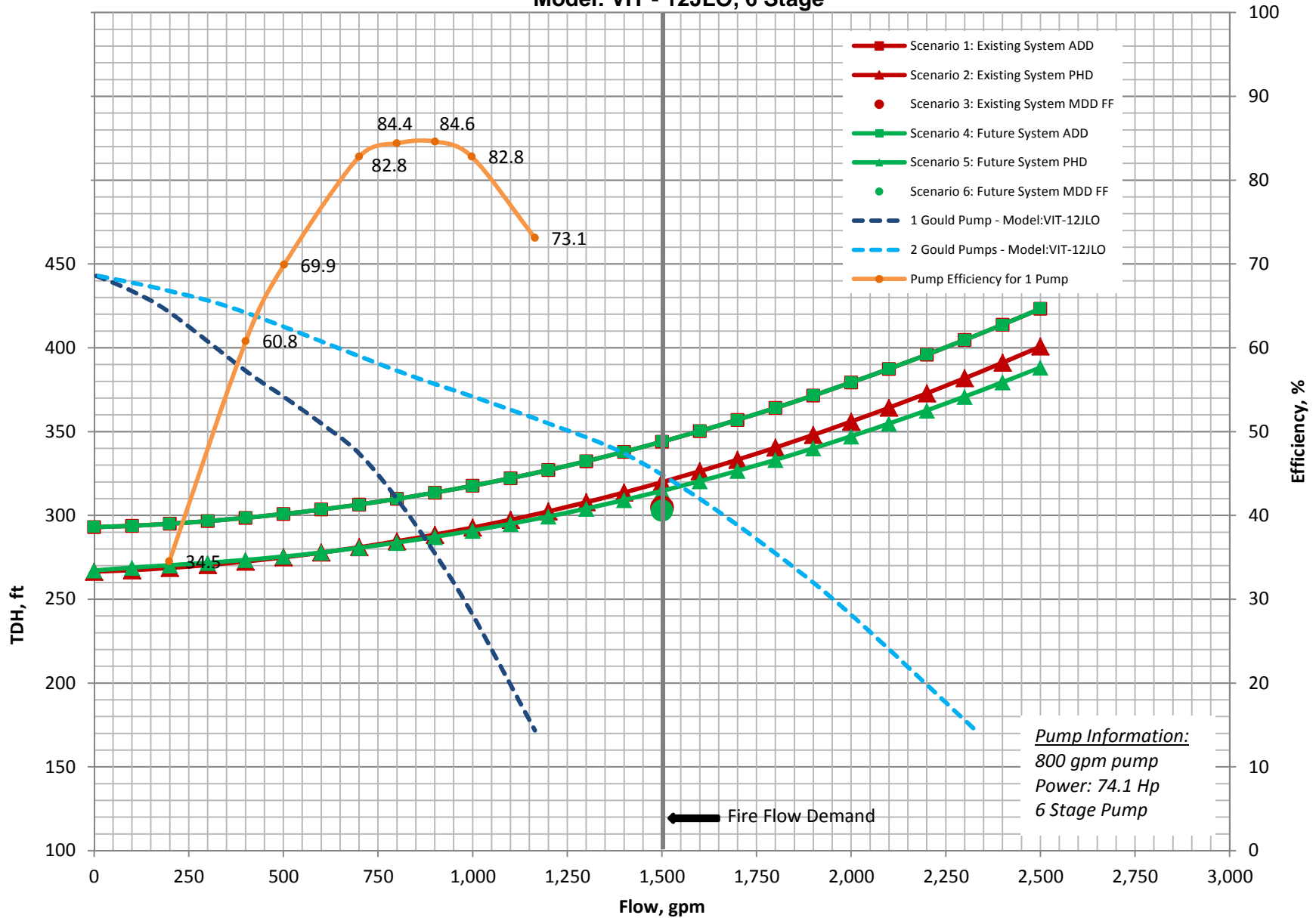


Pump Information:
800 gpm pump
Power: 60.3 Hp
4 Stage Pump

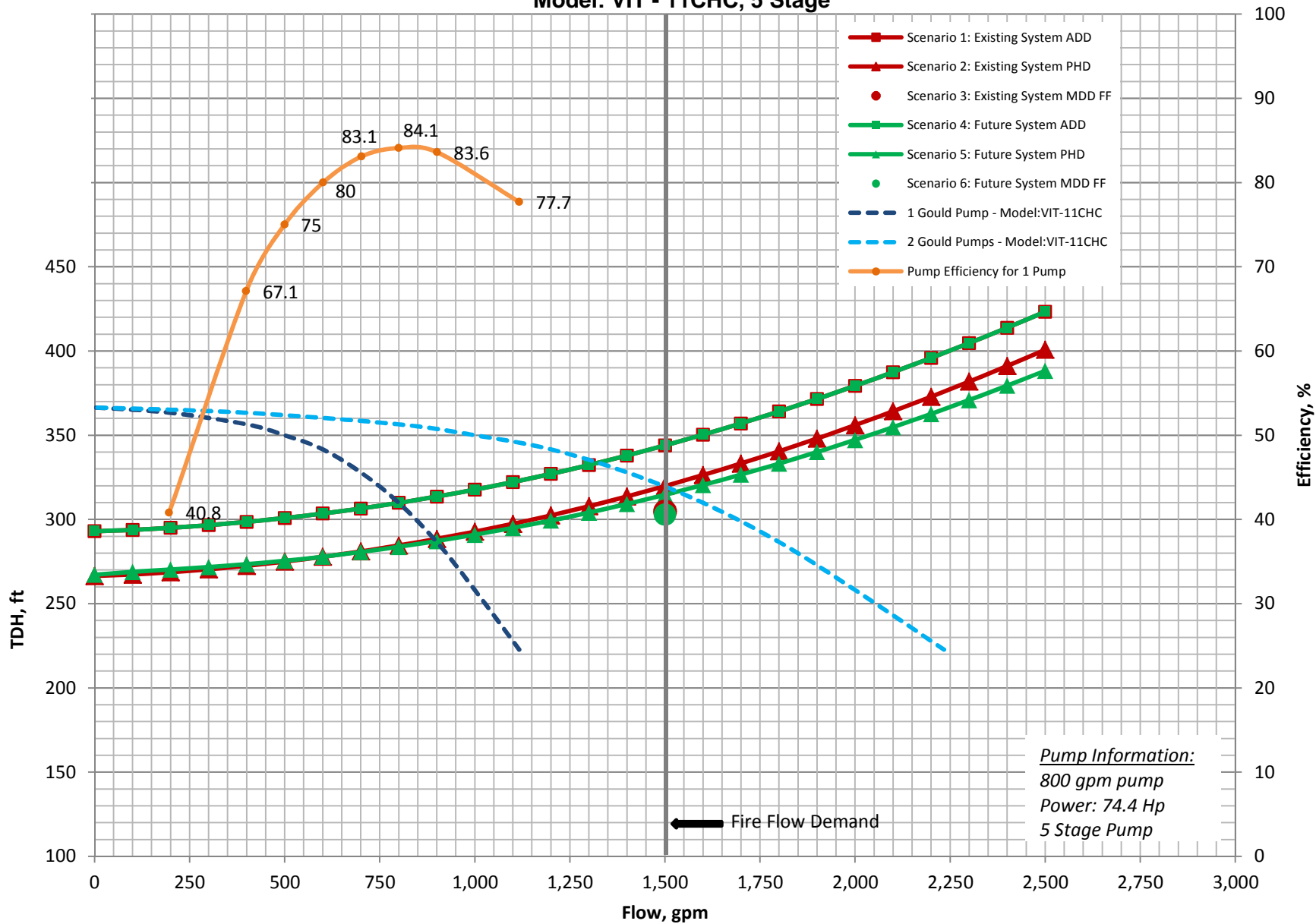
Figure 4. Pump Station S13 System Curves



**Figure 5. Example of Available Pump Curve from Goulds
Model: VIT - 12JLO, 6 Stage**



**Figure 6. Example of Available Pump Curve from Goulds
Model: VIT - 11CHC, 5 Stage**



*Pump Information:
800 gpm pump
Power: 74.4 Hp
5 Stage Pump*

