Appendix I

Parcel 85A Hydraulic Analysis Technical Memorandum

PETERSON . BRUSTAD . INC .
ENGINEERING . CONSULTING

PA Parcel 85A Zone Supplemental Analysis

Prepared for: Ascent Environmental *April 28, 2021*

Prepared by: Scott Putty, EIT and Ashley Smith, PE

Reviewed by: Karl Brustad, PE

Section 1: Introduction

This technical memorandum (TM) describes the assumptions, evaluation, and resulting recommendations regarding City of Folsom (City) service connection to the Folsom Hospital Project (Parcel 85A) located in the northeast corner of East Bidwell Street and Alder Creek Parkway in the Folsom Plan Area (FPA). Parcel 85A consists of 51 acres that have been subdivided into four separate parcels. The future Dignity Health medical center would occupy approximately 33.1 acres of Parcel 85A with other portions of the parcel dedicated to public right of way, a park, and other development compatible with the existing underlying zone.

1.1 Purpose

The Dignity Health medical center includes two 3-story medical office buildings and a 6-story Hospital. Dignity Health desires a minimum of 80psi service to the medical center to avoid the installation of a booster system for their water service which will require modifying the planned connection form FPA Zone 3 to FPA Zone 4. The FPA Zone 5 tank is the only tank currently constructed in the FPA. Therefore, the City's intermediate operations and hydraulic model supplies FPA Zones 4, 5, and 6 from the Zone 5 tank until the Zone 4 tank is constructed. PBI was retained by Ascent Environmental to evaluate any hydraulic impacts to the City's model for intermediate and buildout scenarios. The intermediate scenario will assess the ability to serve the facility from the Zone 5 tank in advance of construction the Zone 4 tank. Each alternative will be evaluated based on three (3) scenario simulations:

- Buildout maximum day demand (MDD) Extended Period Simulation (EPS) – 48-hour pressure curve for each tie-in point (see Figure 2)
- Buildout MDD+ (Fire Flow) FF Steady State
- Buildout peak hour demand (PHD) Steady State

The purpose of this TM is to evaluate the hydraulic impacts to the City's model for the intermediate and buildout scenarios.

Section 2: Evaluation Criteria

The *2014 FPA Water System Master Plan* by Brown & Caldwell is often referenced for FPA demand assessments; however the *2016 Water Master Plan (WMP) Update* is the City's latest assessment of the water demand analysis and supersedes prior assessments. The criteria used to evaluate the various scenarios are consistent with the criteria used in the *2016 WMP Update*. The criteria described in this section include water demands, treated water storage and pumping capacity, and system performance.

2.1 Treated Water Storage Capacity Criteria

This evaluation utilizes the *2016 WMP Update* storage approach which accounts for firm pumping capacity mitigating the need for additional storage. There are three storage requirements in the approach: operational storage; emergency storage; and fire protection storage. Each pressure zone in the system was analyzed individually for required storage to meet the three requirements.

The following criteria was used for determining adequate system storage:

1. Operational Storage equal to 25 percent of maximum day demand
2. Emergency Storage equal to 75 percent of maximum day demand
3. Fire Flow Storage based on the volume of the largest fire flow requirement in the pressure zone for 4 hours

The combined volume of each of these criteria is equal to one maximum day demand plus the required fire flow volume. The largest fire flow requirement is a 4,000 gpm flow for schools; for a 4-hour period this equates to just under 1 million gallons.

The *2016 WMP Update* identified 1.3 MG of minimum useable storage for the FPA Zone 5 tank and 1.5 MG of minimum useable storage for the FPA Zone 4 tank based on these criteria. The zone 4 booster pump station directly fills the Zone 4 tank so it is not eligible for a reduction in tank capacity when firm pumping capacities are met.

Further, the *2016 WMP* identified minimum useable storage requirements but did not discuss minimum tank sizing criteria. The minimum tank sizing criteria is based on the actual tank volume versus the usable tank volume. The actual tank volume is defined as the volume from the overflow elevation to the tank floor. The usable tank volume is calculated as the actual tank volume excluding the bottom 2 feet of the tank and 2 feet below the overflow level of the tank due to operational constraints. On average, this equates to the total usable tank volume being approximately 400,000 gallons less than the actual tank volume. Additionally, reliability and redundancy with tank servicing and outages within each zone may dictate increased tank volumes. This criteria was used to evaluate the impact of the proposed demand being included in FPA Zone 4. The results of this evaluation are presented in Section 4.

2.2 Intermediate Alternative Operation and Demand Allocation

The maximum demand in FPA Zones 4, 5, and 6 associated with the intermediate alternative cannot exceed the maximum day demand sizing criteria associated with the Zone 5 tank as it supplies all three zones in the intermediate scenario. Table A-7 (see Appendix A) provided by MacKay and Somp's *Folsom Phase 2 Water Financing Strategy* was used to determine which year the allowable maximum day demand associated with the FPA Zone 5 tank was anticipated to be exceeded. The total development in Zones 4, 5, and 6, at the end of 2024 H2 is anticipated to exceed a maximum daily demand of 1.3 MGD; therefore, the cumulative development associated with 2024 H1 (halfway through the year 2024) was used as the basis for the demand allocated in the intermediate alternative. This includes the Dignity Health medical office building which is the preliminary development for the planned medical center. The cumulative development through 2024 H1 was compared to the buildout development in order to identify a buildout

ratio by parcel. The buildout ratios were then added to the land use shapefile in order to allocate the intermediate demand in the model.

2.3 Buildout Water Demands

Table 1 presents the proposed updated buildout demands for Parcel 85A in comparison to those used in the 2016 *WMP Update*. Note that the average day to maximum day peaking factor used for this analysis is 1.7 based on the *2016 WMP Update*. The *2016 WMP Update* estimated the average day demand for Parcel 85A to be 0.09 MGD based on a 1.28 gpm/acre unit factor for commercial landuse applied to the overall 51-acre parcel. The proposed demand includes the demand for all four subdivisions within Parcel 85A.

Table 1. Parcel 85A Average Day and Maximum Day Demands

Total Average Day Demand Comparisons		Total Maximum Day Demand Comparisons[2]	
2016 WMP Update	Proposed Demand[1]	2016 WMP Update	Proposed Demand
65 gpm	125 gpm	111 gpm	213 gpm
0.09 MGD	**0.18 MGD**	**0.16 MGD**	**0.31 MGD**

[1]Proposed demand is based on average day demand information provided in Dudek's *Memorandum - Request for Information* dated July 19, 2020 (See Appendix D).

[2]Peaking Factor of 1.7 used based on *2016 WMP Update*

Table 1 shows that, the overall demand in Parcel 85A has approximately doubled from the *2016 WMP Update*. The *2016 WMP Update* estimated demand for Parcel 85A was based on a less intensive development than the proposed development. The conceptual plan for the medical center is shown in Figure 1.

The Dignity Health medical center accounts for 0.12 MGD of the total proposed average day demand (0.18 MGD).

Figure 1. Dignity Health Medical Center Conceptual Plan

2.4 System Performance

The *2016 WMP* established the system evaluation criteria used in the analysis to evaluate overall system performance in the hydraulic simulations. This criteria was used to evaluate the impact of the proposed alternatives under the three service connection scenarios. The results of this evaluation are presented in Sections 3 and 4.

Table 2. System Evaluation Criteria

Maximum-Day Demand Plus Fire Flow[1]			
Maximum Pipe Velocity	10.0 fps		
Desirable Pipe Velocity[3]	3.0 to 7.0 fps		
Pressure	20 psi in the pipelines in the vicinity of a fire; 40 psi without a fire[1]		
Peak-Hour Demand			
Maximum Pipe Velocity[1]	7.0 fps		
Pressure[2]	30 psi or greater (existing service area); 40 psi or greater (new development)[1,2]		
Required Fire Flow[2]			
Land Use Type	Required Fire Flow (gpm)	Duration (hrs)	Volume (MG)
Single Family Residential	1,500	2	0.18
Multi-Family Residential	2,500	2	0.30
Commercial/Industrial	3,000	3	0.54
Schools	4,000	4	0.96

[1]Minimum pressure (without fire) requirements must be met when storage levels are at 30 percent of capacity, per City of Folsom.
[2]Per Waterworks standards Section 64602 (b) Each new distribution system that expands the existing system service connections by more than 20 percent or that may otherwise adversely affect the distribution system pressure shall be designed to provide a minimum operating pressure throughout the new distribution system of not less than 40 psi at all times excluding fire flow.
[3]City staff desires maximum pipeline velocities around 3 fps during maximum day conditions.

Section 3: Intermediate Analysis

The FPA Zone 5 tank is the only tank currently constructed in the FPA and is the only storage available in the intermediate alternative. Therefore, the City's intermediate operations and hydraulic model supplies FPA Zones 4, 5, and 6 from the Zone 5 tank until the Zone 4 tank is constructed. FPA Zone 4 will be supplied through the two PRVs that connect FPA Zone 5 to 4 that are located at Alder Creek Parkway and Grand Prairie Road. The intermediate scenario includes demand allocations based on planned development through the first half of 2024 per Table A-7 in Appendix A.

Modifications to the planned system were necessary to connect the Dignity Health medical center to Zone 4. The FPA Zone 4 connections were located along a new 8" loop main for FPA Zone 4 along McCarthy Way and First Street.

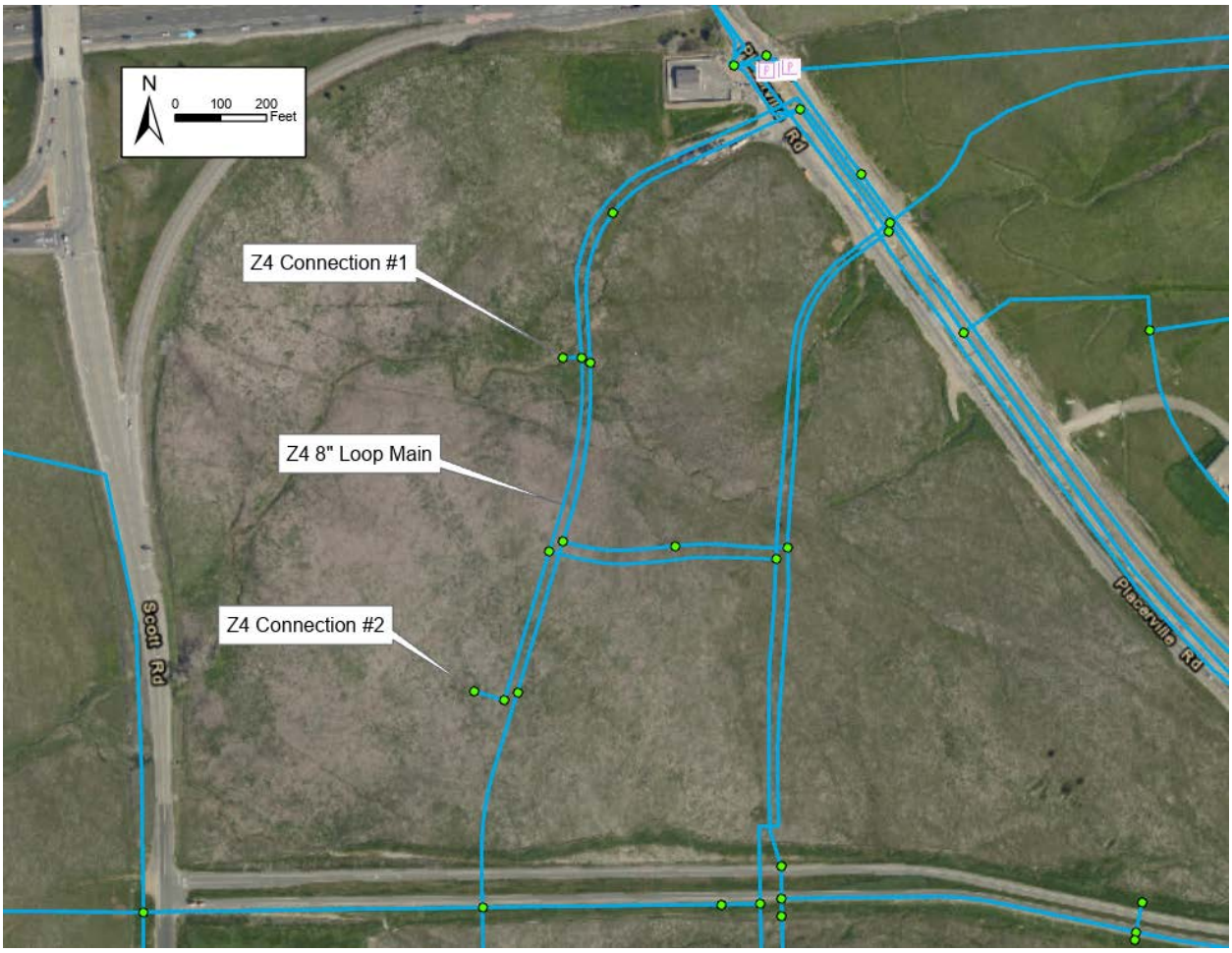

Figure 2. FPA Zone 4 Connection Scenario

3.1 System Performance

The static pressure at the FPA Zone 4 service connections for the intermediate scenario when the Zone 5 tank is at 30% capacity is approximately 99 and 103 psi which is above the desired pressure of 80 psi. Further, the 48-hour pressure curve for maximum day demand for each connection point, shown in Figure 3 and Figure 4, shows that the minimum pressure during the extended period simulation is 99 psi and 103 psi, respectively. There is little fluctuation in the pressure on the intermediate scenario because the pressure is controlled by hydraulic grade lines of the PRVs and not by a storage tank with fluctuating water levels. For the intermediate scenario, the PRVs are set at the hydraulic grade line of the future tank at 50% full.

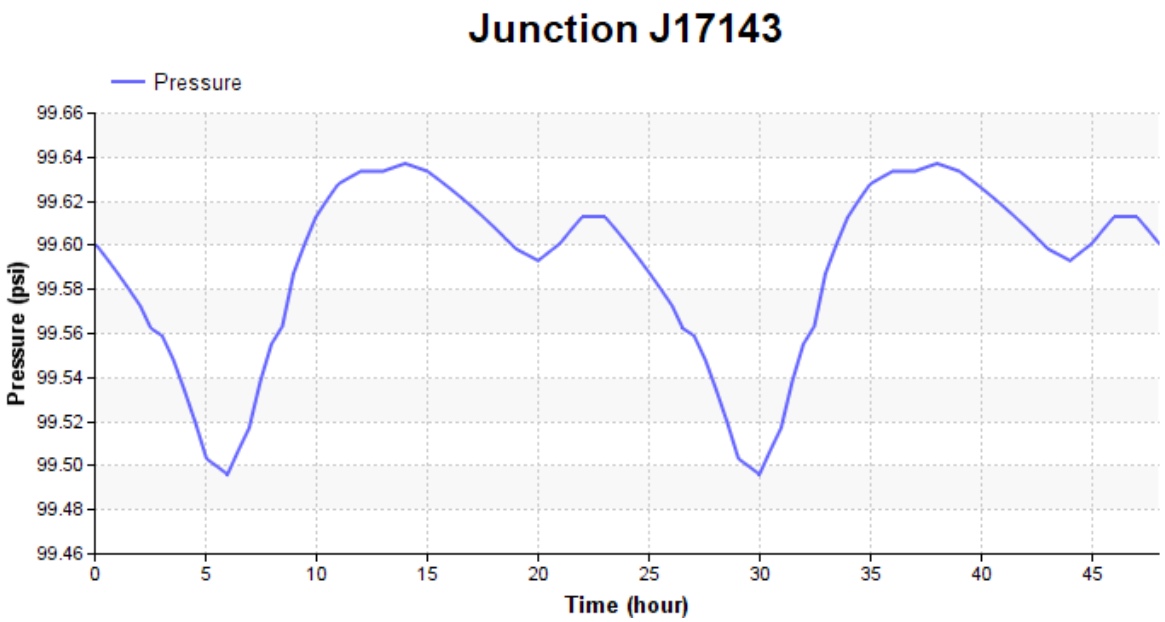

Figure 3. Service Connection 1 48-hr Pressure Curve – Intermediate Scenario MDD

Figure 4. Service Connection 2 48-hr Pressure Curve – Intermediate Scenario MDD

Appendix B provides detailed maps of the velocity and pressure results for the intermediate scenario steady state simulations. The pressure and velocity at steady state meet the system criteria for maximum day demand and peak hour demand.

Section 4: Buildout Analysis

4.1 Minimum Tank Storage Requirements

Table 3 compares the updated buildout demand in FPA Zone 3 and 4 with the addition of the Dignity Health medical center. The maximum day demand in FPA Zone 3 decreased by .06 MGD and the maximum day demand in FPA Zone 4 increased by 0.20 MGD since the *2016 WMP Update*.

Table 3. Updated Demand with Medical Center in Zone 4

	2016 WMP	Updated Demand with Medical Center in Zone 4
Zone	Buildout Maximum Day Demand (MGD)	Buildout Maximum Day Demand (MGD)
FPA 2[1]	2.77	2.77
FPA 3	3.28	3.22
FPA 4	1.00	1.20

[1]FPA Zone 2 is included for reference as it is considered in FPA 3 tank sizing

Table 4 summarizes the minimum usable storage area for FPA Zone 3 and 4 considering the additional demand. The currently planned tank size for FPA Zone 4 is 2 MG with 1.6 MG of useable storage.

Table 4. Minimum Useable Storage Requirements

			Minimum Storage Requirements, MG				2016 WMP Storage Requirements, MG
Pressure Zone	Required Capacity (GPM)[3]	Planned Firm Capacity (GPM)	Emergency/ Operational Storage[2]	Fire Flow	Minimum Useable Required	Total Required	Minimum Useable Required
FPA 3[1]	**4,166**	**6,100**	**3.0**	**0.96**	**4.0**	**(2) 3[5]**	**4.0**
FPA 4	**836**	**1,786[4]**	**1.2**	**0.96**	**2.2**	**2.6**	**1.5**

[1]FPA Zone 2 included with Zone 3; [2]Volume = 1.0 maximum day for gravity zones; [3]Required Capacity = maximum day demand; [4]Planned capacity provided by *Folsom Plan Area Zone 4 and 5 Booster Pump Station Preliminary Design Report* dated August 2014; [5]Two (2) 3 MG tanks were required by the City to provide redundancy and resiliency per the *FPA Zone 3 Tank Sizing Memorandum* dated December 12, 2019.

The total useable storage in FPA Zone 3 remained the same while the total useable storage in FPA Zone 4 increased by 0.7 MG. Table 4 identifies a need for 2.2 MG of useable storage which equates to approximately 2.6 MG of total storage when considering actual tank volume as discussed in Section 2.1. Note that this document does not evaluate the firm pumping capacity planned for FPA Zone 4; however, the proposed pumping capacity provided by WaterWorks Engineer's *Folsom Plan Area zone 4 and Zone 5 Booster Pump Station Preliminary Design Report* (See Appendix E) is adequate to fill the Zone 4 tank.

4.2 System Performance

The static pressure at the FPA Zone 4 service connections for the buildout alternative when the Zone 4 tank is at 30% capacity (hydraulic grade line of 660') is approximately 97 and 101 psi which is above the

desired pressure of 80 psi. Further, the 48-hour pressure curve for maximum day demand for each connection point, shown in Figure 5 and Figure 6, shows that the minimum pressure during the extended period simulation is 100 psi and 104 psi, respectively. The maximum pressure does not exceed 106 psi and 110 psi, respectively.

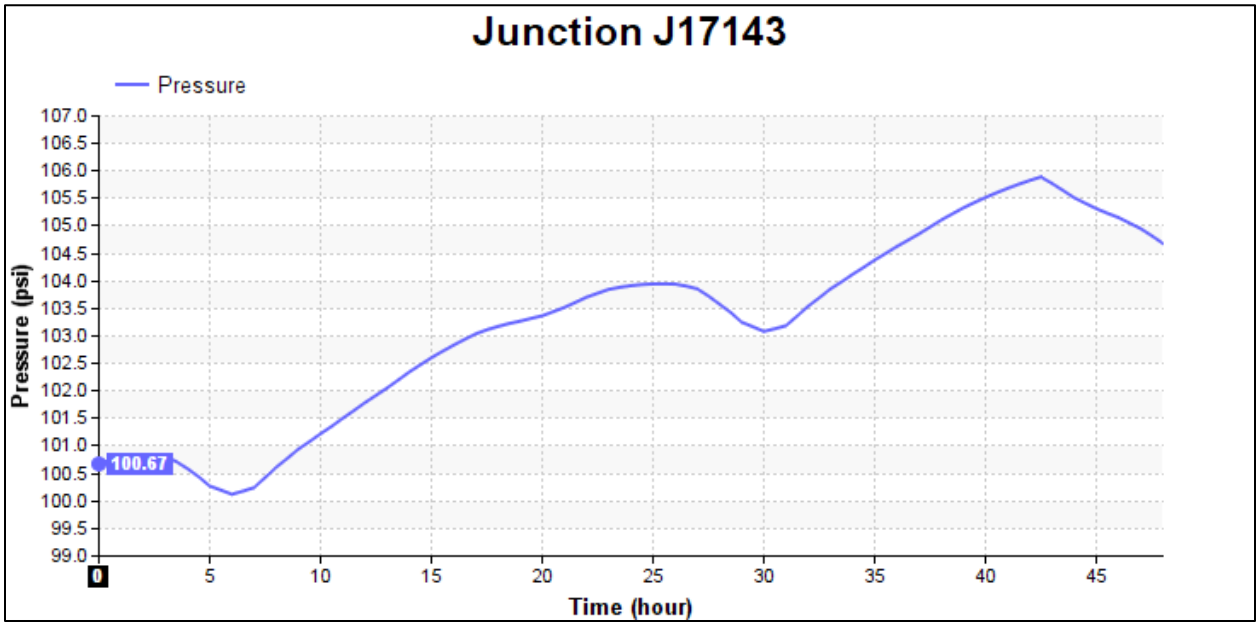

Figure 5. Service Connection 1 48-hr Pressure Curve for MDD

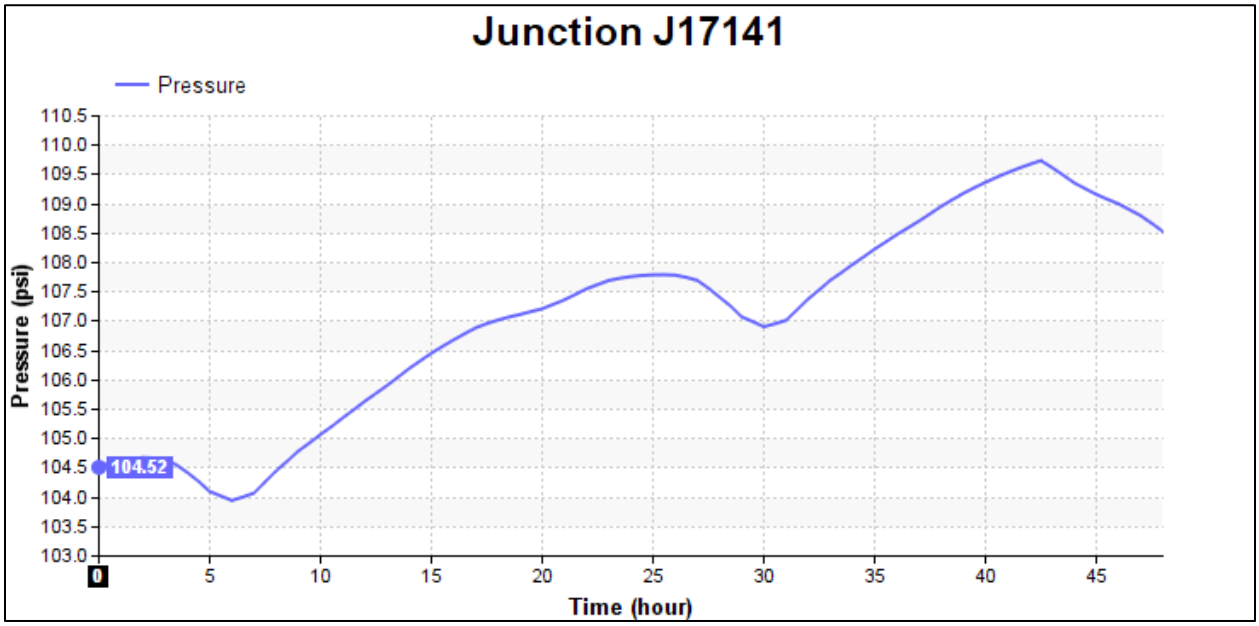

Figure 6. Service Connection 2 48-hr Pressure Curve for MDD

Appendix C provides detailed maps of the velocity and pressure results for the buildout alternative steady state simulations. The pressure and velocity at steady state meet the system criteria for maximum day demand and peak hour demand.

Section 5: Conclusions and Recommendations

The results of the intermediate alternative comply with the system performance criteria with the addition of the preliminary Dignity Health development. The results of the buildout alternative also comply with the system performance criteria with the addition of the Dignity Health medical center. Based on the proposed updates to the buildout demand in FPA Zone 4, the minimum tank size of the FPA Zone 4 tank is approximately 2.6 MG to achieve the minimum useable storage of 2.2 MG. Based on the design criteria of the *2016 WMP*, the Zone 4 tank needs to be constructed prior to the maximum daily demand in Zones 4, 5, and 6 exceeding the minimum useable storage of the Zone 5 tank which is 1.3 MG.

Appendix A: Folsom Phase 2 Water Financing Strategy

Table A-7
Folsom Phase 2 Water Financing Strategy
Occupancy Absorption by FPASP Landowner (Less Folsom Heights) - EPS Projections

Zone 4
Zone 5
Zone 6

Item	Zone	Land Use	Total	2019	2020	2021 H1	2021 H2	2022 H1	2022 H2	2023 H1	2023 H2	2024 H1	2024 H2	2025 H1	2025 H2	2026 H1	2026 H2	2027 H1	2027 H2	2028H2
OCCUPANCY WITHIN ZONES 4-5-6 FPASP LESS FOLSOM HEIGHTS																				
Mangini Phase 1																				
Village 3	Zone 4	SFHD	49	-	-	-	-	20	20	9	-	-	-	-	-	-	-	-	-	-
Village 4	Zone 4	SFHD	86	-	-	42	20	20	4	-	-	-	-	-	-	-	-	-	-	-
Village 5	Zone 4	SFHD	87	-	51	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Village 6	Zone 4	SFHD	116	-	-	57	20	20	19	-	-	-	-	-	-	-	-	-	-	-
Subtotal Mangini Phase 1			**338**	**-**	**51**	**135**	**40**	**60**	**43**	**9**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Mangini Phase 2																				
Village 3	Zone 4	SFHD	53	-	-	-	-	-	-	16	20	17	-	-	-	-	-	-	-	-
Village 4	Zone 4	SFHD	73	-	-	2	12	12	12	16	16	3	-	-	-	-	-	-	-	-
Village 5	Zone 4	SFHD	83	-	-	-	-	-	-	8	16	20	16	16	7	-	-	-	-	-
Village 6	Zone 4	SFHD	70	-	-	-	-	-	-	8	20	20	16	6	-	-	-	-	-	-
Village 8	Zone 4	MLD	36	-	-	-	12	16	8	-	-	-	-	-	-	-	-	-	-	-
Spanos	Zone 4	MHD	265	-	-	-	-	135	-	130	-	-	-	-	-	-	-	-	-	-
Subtotal Mangini Phase 2			**580**	**-**	**-**	**2**	**24**	**163**	**20**	**178**	**72**	**60**	**32**	**22**	**7**	**-**	**-**	**-**	**-**	**-**
Mangini Phase 1C																				
Lot 11	Zone 4	MLD	156	-	-	-	-	8	12	16	20	20	20	20	20	20	-	-	-	-
Lot 11/12	Zone 4	MLD	121	-	-	-	-	-	8	12	16	16	16	16	16	21	-	-	-	-
Arcadian	Zone 4	MLD	63	-	-	-	-	-	-	-	-	8	12	12	16	15	-	-	-	-
St Anton (150)	Zone 4	MUD	150	-	-	-	-	-	-	-	-	75	75	-	-	-	-	-	-	-
Subtotal Mangini Phase 1C			**490**	**-**	**-**	**-**	**-**	**8**	**20**	**28**	**36**	**119**	**123**	**48**	**52**	**56**	**-**	**-**	**-**	**-**
Russell Ranch Phase 1																				
Village 1	Zone 6	SFHD	52	-	-	2	12	12	12	14	-	-	-	-	-	-	-	-	-	-
Village 2	Zone 6	SF	25	-	-	-	15	10	-	-	-	-	-	-	-	-	-	-	-	-
Village 3	Zone 6	SF	26	-	-	-	2	12	12	-	-	-	-	-	-	-	-	-	-	-
Village 4	Zone 6	MLD	114	-	8	54	24	24	4	-	-	-	-	-	-	-	-	-	-	-
Village 5	Zone 6	SF	41	-	-	-	12	24	5	-	-	-	-	-	-	-	-	-	-	-
Village 6	Zone 4	SFHD	43	-	3	6	18	16	-	-	-	-	-	-	-	-	-	-	-	-
Village 7	Zone 5	SFHD	24	-	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Village 7	Zone 6	SFHD	17	-	4	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-
Village 8	Zone 6	SFHD	52	-	3	25	24	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal Russell Ranch Phase 1			**394**	**-**	**18**	**111**	**120**	**98**	**33**	**14**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Russell Ranch Phase 2																				
Village 1	Zone 5	SFHD	33	-	-	-	-	-	-	-	-	-	8	12	13	-	-	-	-	-
Village 2	Zone 5	SFHD	79	-	-	-	-	-	-	-	-	-	8	12	16	16	16	11	-	-
Village 3	Zone 5	SFHD	63	-	-	-	-	-	-	-	-	-	-	-	12	12	12	12	15	-
Village 4	Zone 5	SFHD	96	-	-	-	-	-	-	-	-	-	12	12	16	20	20	16	-	-
Village 5	Zone 5	MLD	118	-	-	-	-	-	-	-	-	-	-	-	24	24	24	24	22	-
Subtotal Russell Ranch Phase 2			**389**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**28**	**36**	**81**	**72**	**72**	**63**	**37**	**-**

Table A-7
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Occupancy Absorption by FPASP Landowner (Less Folsom Heights) - EPS Projections
Zone 4
Zone 5
Zone 6

Item	Zone	Land Use	Total	2019	2020	2021 H1	2021 H2	2022 H1	2022 H2	2023 H1	2023 H2	2024 H1	2024 H2	2025 H1	2025 H2	2026 H1	2026 H2	2027 H1	2027 H2	2028H2
OCCUPANCY WITHIN ZONES 4-5-6 FPASP LESS FOLSOM HEIGHTS																				
Russell Ranch Phase 3																				
SF	Zone 5	SF	55	-	-	-	-	-	-	-	13	13	13	13	3	-	-	-	-	-
SF	Zone 6	SF	48	-	-	-	-	-	-	-	11	11	11	11	4	-	-	-	-	-
SFHD	Zone 4	SFHD	55	-	-	-	-	-	-	6	12	12	12	12	1	-	-	-	-	-
SFHD	Zone 6	SFHD	84	-	-	-	-	-	-	10	18	18	18	17	3	-	-	-	-	-
Subtotal Russell Ranch Phase 3			**242**	**-**	**-**	**-**	**-**	**-**	**-**	**16**	**54**	**54**	**54**	**53**	**11**	**-**	**-**	**-**	**-**	**-**
White Rock Springs Ranch																				
Village 1	Zone 4	SFHD	93	-	-	15	12	12	12	12	12	12	6	-	-	-	-	-	-	-
Village 8	Zone 5	SF	42	-	-	-	3	9	12	12	6	-	-	-	-	-	-	-	-	-
Village 9	Zone 5	SF	44	-	-	19	12	13	-	-	-	-	-	-	-	-	-	-	-	-
Village 2	Zone 5	SF	29	-	-	-	9	12	8	-	-	-	-	-	-	-	-	-	-	-
Village 3	Zone 5	SFHD	52	-	-	-	9	9	12	12	10	-	-	-	-	-	-	-	-	-
Village 4	Zone 5	SFHD	50	-	-	-	9	9	12	12	8	-	-	-	-	-	-	-	-	-
Village 5	Zone 5	SF	21	-	-	-	-	-	8	8	5	-	-	-	-	-	-	-	-	-
Village 6	Zone 5	SFHD	24	-	-	-	-	-	8	8	8	-	-	-	-	-	-	-	-	-
Village 7	Zone 5	SFHD	40	-	-	-	-	-	8	8	12	12	-	-	-	-	-	-	-	-
Carr	Zone 4	SFHD	28	-	-	12	12	4	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal White Rock Springs Ranch			**423**	**-**	**-**	**46**	**66**	**68**	**80**	**72**	**61**	**24**	**6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Broadstone - Elliott																				
	Zone 4	SF	34	-	-	-	-	-	-	-	-	18	16	-	-	-	-	-	-	-
	Zone 5	SF	47	-	-	-	-	-	-	-	-	-	-	18	18	11	-	-	-	-
Subtotal Broadstone - Elliott			**81**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**18**	**16**	**18**	**18**	**11**	**-**	**-**	**-**	**-**
Eagle/Dignity			***GPD***																	
Folsom Medical Center[1]	*Zone 4*	*GC*	*71,186*	-	-	-	-	-	-	-	*19,134*	-	-	-	-	-	-	-	-	*52,051*
Subtotal Eagle/Dignity			***71,186***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***19,134***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***52,051***
											MOB 1									*Hospital*
TOTAL OCCUPANCY LESS FOLSOM HEIGHTS																				
Zone 4	Zone 4		1,661	-	54	170	106	263	95	233	132	221	189	82	60	56	-	-	-	-
Zone 5	Zone 5		817	-	-	43	42	52	68	60	62	25	41	67	102	83	72	63	37	-
Zone 6	Zone 6		459	-	15	81	102	82	33	24	29	29	29	28	7	-	-	-	-	-
TOTAL			**2,937**		**69**	**294**	**250**	**397**	**196**	**317**	**223**	**275**	**259**	**177**	**169**	**139**	**72**	**63**	**37**	**-**
CUMULATIVE																				
Zone 4	Zone 4			-	54	224	330	593	688	921	1,053	1,274	1,463	1,545	1,605	1,661	1,661	1,661	1,661	1,661
Zone 5	Zone 5			-	-	43	85	137	205	265	327	352	393	460	562	645	717	780	817	817
Zone 6	Zone 6			-	15	96	198	280	313	337	366	395	424	452	459	459	459	459	459	459
TOTAL					**69**	**363**	**613**	**1,010**	**1,206**	**1,523**	**1,746**	**2,021**	**2,280**	**2,457**	**2,626**	**2,765**	**2,837**	**2,900**	**2,937**	**2,937**
GPD																				
Zone 4	*Zone 4*										*19,134*									*52,051*

Table A-7
Folsom Phase 2 Water Financing Strategy
Occupancy Absorption by FPASP Landowner (Less Folsom Heights) - EPS Projections
Zone 4
Zone 5
Zone 6

Item	Zone	Land Use	Total	2019	2020	2021 H1	2021 H2	2022 H1	2022 H2	2023 H1	2023 H2	2024 H1	2024 H2	2025 H1	2025 H2	2026 H1	2026 H2	2027 H1	2027 H2	2028H2
OCCUPANCY WITHIN ZONES 4-5-6 FPASP LESS FOLSOM HEIGHTS																				
TOTAL OCCUPANCY LESS FOLSOM HEIGHTS																				
SF		SF	412	-	-	19	53	80	45	20	35	42	40	42	25	11	-	-	-	-
SFHD		SFHD	1,502	-	61	221	161	134	119	139	152	114	96	87	68	48	48	39	15	-
MLD		MLD	608	-	8	54	36	48	32	28	36	44	48	48	76	80	24	24	22	-
MMD		MMD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MHD		MHD	265	-	-	-	-	135	-	130	-	-	-	-	-	-	-	-	-	-
MUD		MUD	150	-	-	-	-	-	-	-	-	75	75	-	-	-	-	-	-	-
TOTAL			**2,937**	**-**	**69**	**294**	**250**	**397**	**196**	**317**	**223**	**275**	**259**	**177**	**169**	**139**	**72**	**63**	**37**	**-**
CUMULATIVE																				
SF		SF		-	-	19	72	152	197	217	252	294	334	376	401	412	412	412	412	412
SFHD		SFHD		-	61	282	443	577	696	835	987	1,101	1,197	1,284	1,352	1,400	1,448	1,487	1,502	1,502
MLD		MLD		-	8	62	98	146	178	206	242	286	334	382	458	538	562	586	608	608
MMD		MMD		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MHD		MHD		-	-	-	-	135	135	265	265	265	265	265	265	265	265	265	265	265
MUD		MUD		-	-	-	-	-	-	-	-	75	150	150	150	150	150	150	150	150
TOTAL				**-**	**69**	**363**	**613**	**1,010**	**1,206**	**1,523**	**1,746**	**2,021**	**2,280**	**2,457**	**2,626**	**2,765**	**2,837**	**2,900**	**2,937**	**2,937**

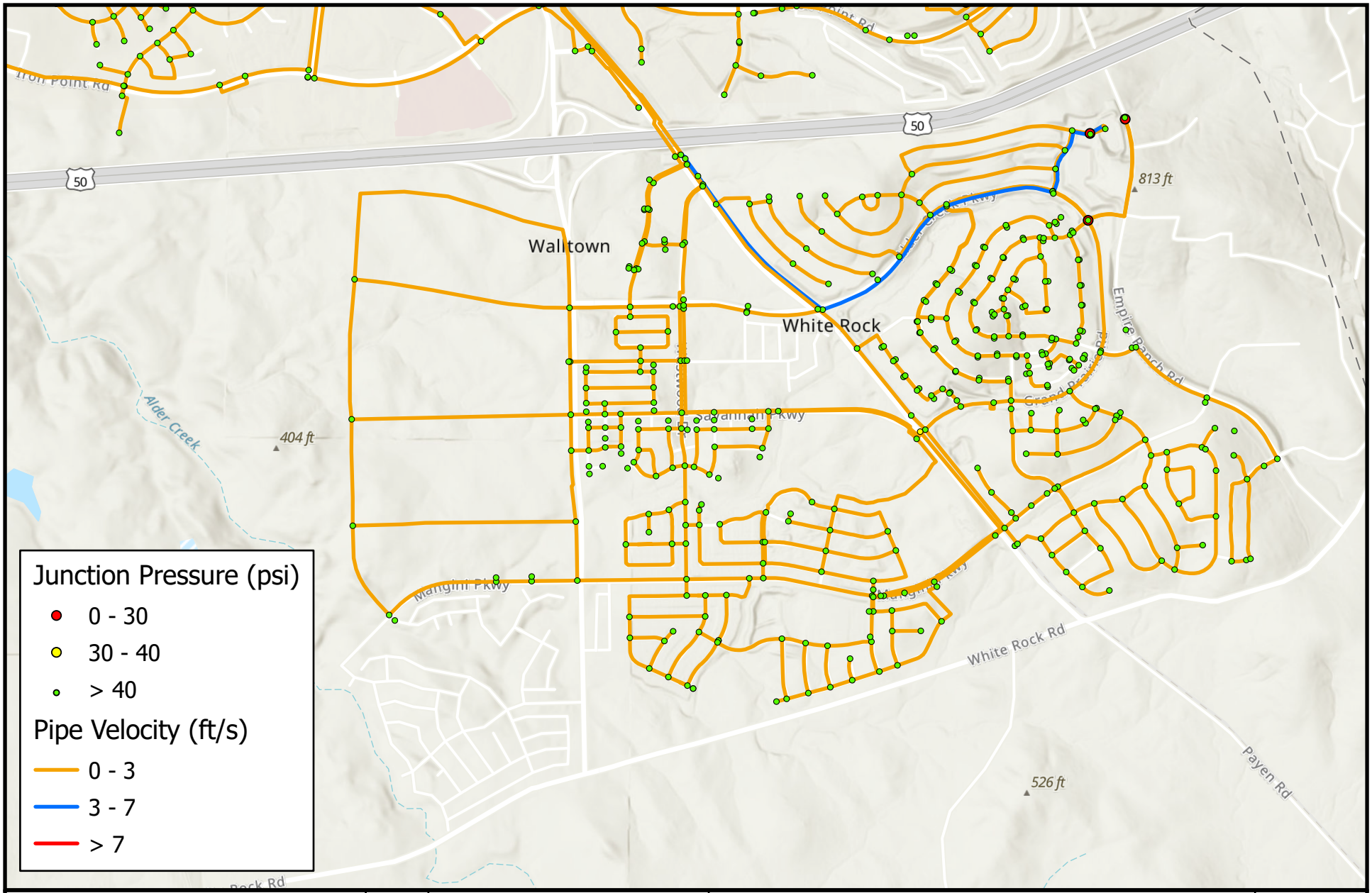
building permit landowner

Item	Zone	Land Use	Total	2019	2020	2021 H1	2021 H2	2022 H1	2022 H2	2023 H1	2023 H2	2024 H1	2024 H2	2025 H1	2025 H2	2026 H1	2026 H2	2027 H1	2027 H2	2028H2
TOTAL MAX DAY WATER DEMAND LESS FOLSOM HEIGHTS																				
	GPD/EDU[2]																			
SF	1,019	SF	420,025	-	-	19,370	54,032	81,558	45,877	20,390	35,682	42,818	40,779	42,818	25,487	11,214	-	-	-	-
SFHD	622	SFHD	934,217	-	37,941	137,458	100,139	83,346	74,016	86,455	94,541	70,906	59,710	54,112	42,295	29,855	29,855	24,257	9,330	-
MLD	395	MLD	239,935	-	3,157	21,310	14,207	18,942	12,628	11,050	14,207	17,364	18,942	18,942	29,992	31,570	9,471	9,471	8,682	-
MMD	312	MMD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MHD	302	MHD	79,944	-	-	-	-	40,726	-	39,218	-	-	-	-	-	-	-	-	-	-
MUD	261	MUD	39,143	-	-	-	-	-	-	-	-	19,571	19,571	-	-	-	-	-	-	-
Folsom Medical Center		GC									19,134									52,051
TOTAL			**1,713,264**	**-**	**41,098**	**178,138**	**168,378**	**224,572**	**132,521**	**157,112**	**163,564**	**150,659**	**139,003**	**115,873**	**97,774**	**72,640**	**39,326**	**33,728**	**18,012**	**52,051**
CUMULATIVE																				
	GPD/EDU[2]																			
SF	1,019	SF		-	-	19,370	73,402	154,961	200,837	221,227	256,909	299,727	340,506	383,324	408,811	420,025	420,025	420,025	420,025	420,025
SFHD	622	SFHD		-	37,941	175,399	275,538	358,884	432,899	519,355	613,896	684,802	744,512	798,625	840,920	870,775	900,630	924,887	934,217	934,217
MLD	395	MLD		-	3,157	24,467	38,674	57,616	70,244	81,294	95,501	112,864	131,806	150,749	180,741	212,311	221,782	231,253	239,935	239,935
MMD	312	MMD		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MHD	302	MHD		-	-	-	-	40,726	40,726	79,944	79,944	79,944	79,944	79,944	79,944	79,944	79,944	79,944	79,944	79,944
MUD	261	MUD		-	-	-	-	-	-	-	-	19,571	39,143	39,143	39,143	39,143	39,143	39,143	39,143	39,143
Folsom Medical Center		GC		-	-	-	-	-	-	-	19,134	19,134	19,134	19,134	19,134	19,134	19,134	19,134	19,134	71,186
TOTAL				**-**	**41,098**	**219,236**	**387,614**	**612,186**	**744,707**	**901,819**	**1,065,383**	**1,216,042**	**1,355,045**	**1,470,918**	**1,568,692**	**1,641,332**	**1,680,658**	**1,714,386**	**1,732,398**	**1,784,449**

Source: WestLand; TNHC; Elliott Homes; Toll Brothers; MacKay & Somps; EPS.

1. Per Capital Engineering 5/28/20 Tech Memo average yearly usage is 156 AFA; 139,760 gpd ADD; 158,100 gpd MDD
2. Per March 2018 FPASP Water Supply Calculator Unit Demands with a Peaking Factor of 1.7

Appendix B: Intermediate Scenario Results



PETERSON . BRUSTAD . INC
ENGINEERING . CONSULTING

80 Blue Ravine Rd., Suite 280
Folsom, CA 95630
Phone: (916) 608-2212

N

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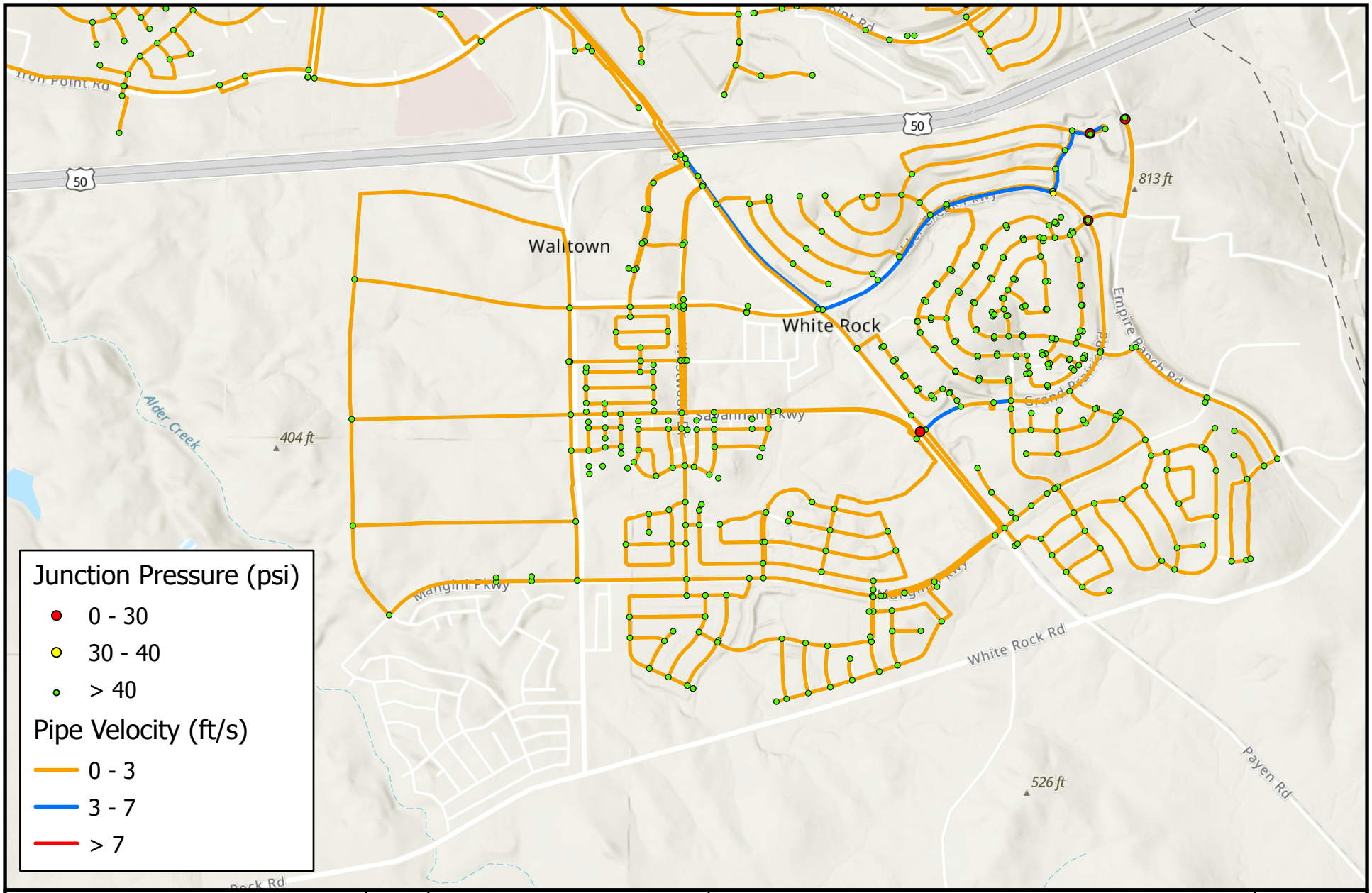
March 2021

CITY OF FOLSOM

Folsom Plan Area Intermediate Scenario MDD SS

APPENDIX

B



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March 2021

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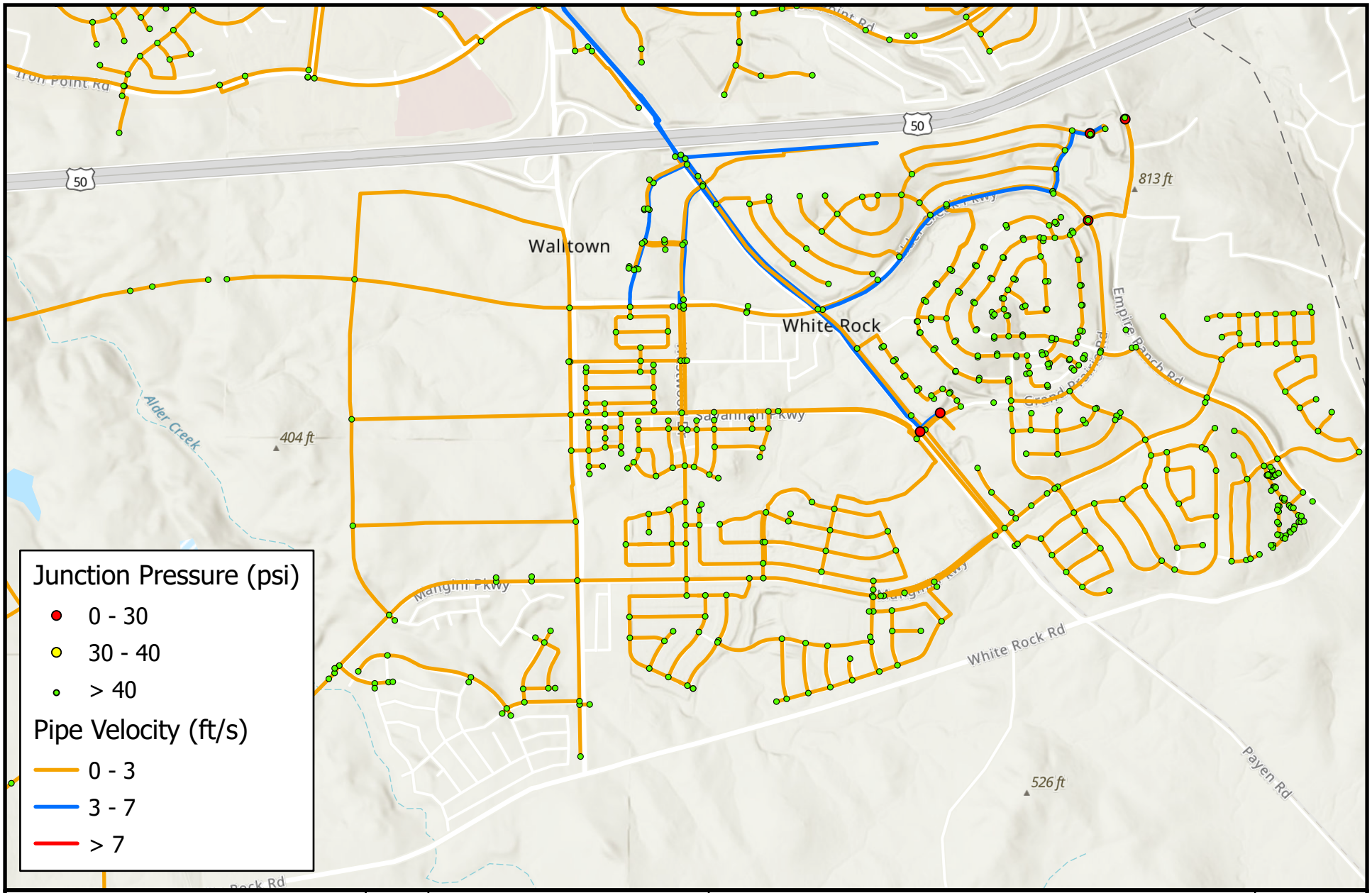
Folsom Plan Area Intermediate Scenario PHD SS

APPENDIX

B

Appendix C: Buildout Scenario Results



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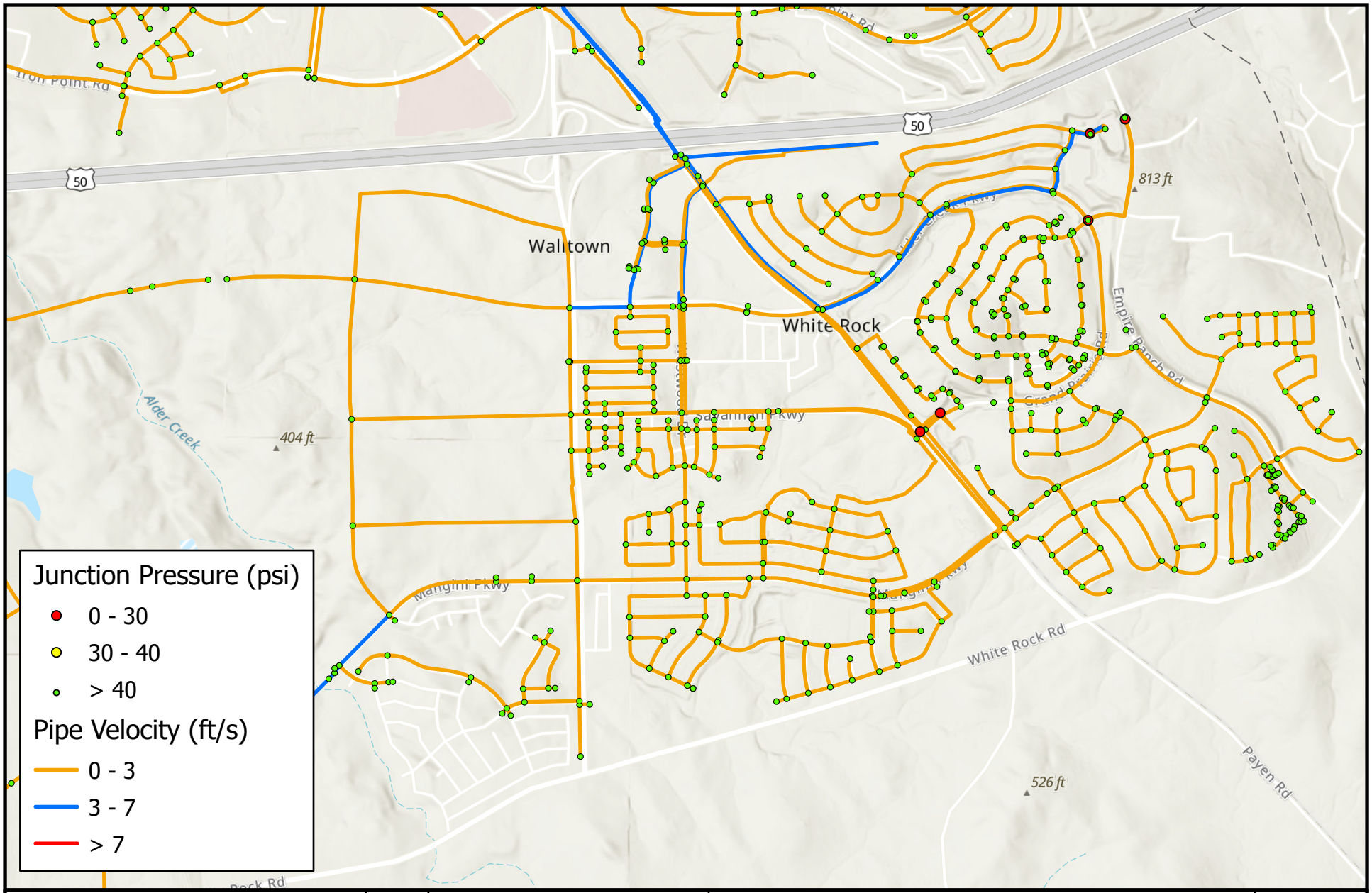
APPENDIX

C



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March 2021

CITY OF FOLSOM

Folsom Plan Area Buildout Scenario PHD SS

APPENDIX

C

Appendix D: Memorandum - Request for Information

MEMORANDUM – REQUEST FOR INFORAMTION

To:	Todd Eising, teising@folsom.ca.us (City of Folsom)
From:	Trey Driscoll, tdriscoll@dudek.com, Elizabeth Calvia, ecaliva@dudek.com
Subject:	Folsom Plan Area Parcel 85A
Date:	July 19, 2020
cc:	Ashley Smith, asmith@pbieng.com, Karl Brustad, kbrustad@pbieng.com, Jeremy Shykowski, jshykowski@folsom.ca.us, Scott Johnson, sjohnson@folsom.ca.us, Robert O'Hare, Robert.O'Hare@DignityHealth.org, Andrew Flanigan, aflanigan@DEVENNEYGROUP.COM, Eric Ubersax, eubersax@DEVENNEYGROUP.COM, Jennifer L Tanner, Jennifer.Tanner003@DignityHealth.org

1 Background

1.1 Folsom Hospital Project – Parcel 85A

Dignity Health is evaluating the location and design of a hospital medical center on 'Parcel 85A' located within the Folsom Plan Area (FPA). Parcel 85A consists of 54.30 acres that has been subdivided into four parcels and has an approved Tentative Parcel Map (City of Folsom 2019). Parcel 85A is located at the northeast corner of East Bidwell Street and Alder Creek Parkway (Figure 1). The FPA designation for the parcel is SP-GC-PD (Specific Plan, General Commercial, and Planned Development District) and the General Plan land use designation is GC (General Commercial). Parcel 85A is one of four commercial parcels (61, 77, 78 and 85A) located within the FPA (Folsom Ranch 2020). The future medical center would occupy approximately 33.1 acres of Parcel 85A with other portions of the parcel dedicated to public rights of way, a park, and other development compatible with the existing underlying zoning. The FPA will be supplied water from the City.

1.1.1 Folsom Plan Area Water Demands

Future water demands for the FPA were originally developed for each parcel based on water use factors for proposed land uses. Brown & Caldwell presents FPA water demands in the Water System Master Plan (Table 1).

Table 1: FPA Water Demands

Average Day Demand (MGD)	Maximum Day Demand MGD (GPM)	MDD/ADD Peaking Factor	Peak-Hour (GPM)	Average annual, (Acre-feet per Year)
4.8	8.8 (6,096)	1.8	9,717	5,421[a]

Notes: MGD = millions of gallons per day, GPM – gallons per minute, ADD = average day demand, MDD = maximum day demand

a. Ultimate potable water demand, no recycled water.

Source: Brown & Caldwell 2014

1.1.2 Parcel 85A and Folsom Hospital Project Water Demands

The 2014 Folsom Plan Area Water System Master Plan assumed a maximum day demand (MDD) of 0.155 million gallons per day (MGD) for Parcel 85A based on preliminary analysis by Mackay & Somps (Brown & Caldwell 2014). With consideration of development of the parcel by Dignity Health for an approximately 530,000 sf medical center consisting of two Medical Office Buildings and acute care Hospital Building, that number subsequently was revised upward to include an average annual demand of approximately 135 acre-feet per year (AFY), or 0.120-MGD, with a MDD of 0.22-MGD (assuming the 1.8 MDD Peaking factor from the 2014 Water System Master Plan, Table 2-1) for the medical center. This water demand is significantly higher than the preliminary estimate for Parcel 85A that was based on less intensive development.

The current average demand estimate of 135 AFY for the Dignity Health facility equates to a water use factor of 227 gallons per day per 1,000 square feet (gpd/KSF). This water use factor was compared to other water use data from agency planning criteria. The results are compared in the following table.

Table 2: Parcel 85 A Potable Water Demand Comparison

Land Use	Development (Acres)	Development (square feet)	Annual Water Use (gallons)[a]	Annual Water Use (Acre-feet)	Daily Water Demand (gpd/KSF)	Daily Water Use (MGD)[b]
Existing Parcel 85A Proposed Water Supply						
Multiple	51.4	377,076	39,753,822	122		0.11
Proposed Dignity Health Folsom Hospital Project and Parcel 85A Build-out						
Hospital[a]	33.1	530,000	43,990,000	135[c]	227[c]	0.12
MHD	NA	11.3	14,663,295	45		0.04
GC	4.2	13,000	2,606,808	8		0.01
Park	2.2	NA	2,932,659	9		0.01
Total			**64,192,762**	**197**		**0.18**

Notes: 1 acre-foot = 325,851 gallons, MGD = million gallons per day, gpd/KSF = gallons per day per 1,000 square feet, NA = Not Applicable

a. Hospital Use demand factor of 83 gallons per year per square foot (Capital Engineering Consultants, Inc.). The projected demands are likely to be reduced through water conservation measures and maximizing indoor and outdoor water efficiency during design development.

b. Daily water use is average day demand.

c. Hospital water demand of 227 gallons per day per 1,000 square feet is comparable to the Kaiser Permanente Los Angeles Medical Center Project water use factor of 250 gpd/KSF (LADWP 2018) as well as the water use factor for the Hospital land use category for Irvine Ranch Water District at 230 gpd/KSF (IRWD 2018).

The Folsom Plan Area Phase 1 Water infrastructure, which is sized to deliver 2.0-MGD to the FPA is currently under construction. Phase 1 infrastructure will be serving pressure zones 2, 3, 4, 5 and 6 and consists of the necessary backbone systems for portions of Zones 3, 5 and 6, including pipelines, booster pump stations, and storage tanks. Zone 3 was initially anticipated to serve Parcel 85A; a subsequent hydraulic analysis has found that based on the number of stories anticipated in the Hospital Building, it would be more efficiently served by Zone 4 (i.e. more advantageous to install pressure reducing to lower floors than to require more expensive pressure boosting for higher floors). However as discussed in the possible water infrastructure scenarios section, Dignity would like to continue to evaluate the potential to remain in Zone 3. Both Zone 3 and Zone 4 infrastructure can be served by

Phase 1, until the 2.0-MGD threshold is exceeded. At that time, Phase 2 infrastructure will be required to meet water demands above 2.0-MGD.

Portions of Phase 2 infrastructure are currently in design, including a 24-inch diameter pipeline from the Folsom WTP to just north of the FPA, a new booster pump station at the Folsom WTP, and a new Zone 3 storage tank. This design is anticipated to be complete and ready for construction bidding by January 2021. The Phase 2, 24-inch pipeline is required to be operational when FPA maximum daily demand exceeds 2.0-MGD and construction is estimated to commence when approximately 2,500 to 3,300 EDUs in the FPA have been connected to the system (Pers. Comm. Jim Ray 3/5/2020).

2 Possible Water Infrastructure Scenarios

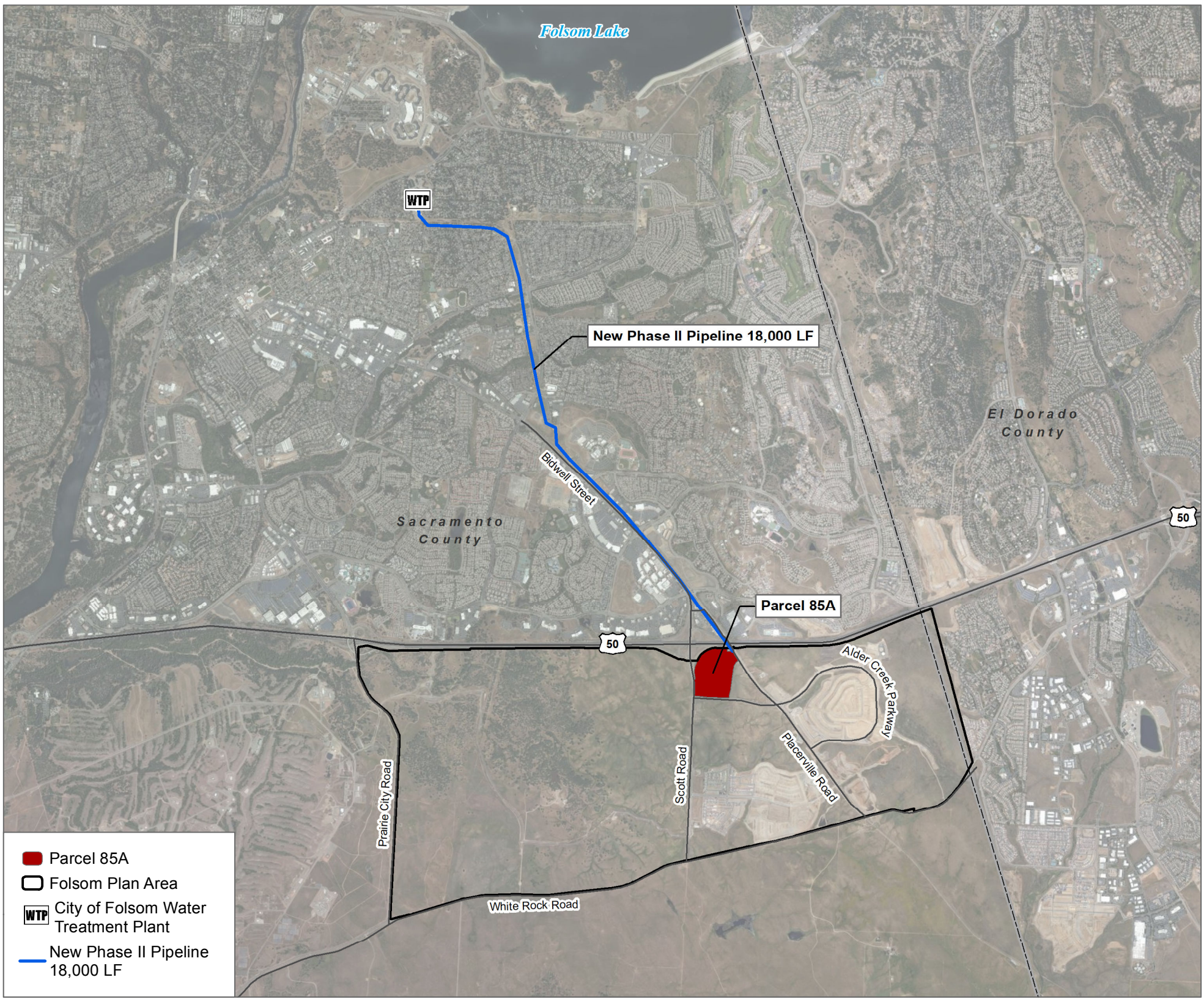
Dignity Health wants to better understand if selecting the FPA Zone 4 for the Medical Office Buildings and Hospital Building puts the other buildings on Parcel 85A (including commercial and residential multi-story apartment building) also in Zone 4. Dignity Health is also considering the following options regarding the zoning of the Medical Office Buildings and the Hospital Building:

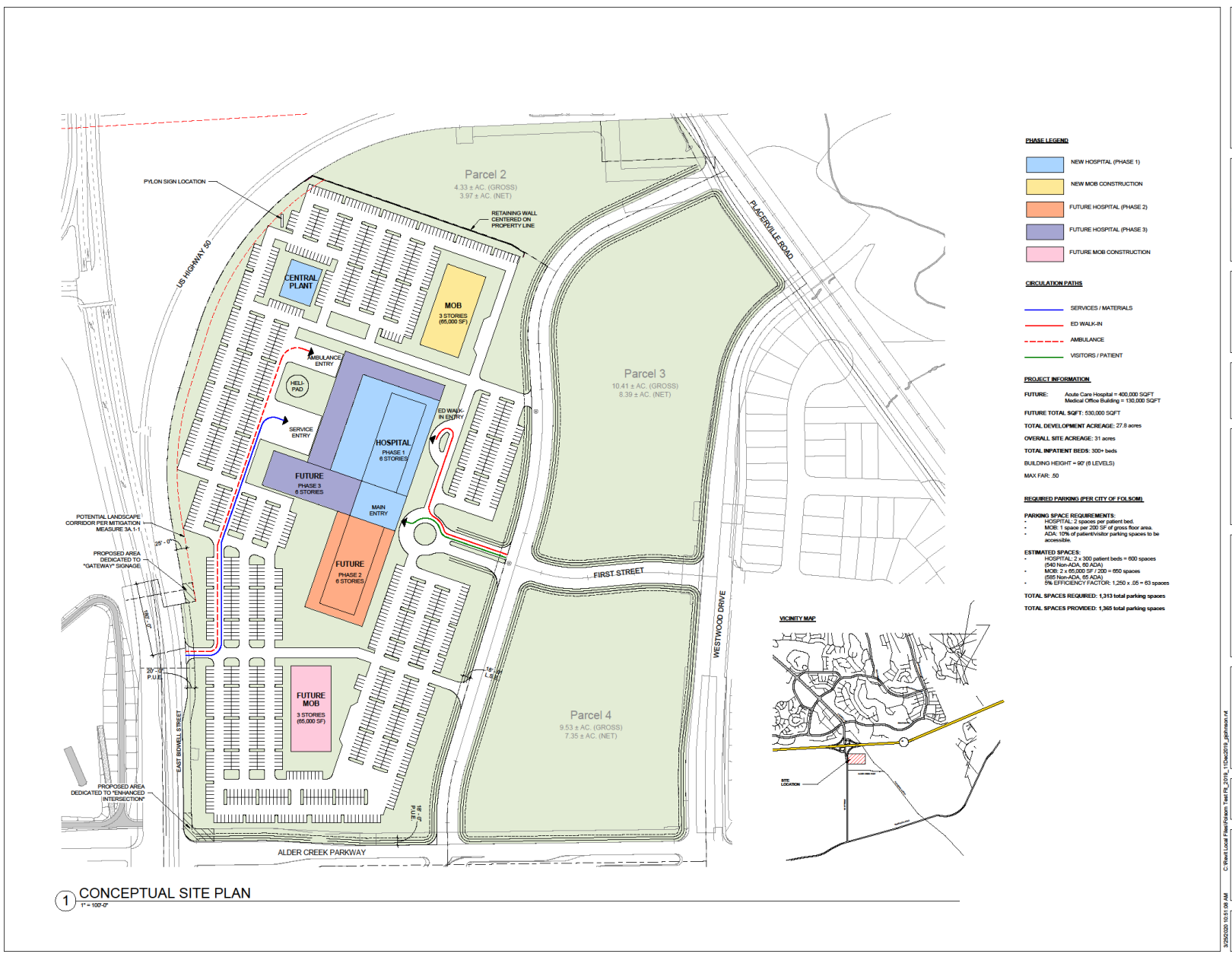
- Connecting 3-story Medical Office Buildings and Hospital to FPA Zone 3
- Connecting 3-story Medical Office Buildings to FPA Zone 3 and Hospital to FPA Zone 4 (Hybrid approach)
- Connecting 3-story Medical Office Buildings and Hospital to FPA Zone 4

Considering these following options Dudek also considered that keeping the Medical Office Buildings and Hospital Building in two separate zones, would need total of eight tie-in points (four for each zone including fire connections) and it will be determined by the City and their engineering consultant how they propose to serve those tie-in points of connection.

At this point, Dudek proposes for the City's consultant (Peterson Brustad Inc.) to run the following four scenarios using the water distribution system model:

- Ultimate MDD Extended Period Simulation (EPS) – 24-hour pressure curve for each tie-in point
- Ultimate MDD+ (Fire Flow) FF EPS – 24-hour pressure curve for each tie-in point
- Ultimate MDD Minimum Pressure with Tanks at minimum water level elevations (Steady State) – One minimum pressure value for each tie-in point
- Ultimate MDD+FF Minimum Pressure with Tanks at minimum water level elevations (Steady State) – One minimum pressure value for each tie-in point





SOURCE: ESRI; Sacramento County

DRAFT

FIGURE 1

Folsom Plan Area – Parcel 85A

DUDEK

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Appendix E: Folsom Plan Area Zone 4 and 5 booster Pump Station Preliminary Design Report

Folsom Plan Area

Zone 4 and 5 Booster Pump Station

Preliminary Design Report

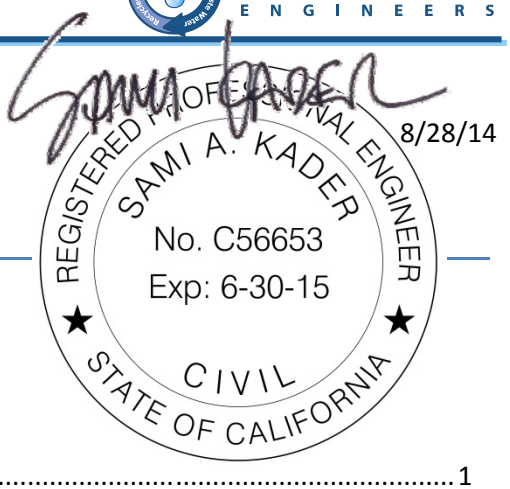
FINAL

August 2014

WATERWORKS ENGINEERS

WATERWORKS ENGINEERS

Folsom Plan Area
Zone 4 and 5 Booster Pump Station
Preliminary Design Report



8/28/14

Date: August 28, 2014
Prepared by: Sami Kader, PE & Anthony Baltazar, EIT
Checked by: Mike Fisher, PE

Contents

Appendices

Tables

Figures

Phasing

The Folsom Plan Area (FPA) Zone 4 and 5 Booster Pump Station will generally pump water from Zone 3 to Zone 4 and 5 of the Folsom Plan Area. Zone 5 will further serve Zone 6 through a separate pump station. The function of the FPA Zone 4 and 5 Booster Pump Station will occur in several phases as follows:

Phase 1A Operations

Initially, the Zone 4 and 5 Booster Pump Station will be constructed with the building for the Zone 4 and 5 Booster Pump Station, but only the Zone 5 pumps. The pump station will be fed through parallel 18" and 24" transmission mains from the existing City of Folsom Zone 3 (WSE = 450 at the FPA Zone 4 and 5 Booster Pump Station). Because initial Zone 5 Booster Pump Station operations will be fed from the transmission mains, there is some limitation on the feed-side capacity of the lift station. The Zone 5 pumps will pump to the new FPA Zone 5 Storage Tank (2.5-MG volume) through a dedicated 12" transmission main. No services will be connected to the transmission main, which will be 9000-ft long. The Zone 5 Storage Tank has a bottom elevation of 750 and a maximum water depth of 24-ft (HWL=774). From the Zone 5 Storage Tank, water will be delivered by gravity to FPA Zone 4 and by a separate Zone 6 Booster Pump Station to Zone 6. Figure 1 shows Phase 1A operations of the facility.

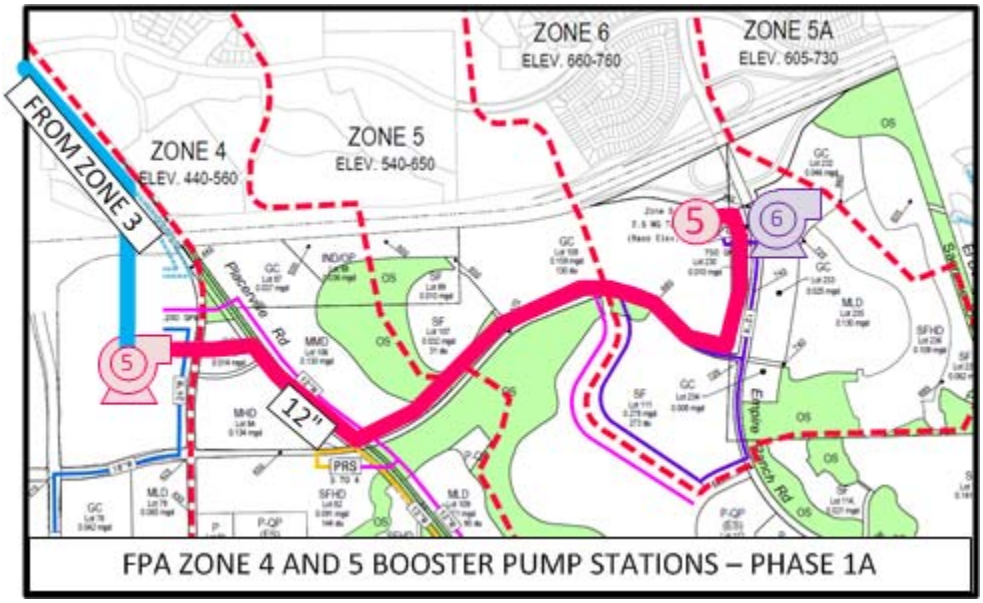


Figure 1. Zone 4 and 5 Booster Pump Station Phase 1A Operations

Phase 1B Operations

As development of the Folsom Plan Area continues, two Zone 3 Storage Tanks will be built (total volume 8-MG). These tanks will feed the Zone 4 and 5 Pump Station directly and allow for less restriction on pump station feed rate. Figure 2 shows Phase 1B operations of the facility.

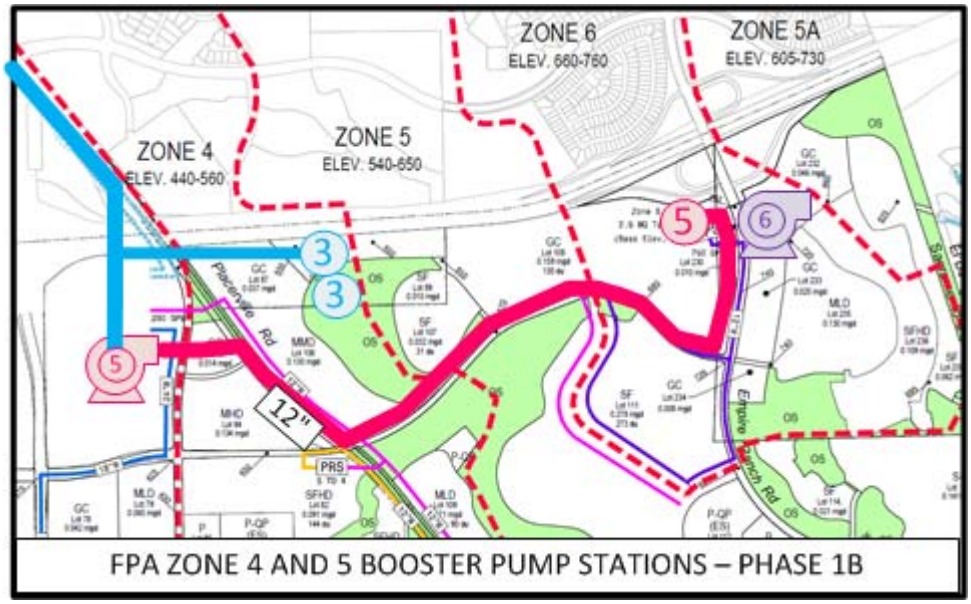


Figure 2. Zone 4 and 5 Booster Pump Station Phase 1B Operations

Ultimate Build-out Operations

As the FPA continues to grow, specifically in Zone 4, eventually a Zone 4 Storage Tank will be constructed. The Zone 4 Storage Tank will be 2-MG with a bottom elevation of 650 and a maximum water depth of 24-ft (HWL=674). The Zone 4 pumps at the Zone 4 and 5 Booster Pump Station will serve the Zone 4 tank through a dedicated 12" transmission main. The transmission main will not have any services on it and will be 3000-ft long. Planned Ultimate Build-out Operations are shown in Figure 3.

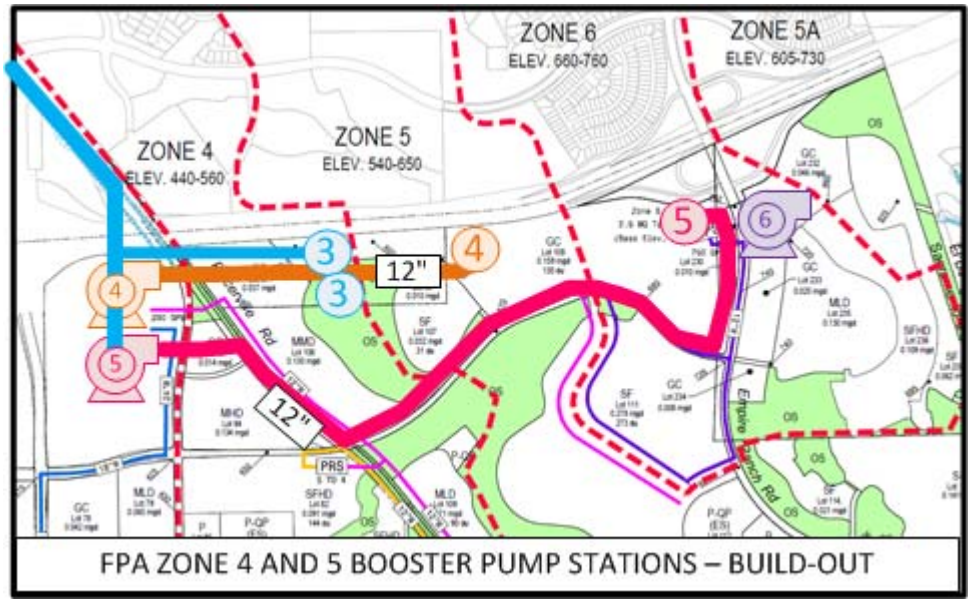


Figure 3. Zone 4 and 5 Booster Pump Station Ultimate Build-out Operations

Preliminary Pump Analysis

The following analysis was conducted in order to select the number and preliminary flow capacity of the pumps for the Zone 4 and 5 Booster Pump Stations. Following this preliminary analysis, more detailed hydraulic calculations will be made in order to make specific pump selections for the stations for use in the development of the final design.

Initial Pump Size Criteria

Flow from the Zone 4 and 5 Booster Pump Station will be designed based on tank fill times for the respective storage tanks. The following criteria have been used in selecting pump sizes:

1. Provide enough total duty pumping capacity to completely refill the entire storage tank volume in 24-hours following/during a fire event.
2. Provide enough total duty pumping capacity to refill peak day demand during off-peak power rate times (a 14 hour window from 10:00 pm to 12:00 noon).
3. Provide enough capacity in a single pump to refill peak day demand in a 24-hour period.

Table 1 summarizes the pump capacity calculations made for the Zone 4 and 5 Booster Pump Station.

Table 1. Pump Station Flows

Pump Station No.	Storage Tank Volume (MG)	Peak Day Demand (MG)	Total Target Pumping Capacity[1] (gpm)	Single Pump Target Capacity[2] (gpm)
4	2	1.5	1786	1042
5	2.5	1.5	1786	1042

1. Total Pumping Capacity allows for refilling entire storage tank in 24-hours or peak day demand in 14 hours, whichever is greater.
2. Single Pump Capacity allows for refilling peak day demand in 24-hours.

Examining the criteria and pumping rates, it is recommended that a system with 2 duty pumps be provided for both stations. One duty pump would have the capacity of 1042-gpm, with two pumps running having the capacity of 1786-gpm. Later in this Preliminary Design Report, system curves will be developed and pump selections are made, at which point these target flowrates will be refined.

Estimated Pump Power Requirements

Table 2 summarizes the estimated head and power requirements for the booster pumps. This estimate is based on estimated friction losses and is intended only to aid in the examination of off-peak pumping. A more detailed assessment of the system curves for both stations will be made later in this Report.

Table 2. Preliminary Estimate of Pump Station Power Requirements

Pump Station No.	Static Head (ft)	Transmission Main Length (ft)	Estimated Friction Loss at 1042-gpm (ft)	Required Pump Head at 1042-gpm (ft)	Total Power at 1042-gpm (hp)	Estimated Friction Loss at 1786-gpm (ft)	Required Pump Head at 1786-gpm (ft)	Total Power at 1786-gpm[1] (hp)
4	174	3000	8	182	100	27	201	150
5	274	9000	24	298	150	80	354	250

Pumping During Off-Peak Power Rate Hours

The use of off-peak pumping to control electricity costs is a desired feature of the Zone 4 and 5 Booster Pump Station. Table 3 summarizes the power rates currently charged to the City of Folsom.

Table 3. Power Rates

Season	Off-Peak Power Rate (22:00-12:00) ($/kW-h)	On-Peak Power Rate (12:00-14:00) ($/kW-h)	Super-Peak Power Rate (14:00-22:00) ($/kW-h)
Winter	$ 0.0717	$ 0.0906	$ 0.0906
Summer	$ 0.0863	$ 0.1057	$ 0.1203

The use of off-peak pumping at the Zone 4 and 5 Booster Pump Station will save considerable money, especially during peak demand periods in the summer. Using the approximated pump horsepowers developed in Table 2, and the power rates from Table 3, Table 4 compares power costs with 1 pump running to refill peak day demand over a 24-hour period versus 2 pumps running to refill peak day demand in a 14-hour period, operated during the off-peak power rate time of day.

Table 4. Cost Savings of Off-Peak Pumping During Summer Peak Demand Periods

Pump Station No.	Daily Cost to Pump at 1042-gpm (one pump) for 24-hours	Daily Cost to Pump at 1786-gpm (two pumps) for 14 hours	Cost Savings (%)
4	$178	$135	31%
5	$266	$225	18%

Having the flexibility to operate the station during off-peak hours only allows the City of Folsom to take advantage of off-peak pumping strategies for reducing energy usage.

Assessment of Initial Pump Sizing

This analysis confirms that the sizing approach of having two duty pumps able to re-fill the peak day demand in each tank during the 14-hour off-peak power period is appropriate as this will be an operational strategy that is likely to be used in order to save money. Given the infrequency of fire flow use, having pumps which can refill the entire tank in 14 hours is oversizing the pumps, but being able to recover from a fire event in 24-hours is prudent. Overall, the initial sizing approach appears to be appropriate and the remainder of this Preliminary Design Report will proceed with those target flowrates and a 2-duty/1 standby pump station for each the Zone 4 and Zone 5 Booster Pump Stations.

Variable Speed versus Full Speed Drives

While variation in pump flowrates is not necessary for operation of the pump station, variable speed drives may be necessary in order to accommodate the entire operating range of hydraulic conditions (changes in static head, generally) that can be encountered at this station. In the pump selection section of this Report the need for variable speed drives will be assessed.

Pump Type

Either split-cased centrifugal or vertical turbine pumps are appropriate for this application. Discussions with the City of Folsom Engineering and Operations and Maintenance personnel indicated that for this booster station installation, because there will be significant booster station pressures and no cause for concern regarding net positive suction head (NPSH), split-cased centrifugal pumps are the preferred pump selection. The split-cased centrifugal pumps are much easier to maintain than the vertical turbine pumps, principally because the entire pump is above grade, easy to access, and easier to manage for maintenance and removal/replacement without having to use a hired crane.

Pump Selection

The following describes the final selection of pumps for the Zone 4 and 5 Booster Pump Stations.

Preliminary Pump Selection

Using the criteria set forth in Tables 1 and 2, the following preliminary split-case centrifugal pump selections were made. Both of the pumps are from the PACO line of pumps that are manufactured and sold by Grundfos. There are other manufacturers which also would be able to meet the design criteria developed in this Report, but preliminary selections were made using these pumps. Details on the Grundfos/PACO split-case centrifugal pumps are included in Appendix A. Table 5 below summarizes related data about the pumps.

Table 5. Split-Case Centrifugal Pump Selections

Pump Station No.	PACO Model	Rated Impeller Diameter (in)	Total Power (hp)	RPM	Material
4	4015-9/0 KP	13.2	75	1800	Cast Iron
5	6019-7/8 KP	17.57	250	1800	Cast Iron

Both of the pumps are NSF-61 certified, meeting CDPH requirements for equipment used in potable water systems. Both pump models are suitable for variable speed drives. Figure 4 below shows a Grundfos/PACO horizontal split-case pump.

Figure 4. Grundfos/PACO Horizontal Split-Case Pump

System Curve Development

Two different hydraulic scenarios, described below, were modeled for each zone to develop the range of system curves for each the Zone 4 and Zone 5 systems. The two scenarios are described below:

1. Worst-Case Hydraulic Conditions
    a. Both Zone 4 and Zone 5 stations are running.
    b. Hazen-Williams Coefficient, C=120 (i.e. high friction).
    c. Zone 3 Supply Water Surface Elevation = 500' (i.e. low head in Zone 3).
    d. Receiving Tank Water Surface Elevation = 674' (Zone 4) and 774' (Zone 5) (i.e. high head in tank).
2. Best-Case Hydraulic Conditions
    a. Only one station is running at a time.
    b. Hazen-Williams Coefficient, C=140 (i.e. low friction).
    c. Zone 3 Supply Water Surface Elevation = 580' (i.e. high head in Zone 3).
    d. Receiving Tank Water Surface Elevation = 650' (Zone 4) and 750' (Zone 5) (i.e. low head in tank).

System curve calculations are included in the hydraulic calculations in Appendix B. Figure 5 and Figure 6 illustrate the range of system curves for the Zone 4 and Zone 5 Booster Pump Stations, respectively. The system curves have been calculated assuming that one pump is running up to a flowrate of 1042-gpm and above that flowrate, 2 pumps are running.

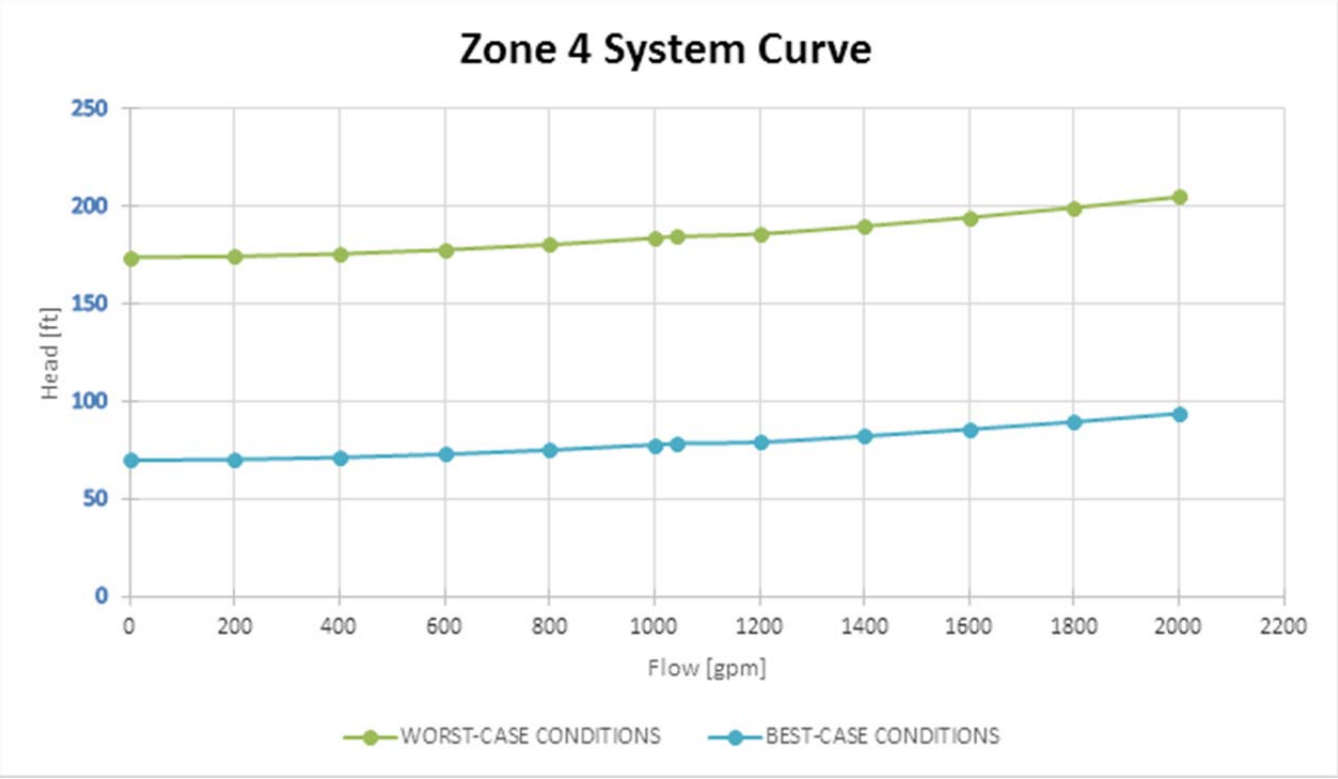


Figure 5. System Curve Range for Zone 4 Booster Pump Station

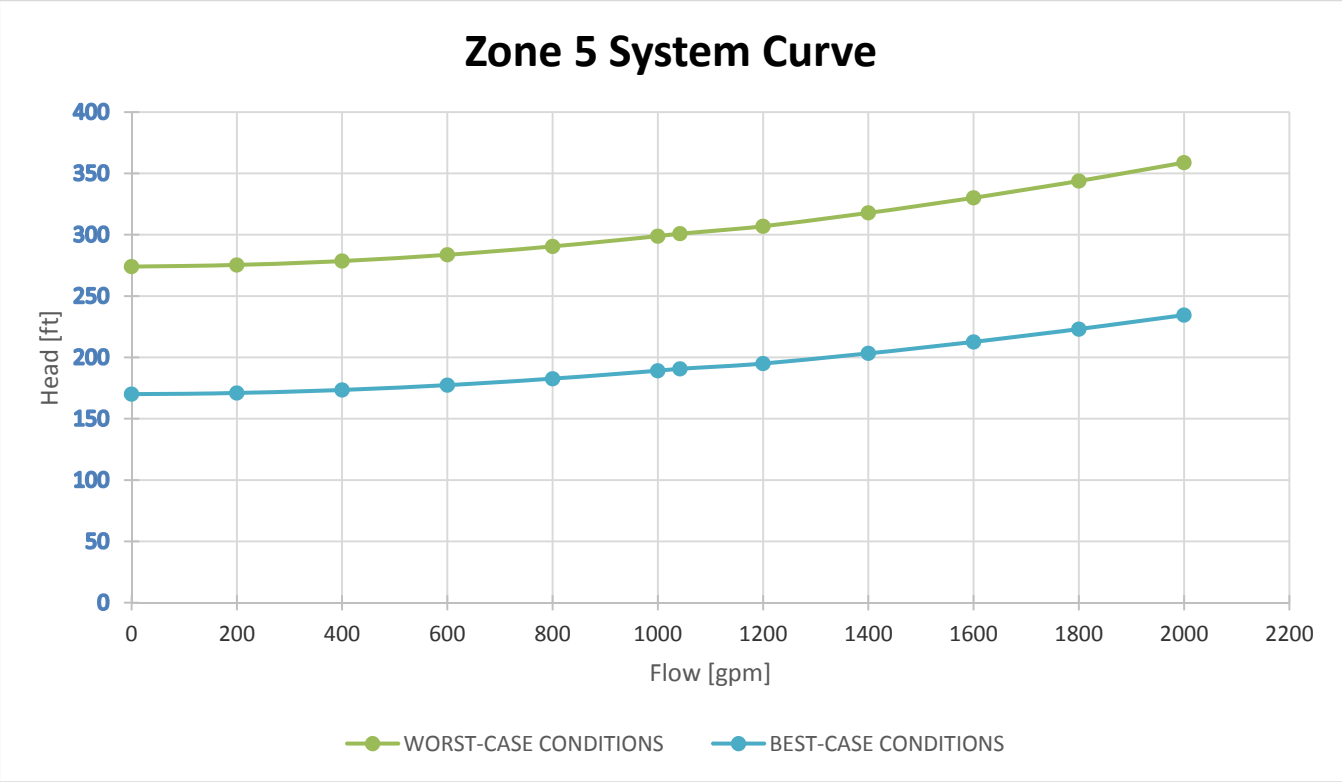


Figure 6. System Curve Range for Zone 5 Booster Pump Station

Selected Pump Performance

The preliminary pump selections have been checked against the system curves developed. Figure 7 and Figure 8 below illustrate the anticipated performance of the selected pumps across the range of anticipated system curve behavior in the Zone 4 and Zone 5 Booster Pump Stations, respectively.

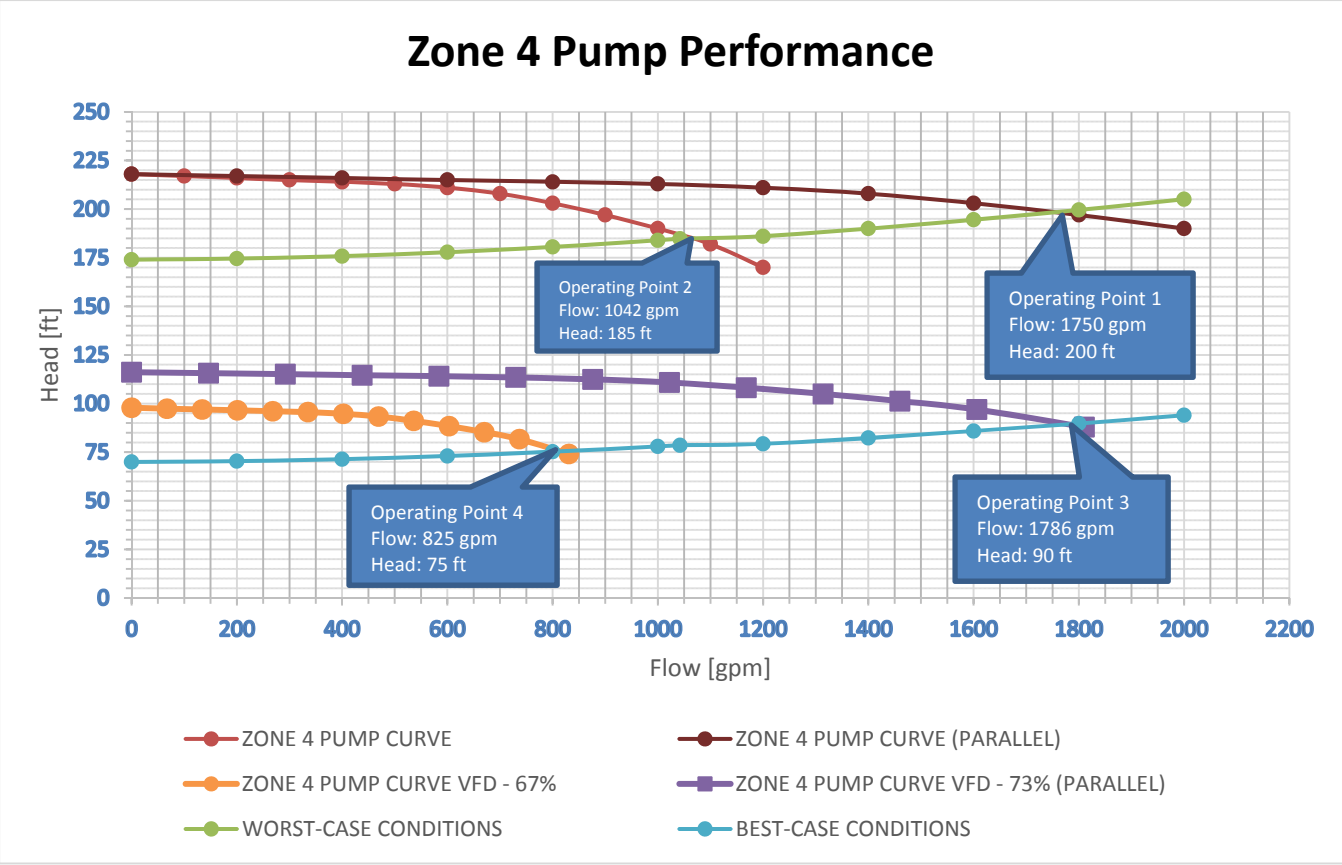


Figure 7. Pump Performance for Zone 4 Booster Pump Station

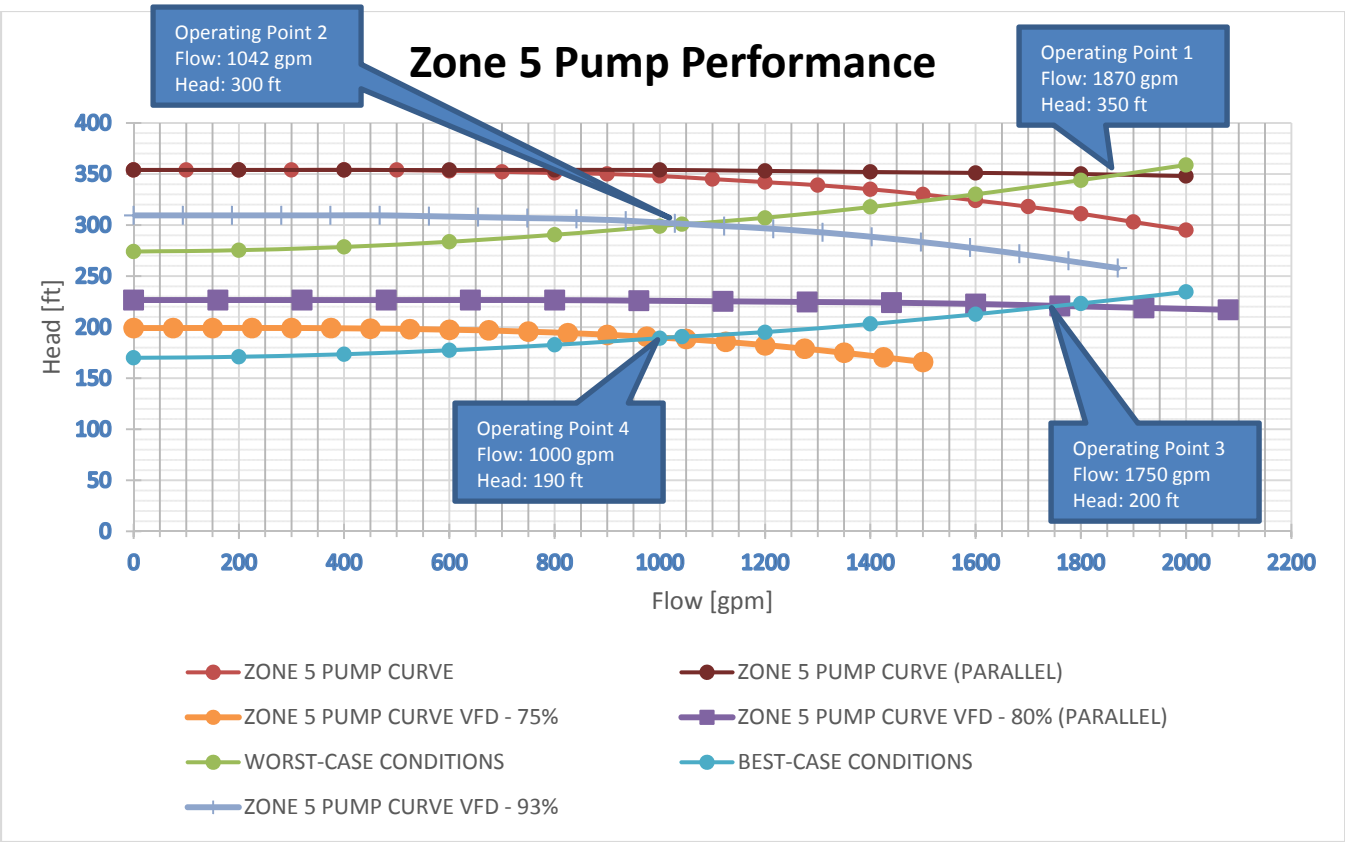


Figure 8. Pump Performance for Zone 5 Booster Pump Station

As can be observed in Figure 7 and Figure 8, flows close to the preliminary target flows can be achieved with the selected pumps and system curves developed. The resulting pump flows for the selected pumps and calculated system curves are as follows in Table 6.

Table 6. Pump Station Performance with Selected Pumps and Calculated System Curves

Pump Station No.	Storage Tank Volume (mg)	Peak Day Demand (mg)	One Pump Capacity Range (gpm)	Time Range to Refill Peak Day Demand with One Pump (hrs)	Two Pump Capacity Range (gpm)	Time Range to Refill Peak Day Demand with Two Pumps (hrs)	Time Range to Entire Tank Volume with Two Pumps (hrs)
4	2	1.5	825-1042	24-30	1750-1786	14-14.5	18.7-19.3
5	2.5	1.5	1000-1042	24-25	1750-1870	13.5-14.5	22.5-24

For both stations, the time to refill peak day demand with one pump can meet the 24-hour criteria established in this Report. The time to refill peak day demand with two pumps running can meet the 14-hour criteria which allows the City to take full advantage of off-peak power rates.

As shown on Figure 7, because there is such a wide range of static head in the system, the operating point for the pump operating during the best-case conditions system curve nears the run-out condition of the selected pump. The pump VFDs will be operated to achieve as close to the flow setpoint (e.g. 1000-gpm) as possible from the single operating pump while avoiding pump run-out.

The preliminary pump selections that have been made will be further refined during final design as more detailed system conditions have been identified.

Surge Management

A surge assessment will be performed on each of the two pump systems (Zone 4 and Zone 5) and appropriate surge management provisions made. In general, surge control will be accomplished using valves (surge anticipator valves which relieve into the suction side of the pump station for positive pressure wave surges and air-admittance valves for negative pressure wave surges). A surge tank of any sort is not anticipated to be used to manage surge at this booster pump station.

Flow Metering

Flow from each of the two pump stations (the Zone 4 and Zone 5 Booster Pump Stations) will be independently monitored using a magnetic flowmeter on the discharge line. They will be placed on a segment of 12" piping that is straight at least 5 pipe diameters upstream and 3 pipe diameters downstream of the flowmeter. Magnetic flowmeter will be located inside of the pump station building.

Chlorine Feed Provisions

Water quality degradation as related to water age is anticipated to be a concern in the Folsom Plan Area, especially during initial operations. The Zone 4 and 5 Booster Pump Station will have the infrastructure (building, electrical, control systems, etc.) to support a re-chlorination facility and will be centrally located to address the loss of chlorine residual. A storage room will be provided within the pump station building for the purpose of holding 12.5% sodium hypochlorite storage drums. Table 7 describes the design criteria for the chlorine feed system.

Table 7. Chlorine Feed System Design Criteria

Design Criteria	Value	Units	Comments
Maximum Re-chlorination Dose	2	mg/L	Estimated Dose
Average Re-chlorination Dose	1	mg/L	Estimated Dose
Zone 4 Build-out Maximum Day Demand[1]	720	gpm	
Zone 5 and 6 Build-out Maximum Day Demand[1]	830	gpm	The Zone 5 Booster Pump station Serves both Zone 5 and Zone 6 flows
Total Zone 4 and 5 Booster Pump Station Maximum Day Build-out Flowrate	1550	gpm	The chlorine storage system will serve both stations
Total Zone 4 and 5 Booster Pump Station Average Day Build-out Flowrate	775	gpm	50% of max day
55-gallon Storage Time at Average Day Build-out Flowrate and Average Re-chlorination Dose	6	days	

[1]From FPA Master Plan, Table 2-2

Initial estimates (reference Table 7) indicate that 55-gallon polyethylene drums containing 12.5% sodium hypochlorite will be adequate storage for the facility. Although this appears to be adequate at this time, there are many variables which may change as the system is operated. The stored amount of sodium hypochlorite may need to be increased to accommodate larger flows or higher dosage rates in the future. While the storage room will have enough space to store multiple 55-gallon drums, it will also be able to accommodate a 550-gallon tank and containment basin (reference Appendix C) if someday needed to accommodate mini-bulk (300 to 350-gallon tote) deliveries of sodium hypochlorite. The room will therefore have a minimum floor dimension of 7-ft x 7-ft and double doors to allow for delivery of drums and installation of a future containment basin and 550-gallon storage tank.

In order to allow for control of dosing rates to Zone 4 and Zone 5 independently, chlorine will be dosed on the discharge piping for each pump line-up, with an injection quill installed inside of the pump building in the discharge header. There is no need for mixing at the point of chemical injection as the chlorine will be injected into a dedicated transmission main, which will allow for dissolution and mixing during the transmission of water to the storage tank (across which there will be no water services).

General Pump Station Arrangement

Mechanical

A single 24" feed header will enter the pump station building underground from the east side. The feed header will continue down the middle of the station, with discharge headers on either side. The underground suction header will allow for easier access to the pumps inside of the station for maintenance. Even though only the Zone 5 pumps will be operational in the initial phase, the underground piping for both Zone 4 and Zone 5 stations will be constructed. Figure 9 below illustrates the general pump arrangement anticipated for the pump station.

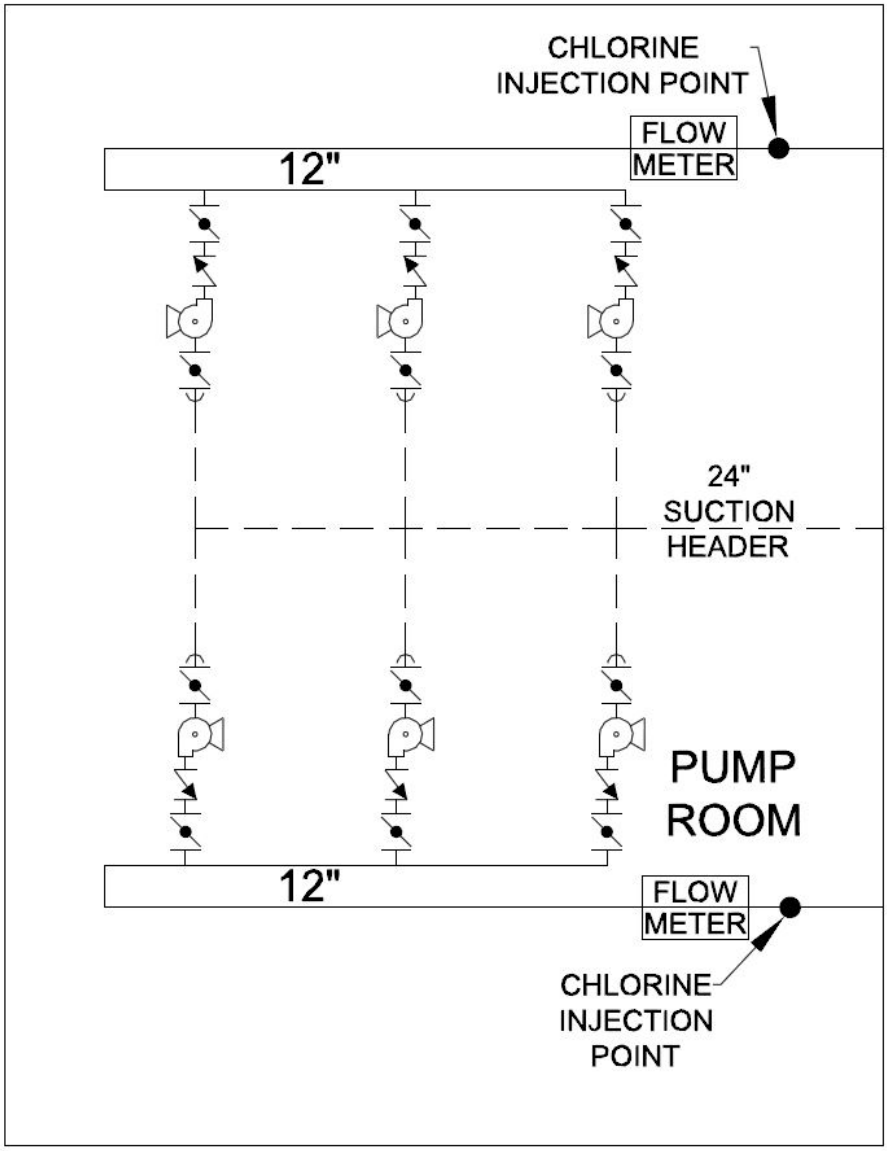


Figure 9. Pump Station Preliminary General Mechanical Arrangement

Pump Removal and Maintenance Access

The Zone 4 and 5 Booster Pump Station will be designed to allow for pump removal and maintenance with relative ease. A 12-foot roll-up door will be installed at the front of the building, providing enough width to transport pump parts in and out of the pump station for installation and future maintenance access. The roll-up door shall be 10 feet tall to provide enough clearance for backing a truck into the building. A portable manual floor crane will be used to handle valves, pump parts, motors, or even entire pumps. The HP2000R Portable Floor Crane from Ruger Industries, Inc. (shown in Figure 10) provides enough lifting capacity to carry the heaviest pumps for removal and re-installation and lift the top casing when maintenance needs to be performed. A 12-foot clearance between the pump line-ups will likely allow enough room for the portable crane to maneuver during maintenance operations as well as provide clearance for backing a truck into the building. The manual crane will be provided and permanently stored in the building for pump maintenance operations.

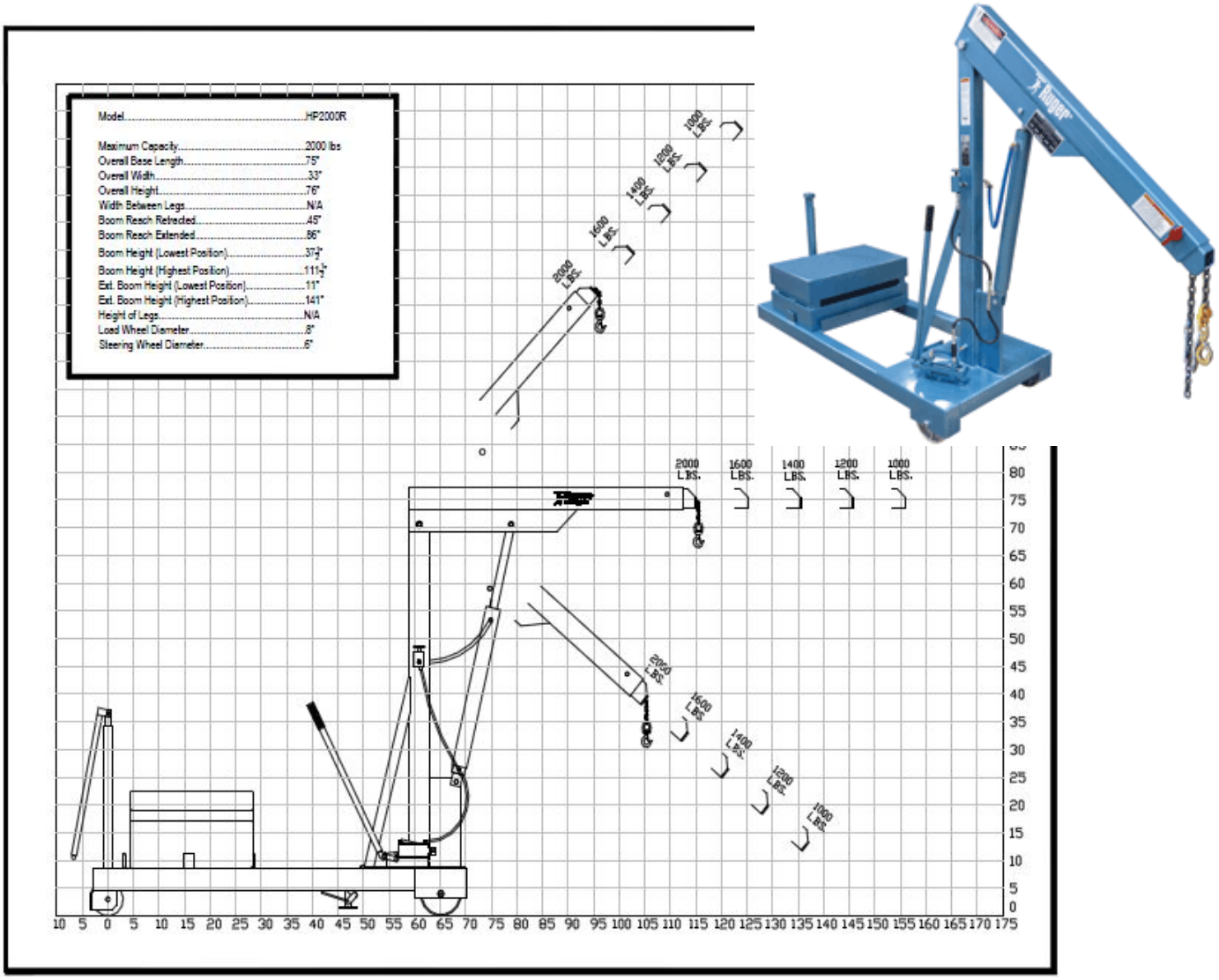


Figure 10. Portable Floor Crane and Crane Capacity Chart

Electrical Room

The electrical room, located in the southwest corner of the pump station building, will be 20 feet long and 13 feet wide. The ceiling will be at least 9 feet high to provide enough clearance height for the various electrical equipment. Two doors will be installed to open in the direction of egress travel, with the door height being at least 8 feet (including transom) to allow for installation and removal of the electrical equipment.

Emergency Generator

An emergency generator and automatic transfer switch will provide power for the entire pump station in the event of a power outage. The generator will be rated at least 600-kW and powered by diesel. A fuel storage tank will be on-site which will store sufficient fuel for at least 24 hours of continuous operation of the emergency generator under full load. The footprint of the generator will be about 14 feet in length and 6 feet in width. A minimum of 4 feet of space around the generator will be provided, resulting in the generator room being 24 feet long and 14 feet wide. The generator room will have two doors installed that open in the direction of egress travel. The generator room will be located in the northwest corner of the pump station building and adjacent to the electrical room. A suction and discharge louver will be installed. If the emergency generator needs to be removed from the generator room, it can be taken out through the louver on the radiator end.

Manufacturer and California Building Code ventilation requirements are to be followed for the generator room. Ventilation assessment calculations will be performed for the generator room during final design and the appropriate provisions made.

Chemical Storage and Feed

The chemical feed storage room will be adjacent to the generator room on the north side of the building and will be 7 feet long and 7 feet wide to accommodate the potential for a future 500-gallon chemical storage and feed station. The entrance doors will be on the outside of the building to allow for delivery of chemical storage drums.

Overall Building Size and Layout

The pump station building as a whole will be 60 feet long and 40 feet wide. Figure 11 illustrates the planned general layout of the pump station building.

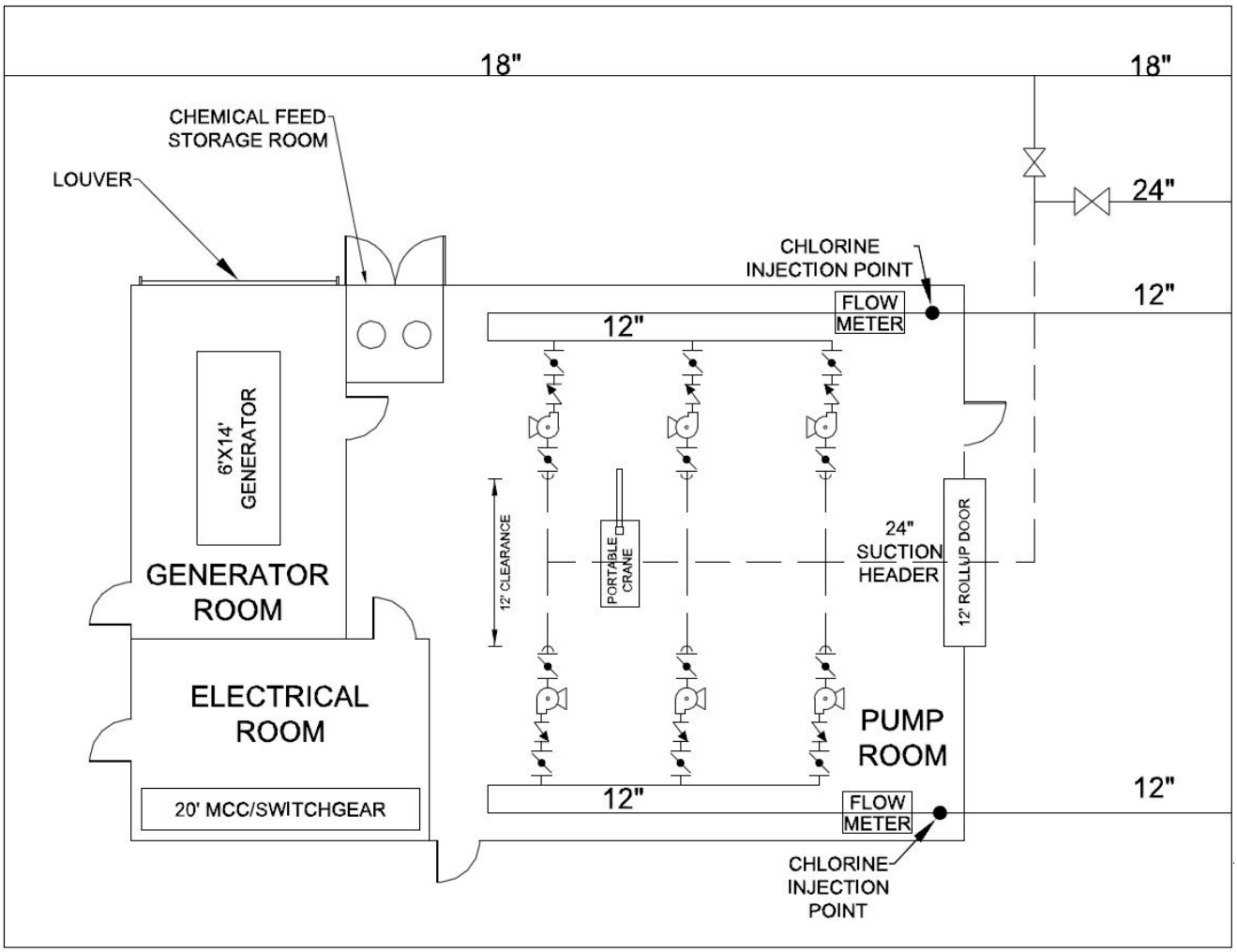


Figure 11. Overall Pump Station Preliminary Floorplan

Building Design

Structure

Generally, the building will be a concrete slab foundation, CMU block (either 8x8x16 or 12x8x16 CMU, as required by the structural design) building with a concrete tile roof. CMU block will be completely grout filled. The structure will be designed to meet 2013 California Building Code standards. As a critical part of providing fire flow to the Zone 4 and 5 tanks and therefore a significant portion of the Folsom Plan Area, the facility will be Risk Category IV and structural design calculations will be made accordingly.

Building Architecture

Generally, split faced block and concrete tile are the primary building materials to be used in the construction of the building. The overall color scheme is a beige/brown combination so as to be unobtrusive and easy to maintain. Figure 12 shows a building with the general architectural themes as planned. Specific architectural selections and colors follow in the key note descriptions.

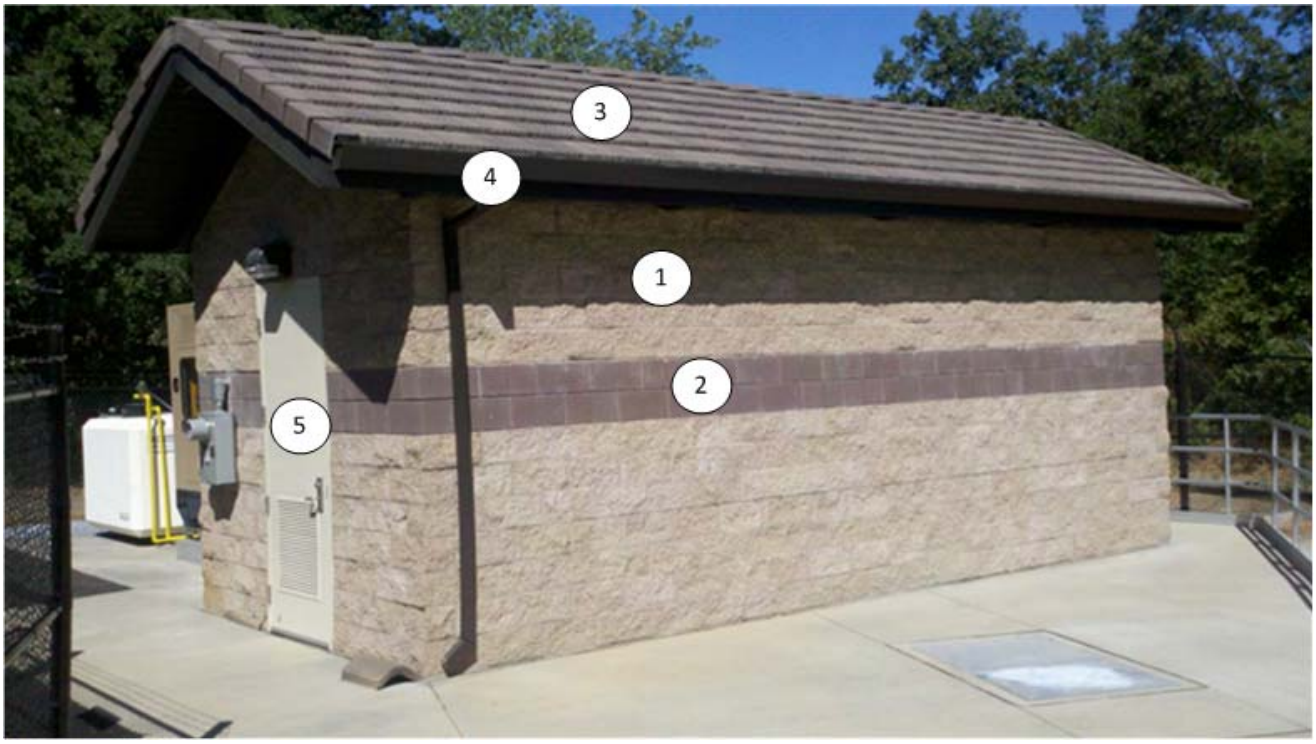


Figure 12. Example of Planned Building Architecture

The specific building material and color selections will be as follows (see keynotes on Figure 12):

1. Main CMU block will be split face block, light tan in color (Basalite color 345, or equal)

2. Accent stripe to be installed just above centerline of building. Accent stripe will be scored precision face block, brown in color (Basalite color 498, or equal)

3. Roofing to be concrete tile with a wooden shake profile, brown in color. (Eagle Roofing Ponderosa profile, Brown Gray Range, or equal).

4. Fascia and other wood trim and eaves will be painted dark brown (Tnemec Color 49RD "Black Forest", or equal). Gutters, downspouts and other flashing in the roof and eave area to be galvanized steel, painted the same color as fascia. Any wall mounted light fixtures to be a matching dark brown/bronze color.

5. Personnel doors and metal coiling overhead doors (roll-up doors) to be galvanized steel. Louvers to be aluminum. All door hardware to be stainless steel. All doors, louvers and any exterior wall-mounted panels or equipment to be painted light tan (Tnemec Color 66BR "Dust Bowl", or equal).

HVAC

The pump room will utilize an evaporative cooler for cooling and electric space heaters for heating. The evaporative cooler ventilation will be run through the chlorine storage and feed room using louvers in the divider wall and doors to provide conditioning in that space. The evaporative cooler will be ground-mounted for easy maintenance access with ductwork in the building and ventilation louvers to allow for appropriate airflow to cool the building to a design temperature of 80°F with the maximum number of pumps running. The generator room will be unconditioned, with the ventilation design intended only to serve the internal combustion engine on the generator unit. It will be completely separated from the remainder of the building. The electrical room will be heated and cooled using a through-wall unitary heat pump with easy maintenance access from the ground. The room will have a design temperature of 72°F and the use of a heat pump will provide conditioning without increasing humidity in order to preserve the electrical and SCADA equipment inside.

Site Layout

Figure 13 shows the preliminary site layout for the FPA Zone 4 and 5 Booster Pump Station.

Yard Piping

The 18" and 24" water lines will enter the site from the east side of the site, near the north end. They will then manifold together into the 24" suction header that will enter the pump station building on the east side. The 18" will be continued westward across the site to allow for future tie-in to Zone 3 distribution. The two 12" water lines will exit the building and site eastward. All of the water lines will be capped just outside of the CMU block fencing so that they can be accessed without disturbing the pump station site when connections are made.

Vehicle Access and Parking

Access to the site will be from the east side of the property, near the south end through a wrought-iron gate. The pump station building will have concrete pavement to the east and south for vehicular access and parking. There will be space for a truck to drive to the fuel storage tank at the southwest corner of the site for fuel deliveries. For chemical feed deliveries, the truck can park on the north side of the pavement and the sodium hypochlorite can be transported into to the chemical storage and feed room.

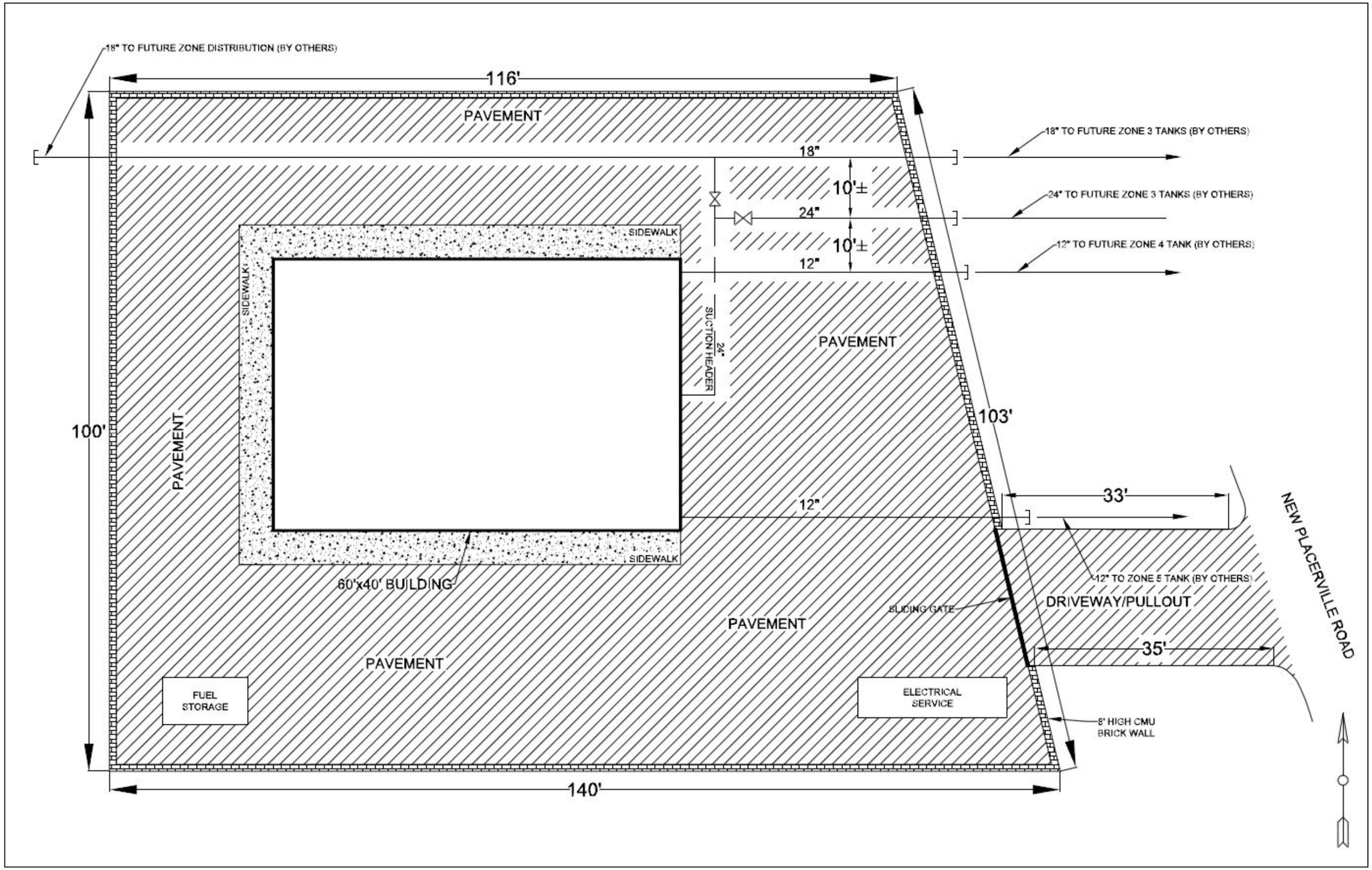


Figure 13. Preliminary Site Layout

Security

Fencing and Gates

Fencing for the site will be 8-ft tall CMU block fencing with columns at the corners of the site, matching the main block style and color of the building (split face block, light tan color). CMU fencing will be 8x8x16 reinforced CMU with a continuous concrete footing and grout fill in the cells with reinforcing. The post and fence cap block will be matching color to the split face field block. An example of what the fencing will look like is shown in Figure 14.

Figure 14. Example of Planned CMU Block Fence

Wrought-iron vehicle and personnel access gates will be provided with automatic openers and keypad entry systems. Vehicle gate will be a 20-ft wide rolling gate to allow for large vehicle access. Gate color will match block wall color (light tan). Gates will be designed for climb prevention and general vehicle security, but will not be anti-ram gates or meet any specific anti-ram requirements of ASTM F2656 - 07 *Standard Test Method for Vehicle Crash Testing of Perimeter Barriers*. Gates will be similar to those shown in Figure 15 (note that the gates will have anti-climb bars, but the wall will not).

Figure 15. Example of Planned Wrought Iron Access Gates

Alarm System

Security systems for the pump building will include door alarms and motion detectors inside of the building as well as smoke alarms, all wired to a single alarm panel which will be able to alarm to SCADA as well as dial out to a security provider of the City's choosing.

Cost Estimate

Table 8 is the preliminary construction cost estimate for the facilities described in this report. The cost estimate only includes the pumps and valves inside the Pump Station Building for the Zone 5 Booster Pump Station. The building will be designed for both pump stations and the underground piping will be constructed to allow for future installation of the Zone 4 Booster Pump Station by simply adding pumps and valves inside the building. A contingency of 25% has been added to the estimate to account for further cost detailing as the design moves forward with further detail. A construction contingency of 10% has been added as well to account for unforeseen conditions which may occur during construction. The total cost of the station is estimated to be between $1.5M-2.0M. As the design is detailed, the cost estimate will also be more detailed, but a conservative budget of $2.0M for the facility is indicated at this time.

Table 8. Preliminary Cost Estimate

Project Number:	14-011
Title:	Folsom Plan Area Zone 4&5 BPS
Computed By:	Anthony Baltazar
Date:	8/18/2014
Checked By:	Sami Kader
Date:	8/28/2014

Preliminary Design Construction Costs

	Item	Quantity	Unit	Unit Cost	Total Cost
Site Work					
1	Site Fencing	459	LF	$150	$68,850
2	Site Gate	1	EA	$20,000	$20,000
3	Site Clearing/Mass Grading	1	LS	$20,000	$20,000
4	Personnel Gate	1	EA	$2,000	$2,000
5	Concrete (Sidewalk)	10	CY	$500	$5,185
6	AC Paving	10440	SF	$6	$62,640
					$178,700
Piping, Valves, and Fittings					
7	12" DIP	252	LF	$84	$21,168
8	18" DIP	130	LF	$144	$18,720
9	24" DIP	100	LF	$192	$19,200
10	18" Gate Valve	1	EA	$4,500	$4,500
11	24" Gate Valve	1	EA	$6,000	$6,000
12	Fittings	1	LS	$20,000	$20,000
13	Pipe Supports	1	LS	$10,000	$10,000
12	12" Butterfly Valve	3	EA	$3,000	$9,000
13	8" Butterfly Valve	3	EA	$2,000	$6,000
14	8" Swing Check Valve	3	EA	$4,000	$12,000
15	Installation of Piping and Valves	1	LS	$25,000	$25,000
					$151,600
Major Equipment					
16	Zone 5 Pumps; PACO 6019-7/8 KP	3	EA	$40,150	$120,450
17	Pump Installation	1	LS	$25,000	$25,000
18	Portable Crane	1	EA	$6,930	$6,930
					$152,400
Major Structural					
19	Pump Station Building (incl. HVAC & Plumbing)	2400	SF	$200	$480,000
					$480,000
Major Electrical					
20	Electrical Switchgear, Wire, Lighting, Controls, etc.	1	EA	$400,000	$400,000
21	Generator	1	EA	$110,000	$110,000
22	Magnetic Flow Meter	2	EA	$14,000	$28,000
					$538,000

Subtotal, Site Work		**$178,700**
Subtotal, Major Piping & Valves		**$151,600**
Subtotal, Major Equipment		**$152,400**
Subtotal, Major Structural		**$480,000**
Subtotal, Major Electrical		**$538,000**
General Conditions, Bonds, Insurance	7%	**$105,049**
Contractor Profit	8%	**$120,056**
Project SUBTOTAL		**$1,501,000**
Design Contingency	25%	$375,250
Construction Contingency	10%	$150,100
TOTAL CONSTRUCTION COST OPINION		**$2,026,350**

Appendix A – Grundfos/PACO Split Cased Centrifugal Pumps

Pump Performance Datasheet

Project name / location	: City of Folsom	Tag Number	: Booster Pumps
Consulting engineer	:	Service	: Pump Station #4
Customer	:	PACO Model	: 4015-9/0 KP
Customer ref. / PO	:	Quantity	: 3
Quote number	: KP071814-3	Quoted By (Sales Office)	: R. F. MacDonald Co.
Date last saved	: 08/01/2014 11:26 AM	Quoted By (Sales Engineer)	: Kevin Peters

Operating Conditions

Flow, rated	: 1,042.0 USgpm
Differential head / pressure, rated (requested)	: 182.0 ft
Differential head / pressure, rated (actual)	: 187.2 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1,780 rpm
Impeller diameter, rated	: 13.20 in
Impeller diameter, maximum	: 15.25 in
Impeller diameter, minimum	: 9.50 in
Efficiency	: 76.10 %
NPSH required / margin required	: 17.55 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 13 / 78 Metric units
MCSF	: 260.8 USgpm
Head, maximum, rated diameter	: 216.6 ft
Head rise to shutoff	: 15.70 %
Flow, best eff. point (BEP)	: 919.8 USgpm
Flow ratio (rated / BEP)	: 113.29 %
Diameter ratio (rated / max)	: 86.56 %
Head ratio (rated dia / max dia)	: 70.75 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	: Potable Water
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

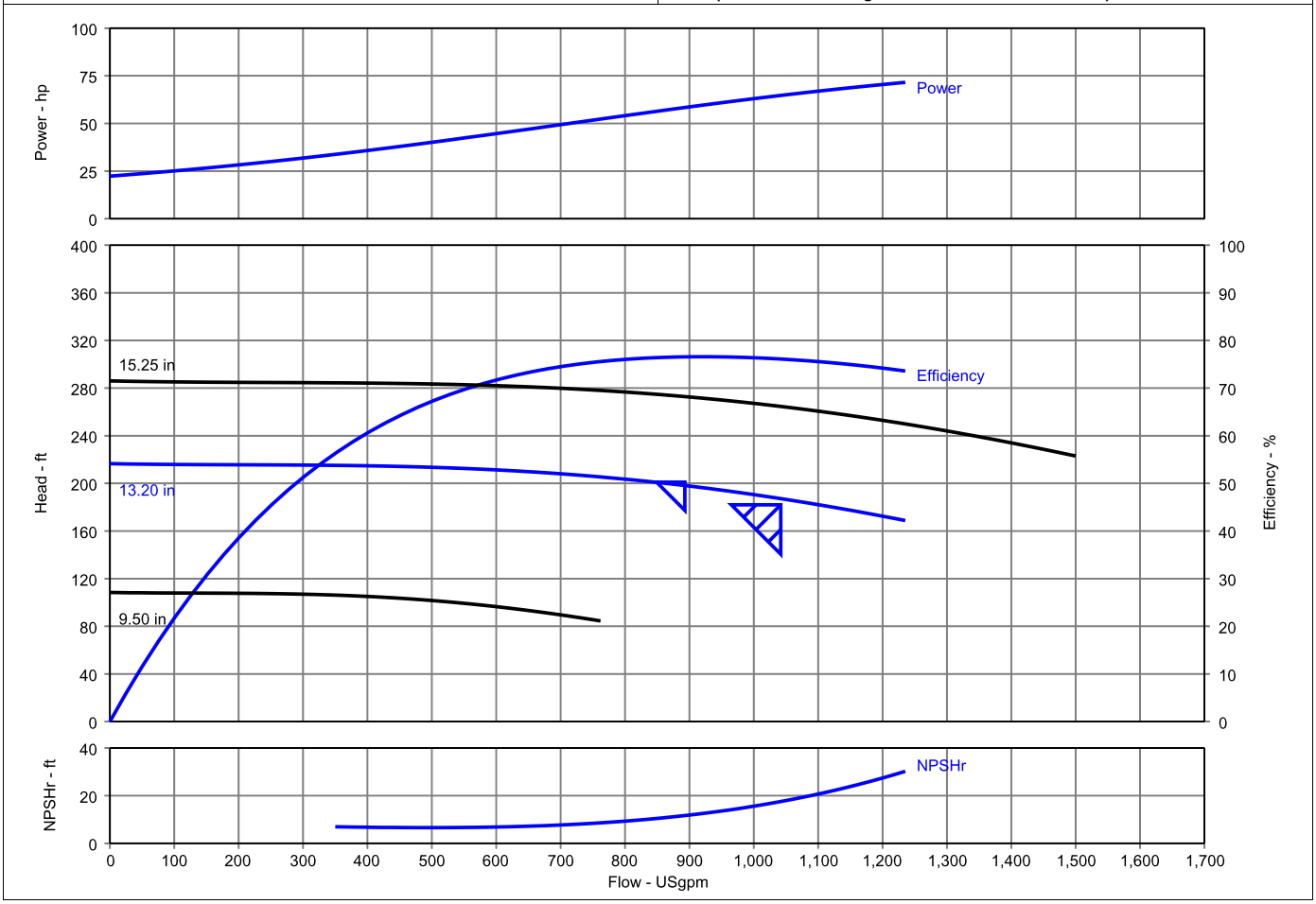
Material selected	: Cast Iron

Pressure Data

Maximum working pressure	: 93.73 psi.g
Maximum allowable working pressure	: 250.0 psi.g
Maximum allowable suction pressure	: 199.0 psi.g
Hydrostatic test pressure	: 375.0 psi.g

Driver & Power Data

Motor sizing specification	: Non-overloading (max power)
Margin over specification	: 0.00 %
Service factor	: 1.15 (used)
Power, hydraulic	: 49.24 hp
Based on duty point (rated power)	: 64.70 hp
Non-overloading (max power)	: 71.55 hp
Nameplate motor rating	: 75.00 hp / 55.93 kW



R. F. MacDonald Co. · 25920 Eden Landing Road · Hayward, California 94545-3816
phone: 510-784-0110 · fax: 510-784-1004

Construction Datasheet

Project name / location	: City of Folsom	Tag Number	: Booster Pumps
Consulting engineer	: -	Service	: Pump Station #4
Customer	:	PACO Model	: 4015-9/0 KP
Customer ref. / PO	:	Quantity	: 3
Quote number	: KP071814-3	Quoted By (Sales Office)	: R. F. MacDonald Co.
Date last saved	: 08/01/2014 11:25 AM	Quoted By (Sales Engineer)	: Kevin Peters

Construction

Nozzle	Size (in.)	Nozzle Configuration	Pos'n
Suction	5	125# ANSI	Side
Discharge	4	125# ANSI	Side

Orientation / Configuration	: Horizontal
Rotation	: Clockwise
Wear Ring Configuration	: Single - Case
Discharge Elbow Size	: -
Subplate	: -
Sump Depth (feet)	: -
Bearing Frame	: -
Bearing Frame Foot	: -
Bearing Type (Radial/Thrust)	: Ball/Ball
Bearing Lubrication	: Regreasable
Thrust Bearing	: -
Intermediate Bearing	: -
Lower Bearing	: -
Bearing Housing Accessories	: -
PACO Construction code	: 29N6-40159-14050X-2922EE

Baseplate, Coupling and Guard

Baseplate	: Welded Steel Fabrication
Drip Pan	: Drip Pan
Coupling	: Falk Type T10 (metal grid) 1070T10
Guard	: OSHA Approved

Seal & Packing Construction

Sealing Method	: Single Seal, Type 21S
Seal Material	: Buna Carbon Ceramic SS-Spring and Hardware
Packing Gland	: -
Lantern Ring	: -
Recirculation Lines	: Copper Tubing with Brass Fittings

Weights (Approx.)

Pump	: 575.0 lb
Baseplate	: 0.00 lb
Driver	: 908.0 lb
Estimated Shipping gross weight	: 1,483.0 lb

Motor Information

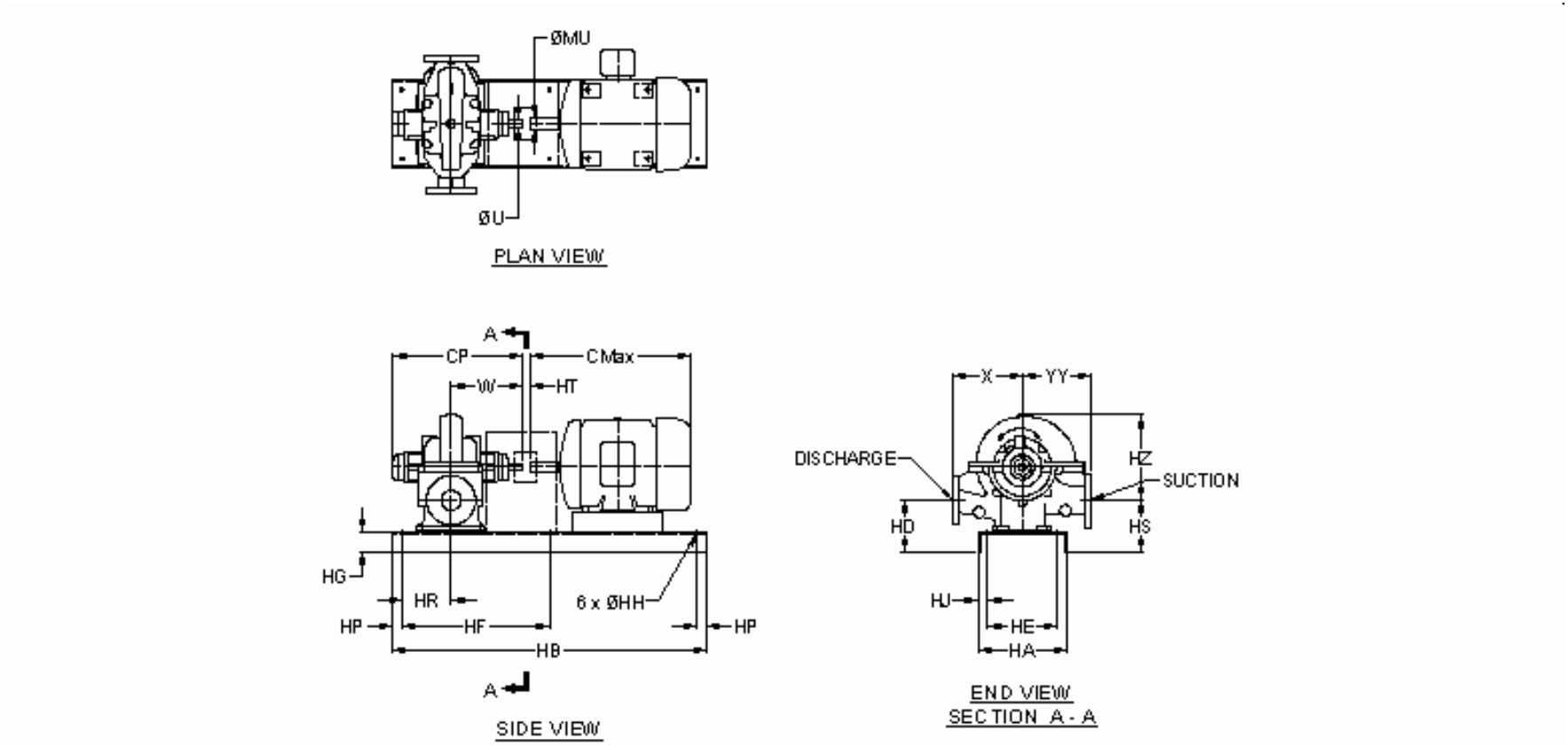
Manufacturer	: Baldor
Frame Size	: 365T
Power	: 75.00 hp
RPM	: 1,800 rpm
Enclosure	: TEFC
Operating Power Supply	: 230/460/3/60
Efficiency	: Premium
Service factor	: 1.15
Motor Application	: Suitable for Variable Speed Drive
Motor Options/Accessories	: -
Cord Length (feet)	: -

Materials

Case	: Cast Iron, ASTM A48 - Class 35
Motor Bracket	: -
Impeller	: Aluminum Bronze ASTM B148 UNS C95400 (B22)
Impeller Cap Screw and Washer	: -
Impeller Key	: Steel, Cold Drawn C1018
Case wear ring	: Tin Bronze, ASTM B584-90500 (B18)
Impeller wear ring	: Not Applicable
Pump Shaft	: Stressproof Steel, AISI 1144
Sleeve	: Bronze, III932, C89835
Line Shaft	: -
Column	: -
Discharge Pipe	: -
Discharge Elbow	: -
Suction Elbow	: -
Subplate	: -
Hardware	: Steel, Grade 5
O Rings	: Buna N
Pump Coatings	: Standard Manufacturers Paint

General Arrangement

Project name / location	: City of Folsom	Tag Number	: Booster Pumps
Consulting engineer	:	Service	: Pump Station #4
Customer	:	PACO Model	: 4015-9/0 KP
Customer ref. / PO	:	Quantity of pumps	: 3
Quote number	: KP071814-3	Quoted By (Sales Office)	: R. F. MacDonald Co.
Date last saved	: 08/01/2014 11:25 AM	Quoted By (Sales Engineer)	: Kevin Peters



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Units	Frame	Suct(in)	Disch(in)	C	CP	HA	HB	HD	HE	HF	HG	HH	HJ	HP	HR	HS	HT	HZ	MU	U	W	X	YY	Weight ea
inches	**365T**	**5**	**4**	**35.00**	**26.25**	**18.00**	**64.00**	**10.50**	**14.00**	**30.00**	**4.00**	**0.62**	**2.00**	**2.00**	**10.00**	**10.50**	**0.75**	**20.00**	**2.38**	**1.50**	**14.50**	**14.06**	**14.06**	**1,483.0**

Conditions of Service		Motor Data			
Flow: 1,042.0 USgpm	Fluid: Water	HP: 75	Encl: TEFC	Phase: 3	Efficiency: Premium
TDH: 182.0 ft	Temp.: 68.00 deg F	RPM: 1,780 rpm	Hz: 60	Voltage: 230/460	S.F.: 1.15

Pump Performance Datasheet

Project name / location	:	Tag Number	: Booster Pumps
Consulting engineer	:	Service	: Pump Station #5
Customer	:	PACO Model	: 6019-7/8 KP
Customer ref. / PO	:	Quantity	: 3
Quote number	: City of Folsom _ Rev1	Quoted By (Sales Office)	: R. F. MacDonald Co.
Date last saved	: 08/15/2014 9:36 AM	Quoted By (Sales Engineer)	: John Patterson

Operating Conditions

Flow, rated	: 900.0 USgpm
Differential head / pressure, rated (requested)	: 350.0 ft
Differential head / pressure, rated (actual)	: 350.2 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1,780 rpm
Impeller diameter, rated	: 17.57 in
Impeller diameter, maximum	: 19.00 in
Impeller diameter, minimum	: 15.00 in
Efficiency	: 64.77 %
NPSH required / margin required	: 6.58 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 13 / 153 Metric units
MCSF	: 464.1 USgpm
Head, maximum, rated diameter	: 354.1 ft
Head rise to shutoff	: 0.90 %
Flow, best eff. point (BEP)	: 1,741.3 USgpm
Flow ratio (rated / BEP)	: 51.68 %
Diameter ratio (rated / max)	: 92.47 %
Head ratio (rated dia / max dia)	: 84.76 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

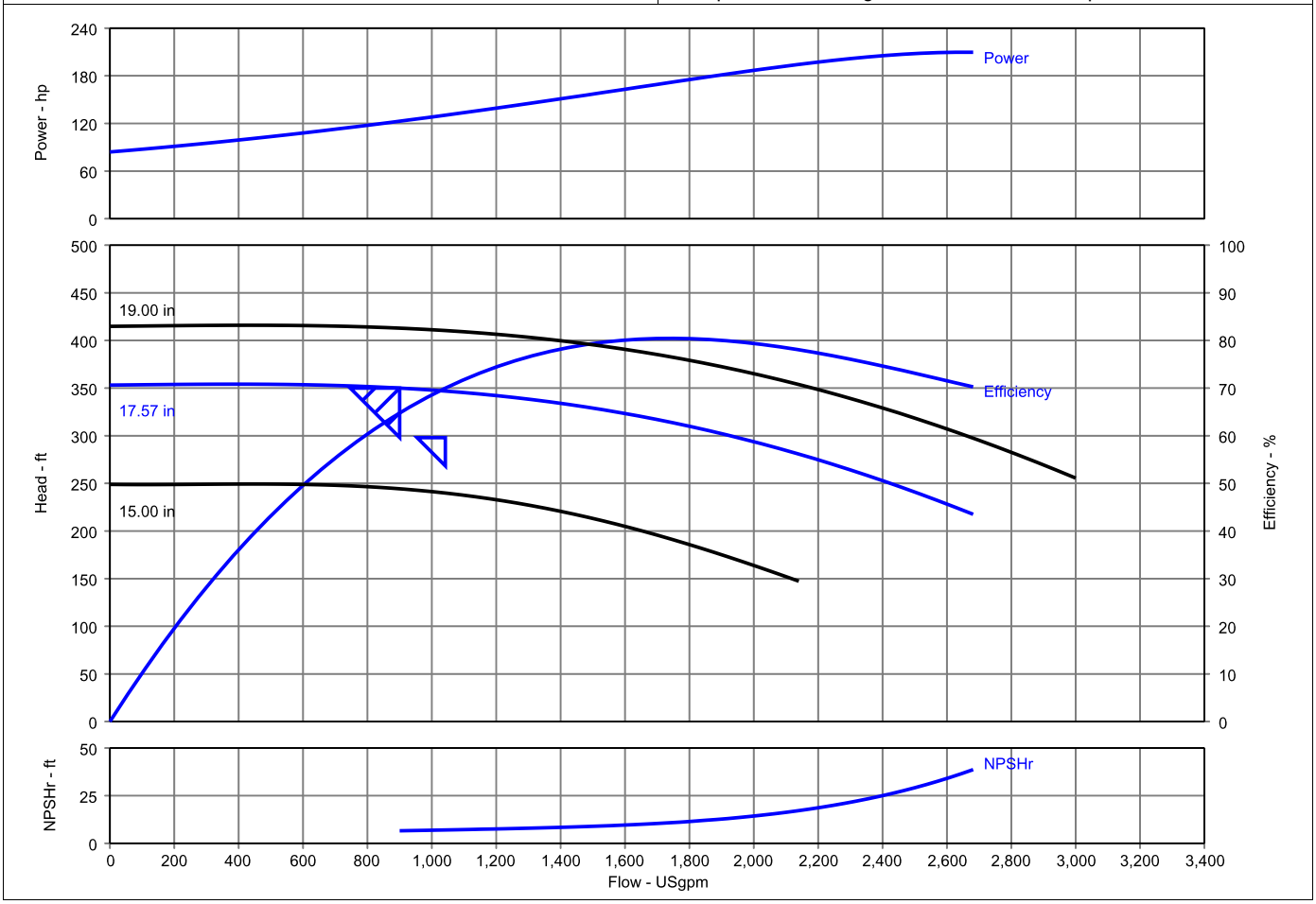
Material selected	: Cast Iron

Pressure Data

Maximum working pressure	: 153.3 psi.g
Maximum allowable working pressure	: 250.0 psi.g
Maximum allowable suction pressure	: 170.0 psi.g
Hydrostatic test pressure	: 375.0 psi.g

Driver & Power Data

Motor sizing specification	: Non-overloading (max power)
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 79.52 hp
Based on duty point (rated power)	: 123 hp
Non-overloading (max power)	: 210 hp
Nameplate motor rating	: 250 hp / 186 kW



R. F. MacDonald Co. · 25920 Eden Landing Road · Hayward, California 94545-3816
phone: 510-784-0110 · fax: 510-784-1004

Construction Datasheet

Project name / location	: -	Tag Number	: Booster Pumps
Consulting engineer	: -	Service	: Pump Station #5
Customer	:	PACO Model	: 6019-7/8 KP
Customer ref. / PO	:	Quantity	: 3
Quote number	: City of Folsom _ Rev1	Quoted By (Sales Office)	: R. F. MacDonald Co.
Date last saved	: 08/15/2014 9:36 AM	Quoted By (Sales Engineer)	: John Patterson

Construction

Nozzle	Size (in.)	Nozzle Configuration	Pos'n
Suction	8	125# ANSI	Side
Discharge	6	125# ANSI	Side

Orientation / Configuration	: Horizontal
Rotation	: Clockwise
Wear Ring Configuration	: Single - Case
Discharge Elbow Size	: -
Subplate	: -
Sump Depth (feet)	: -
Bearing Frame	: -
Bearing Frame Foot	: -
Bearing Type (Radial/Thrust)	: Ball/Ball
Bearing Lubrication	: Regreasable
Thrust Bearing	: -
Intermediate Bearing	: -
Lower Bearing	: -
Bearing Housing Accessories	: -
PACO Construction code	: 29N6-60197-16050X-1972EE

Baseplate, Coupling and Guard

Baseplate	: Welded Steel Fabrication
Drip Pan	: No drip pan
Coupling	: Falk Type T10 (metal grid) 1090T10
Guard	: OSHA Approved

Seal & Packing Construction

Sealing Method	: Single Seal, Type 21S
Seal Material	: Buna Carbon Ceramic SS-Spring and Hardware
Packing Gland	: -
Lantern Ring	: -
Recirculation Lines	: Copper Tubing with Brass Fittings

Weights (Approx.)

Pump	: 1,175.0 lb
Baseplate	: 0.00 lb
Driver	: 1,580.0 lb
Estimated Shipping gross weight	: 2,755.0 lb

Motor Information

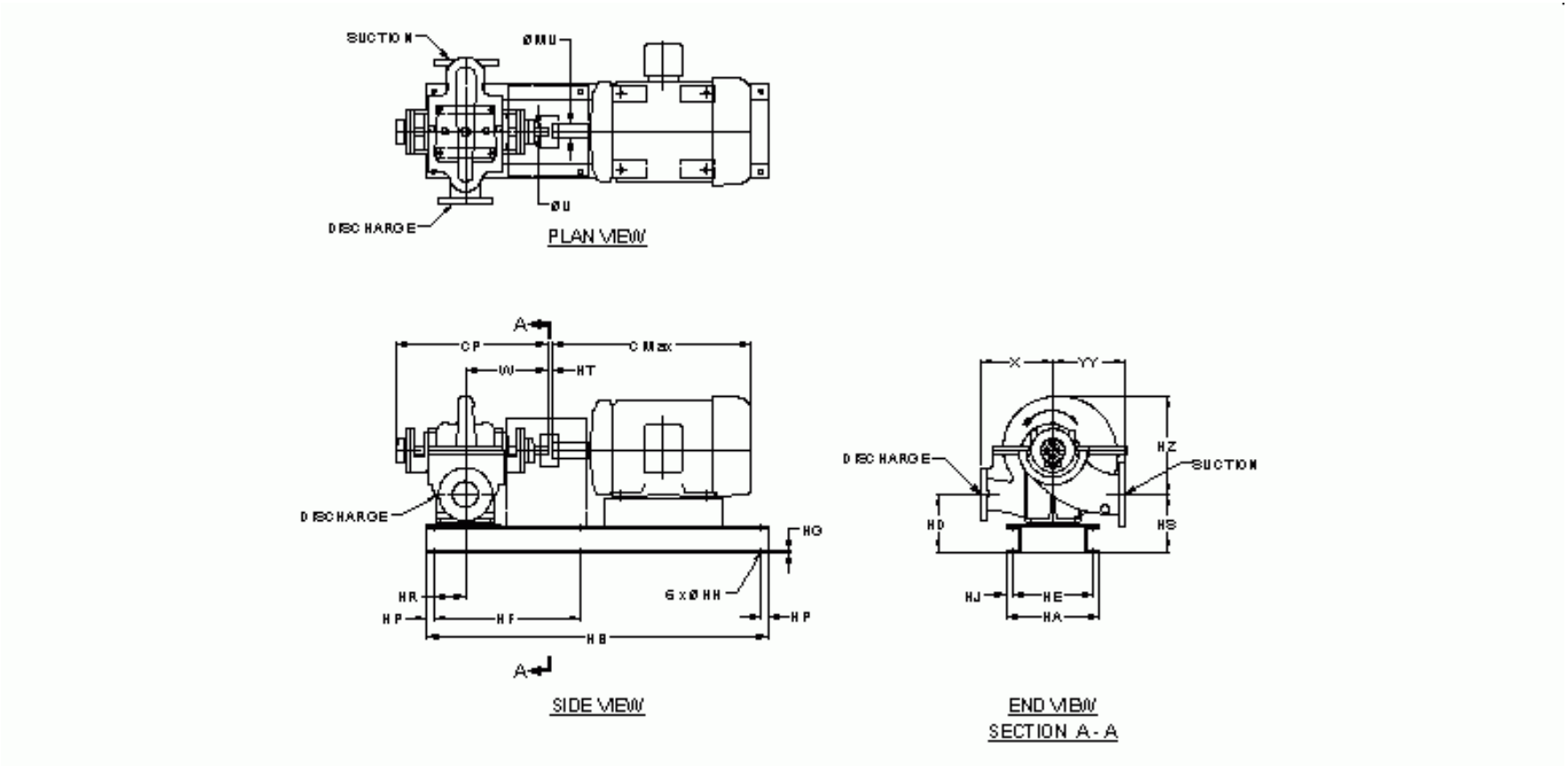
Manufacturer	: Baldor
Frame Size	: 447T
Power	: 250 hp
RPM	: 1,800 rpm
Enclosure	: ODP
Operating Power Supply	: 460/3/60
Efficiency	: Premium
Service factor	: 1.15
Motor Application	: Suitable for Variable Speed Drive
Motor Options/Accessories	: -
Cord Length (feet)	: -

Materials

Case	: Cast Iron, ASTM A48 - Class 35
Motor Bracket	: -
Impeller	: Aluminum Bronze ASTM B148 UNS C95400 (B22)
Impeller Cap Screw and Washer	: -
Impeller Key	: Steel, Cold Drawn C1018
Case wear ring	: Tin Bronze, ASTM B584-90500 (B18)
Impeller wear ring	: Not Applicable
Pump Shaft	: Stressproof Steel, AISI 1144
Sleeve	: Bronze, III932, C89835
Line Shaft	: -
Column	: -
Discharge Pipe	: -
Discharge Elbow	: -
Suction Elbow	: -
Subplate	: -
Hardware	: Steel, Grade 5
O Rings	: Buna N
Pump Coatings	: Standard Manufacturers Paint

General Arrangement

Project name / location	: -	Tag Number	: Booster Pumps
Consulting engineer	:	Service	: Pump Station #5
Customer	:	PACO Model	: 6019-7/8 KP
Customer ref. / PO	:	Quantity of pumps	: 3
Quote number	: City of Folsom _ Rev1	Quoted By (Sales Office)	: R. F. MacDonald Co.
Date last saved	: 08/15/2014 9:36 AM	Quoted By (Sales Engineer)	: John Patterson



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Units	Frame	Suct(in)	Disch(in)	C	CP	HA	HB	HD	HE	HF	HG	HH	HJ	HP	HR	HS	HT	HZ	MU	U	W	X	YY	Weight ea
inches	**447T**	**8**	**6**	**51.00**	**35.50**	**22.00**	**80.00**	**13.63**	**19.00**	**34.50**	**0.38**	**1.00**	**1.50**	**1.50**	**7.50**	**13.63**	**0.75**	**23.88**	**3.38**	**1.75**	**19.25**	**17.00**	**17.00**	**2,755.0**

Conditions of Service		Motor Data			
Flow: 900.0 USgpm	Fluid: Water	HP: 250	Encl: ODP	Phase: 3	Efficiency: Premium
TDH: 350.0 ft	Temp.: 68.00 deg F	RPM: 1,780 rpm	Hz: 60	Voltage: 460	S.F.: 1.15

Appendix B – Hydraulic Calculations

Hydraulic Analysis

Project:	FPA BPS 4	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 4 Best Case (1 Pump)	**Calc By:**	ARB	1042	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																580.000	0.000	
Pipe, PVC		Class 250	24.85	2.32	2.07	2.07	11	3.37	0.52	0.69	0.0074	140.000	0.0008	0.0008	440.00	579.999	139.999	0.001
Valve, Gate		Class 250	24.85	2.32	2.07	2.07	0	3.37	0.52	0.69	0.0074	0.200	0.0015	0.0022	440.00	579.998	139.998	0.002
Pipe, PVC		Class 250	24.85	2.32	2.07	2.07	22	3.37	0.52	0.69	0.0074	140.000	0.0015	0.0037	440.00	579.996	139.996	0.004
90-deg bend, Standard		Class 250	24.85	2.32	2.07	2.07	0	3.37	0.52	0.69	0.0074	0.300	0.0022	0.0059	440.00	579.994	139.994	0.006
Pipe, PVC		Class 250	24.85	2.32	2.07	2.07	11	3.37	0.52	0.69	0.0074	140.000	0.0008	0.0067	440.00	579.993	139.993	0.007
90-deg bend, Standard		Class 250	24.85	2.32	2.07	2.07	0	3.37	0.52	0.69	0.0074	0.300	0.0022	0.0089	440.00	579.991	139.991	0.009
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.330	0.0393	0.0482	446.00	579.952	133.952	6.048
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	1	0.84	0.26	2.77	0.1190	140.000	0.0020	0.0502	450.00	579.950	129.950	10.050
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	0.0740	450.00	579.926	129.926	10.074
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.500	0.0595	0.1335	450.00	579.866	129.866	10.134
Pipe, PVC	PUMP	Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	140.000	0.0561	0.1897	450.00	579.810	129.810	10.190
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	2.500	1.4610	1.6507	450.00	578.349	128.349	11.651
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	140.000	0.0140	1.6647	450.00	578.335	128.335	11.665
Valve, Butterfly		Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.500	0.2922	1.9569	450.00	578.043	128.043	11.957
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	140.000	0.0140	1.9709	450.00	578.029	128.029	11.971
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	1.9936	441.00	578.006	137.006	2.994
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	2	0.84	0.26	2.77	0.1190	140.000	0.0040	1.9976	441.00	578.002	137.002	2.998
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.0333	441.00	577.967	136.967	3.033
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	5	0.84	0.26	2.77	0.1190	140.000	0.0101	2.0434	441.00	577.957	136.957	3.043
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.0791	441.00	577.921	136.921	3.079
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	25	0.84	0.26	2.77	0.1190	140.000	0.0506	2.1297	441.00	577.870	136.870	3.130
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.190	0.1110	2.2407	441.00	577.759	136.759	3.241
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	140.000	0.0561	2.2969	441.00	577.703	136.703	3.297
Pipe, PVC	FLOW METER	Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	140.000	0.0140	2.3109	441.00	577.689	136.689	3.311
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	2	0.38	0.17	6.13	0.5844	140.000	0.0281	2.3390	441.00	577.661	136.661	3.339
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	2.3616	441.00	577.638	136.638	3.362
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	13	0.84	0.26	2.77	0.1190	140.000	0.0263	2.3879	441.00	577.612	136.612	3.388
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.4236	441.00	577.576	136.576	3.424
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	21	0.84	0.26	2.77	0.1190	140.000	0.0425	2.4661	441.00	577.534	136.534	3.466
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.5018	441.00	577.498	136.498	3.502
Pipe, PVC	MAIN DISCHARGE	Class 250	12.4	2.32	1.03	1.03	3000	0.84	0.26	2.77	0.1190	140.000	6.0672	8.5689	650.00	571.431	-78.569	218.569

Hydraulic Analysis

Project:	FPA BPS 4	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 4 Best Case (2 Pumps)	**Calc By:**	ARB	2000	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																580.000	0.000	
Pipe, PVC		Class 250	24.85	4.46	2.07	2.07	11	3.37	0.52	1.32	0.0272	140.000	0.0025	0.0025	440.00	579.997	139.997	0.003
Valve, Gate		Class 250	24.85	4.46	2.07	2.07	0	3.37	0.52	1.32	0.0272	0.200	0.0054	0.0080	440.00	579.992	139.992	0.008
Pipe, PVC		Class 250	24.85	4.46	2.07	2.07	22	3.37	0.52	1.32	0.0272	140.000	0.0050	0.0130	440.00	579.987	139.987	0.013
90-deg bend, Standard		Class 250	24.85	4.46	2.07	2.07	0	3.37	0.52	1.32	0.0272	0.300	0.0082	0.0211	440.00	579.979	139.979	0.021
Pipe, PVC		Class 250	24.85	4.46	2.07	2.07	11	3.37	0.52	1.32	0.0272	140.000	0.0025	0.0237	440.00	579.976	139.976	0.024
90-deg bend, Standard		Class 250	24.85	4.46	2.07	2.07	0	3.37	0.52	1.32	0.0272	0.300	0.0082	0.0318	440.00	579.968	139.968	0.032
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.330	0.0362	0.0680	446.00	579.932	133.932	6.068
Pipe, PVC		Class 250	12.4	2.23	1.03	1.03	1	0.84	0.26	2.66	0.1096	140.000	0.0019	0.0699	450.00	579.930	129.930	10.070
45-deg bend		Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.200	0.0219	0.0918	450.00	579.908	129.908	10.092
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.500	0.0548	0.1466	450.00	579.853	129.853	10.147
Pipe, PVC	PUMP	Class 250	8.33	2.23	0.69	0.69	4	0.38	0.17	5.89	0.5382	140.000	0.0520	0.1986	450.00	579.801	129.801	10.199
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	2.500	1.3456	1.5442	450.00	578.456	128.456	11.544
Pipe, PVC		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	140.000	0.0130	1.5572	450.00	578.443	128.443	11.557
Valve, Butterfly		Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	0.500	0.2691	1.8263	450.00	578.174	128.174	11.826
Pipe, PVC		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	140.000	0.0130	1.8394	450.00	578.161	128.161	11.839
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	1.9227	441.00	578.077	137.077	2.923
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	2	0.84	0.26	5.31	0.4385	140.000	0.0135	1.9362	441.00	578.064	137.064	2.936
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.0677	441.00	577.932	136.932	3.068
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	5	0.84	0.26	5.31	0.4385	140.000	0.0338	2.1015	441.00	577.899	136.899	3.101
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.2330	441.00	577.767	136.767	3.233
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	25	0.84	0.26	5.31	0.4385	140.000	0.1689	2.4019	441.00	577.598	136.598	3.402
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	4.46	0.69	0.69	0	0.38	0.17	11.77	2.1529	0.190	0.4091	2.8110	441.00	577.189	136.189	3.811
Pipe, PVC		Class 250	8.33	4.46	0.69	0.69	4	0.38	0.17	11.77	2.1529	140.000	0.1876	2.9986	441.00	577.001	136.001	3.999
Pipe, PVC	FLOW METER	Class 250	8.33	4.46	0.69	0.69	1	0.38	0.17	11.77	2.1529	140.000	0.0469	3.0455	441.00	576.955	135.955	4.045
Pipe, PVC		Class 250	8.33	4.46	0.69	0.69	2	0.38	0.17	11.77	2.1529	140.000	0.0938	3.1393	441.00	576.861	135.861	4.139
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	3.2226	441.00	576.777	135.777	4.223
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	13	0.84	0.26	5.31	0.4385	140.000	0.0878	3.3104	441.00	576.690	135.690	4.310
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	3.4420	441.00	576.558	135.558	4.442
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	21	0.84	0.26	5.31	0.4385	140.000	0.1419	3.5838	441.00	576.416	135.416	4.584
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	3.7154	441.00	576.285	135.285	4.715
Pipe, PVC	MAIN DISCHARGE	Class 250	12.4	4.46	1.03	1.03	3000	0.84	0.26	5.31	0.4385	140.000	20.2692	23.9846	650.00	556.015	-93.985	233.985

Hydraulic Analysis

Project:	FPA BPS 4	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 4 Worst Case (1 Pump)	**Calc By:**	ARB	1042	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																500.000	0.000	
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	6.78	2.07	2.07	11	3.37	0.52	2.01	0.0629	120.000	0.0073	0.0073	440.00	499.993	59.993	0.007
Valve, Gate		Class 250	24.85	6.78	2.07	2.07	0	3.37	0.52	2.01	0.0629	0.200	0.0126	0.0198	440.00	499.980	59.980	0.020
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	6.78	2.07	2.07	22	3.37	0.52	2.01	0.0629	120.000	0.0145	0.0344	440.00	499.966	59.966	0.034
90-deg bend, Standard		Class 250	24.85	6.78	2.07	2.07	0	3.37	0.52	2.01	0.0629	0.300	0.0189	0.0533	440.00	499.947	59.947	0.053
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	6.78	2.07	2.07	11	3.37	0.52	2.01	0.0629	120.000	0.0073	0.0605	440.00	499.939	59.939	0.061
90-deg bend, Standard		Class 250	24.85	6.78	2.07	2.07	0	3.37	0.52	2.01	0.0629	0.300	0.0189	0.0794	440.00	499.921	59.921	0.079
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.330	0.0393	0.1187	446.00	499.881	53.881	6.119
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	1	0.84	0.26	2.77	0.1190	120.000	0.0027	0.1214	450.00	499.879	49.879	10.121
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	0.1452	450.00	499.855	49.855	10.145
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.500	0.0595	0.2047	450.00	499.795	49.795	10.205
Pipe, Ductile Iron w/ CM Lining	PUMP	Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	120.000	0.0747	0.2794	450.00	499.721	49.721	10.279
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	2.500	1.4610	1.7403	450.00	498.260	48.260	11.740
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	120.000	0.0187	1.7590	450.00	498.241	48.241	11.759
Valve, Butterfly		Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.500	0.2922	2.0512	450.00	497.949	47.949	12.051
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	120.000	0.0187	2.0699	450.00	497.930	47.930	12.070
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	2.0925	441.00	497.908	56.908	3.092
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	2	0.84	0.26	2.77	0.1190	120.000	0.0054	2.0979	441.00	497.902	56.902	3.098
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.1336	441.00	497.866	56.866	3.134
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	5	0.84	0.26	2.77	0.1190	120.000	0.0134	2.1470	441.00	497.853	56.853	3.147
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.1827	441.00	497.817	56.817	3.183
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	25	0.84	0.26	2.77	0.1190	120.000	0.0672	2.2500	441.00	497.750	56.750	3.250
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.190	0.1110	2.3610	441.00	497.639	56.639	3.361
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	120.000	0.0747	2.4357	441.00	497.564	56.564	3.436
Pipe, Ductile Iron w/ CM Lining	FLOW METER	Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	120.000	0.0187	2.4544	441.00	497.546	56.546	3.454
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	2	0.38	0.17	6.13	0.5844	120.000	0.0373	2.4917	441.00	497.508	56.508	3.492
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	2.5143	441.00	497.486	56.486	3.514
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	13	0.84	0.26	2.77	0.1190	120.000	0.0350	2.5493	441.00	497.451	56.451	3.549
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.5850	441.00	497.415	56.415	3.585
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	21	0.84	0.26	2.77	0.1190	120.000	0.0565	2.6415	441.00	497.359	56.359	3.641
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.6772	441.00	497.323	56.323	3.677
Pipe, Ductile Iron w/ CM Lining	MAIN DISCHARGE	Class 250	12.4	2.32	1.03	1.03	3000	0.84	0.26	2.77	0.1190	120.000	8.0693	10.7465	674.00	489.253	-184.747	244.747

Hydraulic Analysis

Project:	FPA BPS 4	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 4 Worst Case (2 Pumps)	**Calc By:**	ARB	2000	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																500.000	0.000	
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	8.91	2.07	2.07	11	3.37	0.52	2.65	0.1087	120.000	0.0121	0.0121	440.00	499.988	59.988	0.012
Valve, Gate		Class 250	24.85	8.91	2.07	2.07	0	3.37	0.52	2.65	0.1087	0.200	0.0217	0.0338	440.00	499.966	59.966	0.034
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	8.91	2.07	2.07	22	3.37	0.52	2.65	0.1087	120.000	0.0241	0.0579	440.00	499.942	59.942	0.058
90-deg bend, Standard		Class 250	24.85	8.91	2.07	2.07	0	3.37	0.52	2.65	0.1087	0.300	0.0326	0.0906	440.00	499.909	59.909	0.091
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	8.91	2.07	2.07	11	3.37	0.52	2.65	0.1087	120.000	0.0121	0.1026	440.00	499.897	59.897	0.103
90-deg bend, Standard		Class 250	24.85	8.91	2.07	2.07	0	3.37	0.52	2.65	0.1087	0.300	0.0326	0.1353	440.00	499.865	59.865	0.135
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.330	0.0362	0.1714	446.00	499.829	53.829	6.171
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.23	1.03	1.03	1	0.84	0.26	2.66	0.1096	120.000	0.0025	0.1739	450.00	499.826	49.826	10.174
45-deg bend		Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.200	0.0219	0.1958	450.00	499.804	49.804	10.196
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.500	0.0548	0.2506	450.00	499.749	49.749	10.251
Pipe, Ductile Iron w/ CM Lining	PUMP	Class 250	8.33	2.23	0.69	0.69	4	0.38	0.17	5.89	0.5382	120.000	0.0692	0.3199	450.00	499.680	49.680	10.320
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	2.500	1.3456	1.6654	450.00	498.335	48.335	11.665
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	120.000	0.0173	1.6828	450.00	498.317	48.317	11.683
Valve, Butterfly		Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	0.500	0.2691	1.9519	450.00	498.048	48.048	11.952
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	120.000	0.0173	1.9692	450.00	498.031	48.031	11.969
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	2.0525	441.00	497.948	56.948	3.052
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	2	0.84	0.26	5.31	0.4385	120.000	0.0180	2.0704	441.00	497.930	56.930	3.070
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.2020	441.00	497.798	56.798	3.202
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	5	0.84	0.26	5.31	0.4385	120.000	0.0449	2.2469	441.00	497.753	56.753	3.247
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.3785	441.00	497.622	56.622	3.378
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	25	0.84	0.26	5.31	0.4385	120.000	0.2247	2.6031	441.00	497.397	56.397	3.603
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	4.46	0.69	0.69	0	0.38	0.17	11.77	2.1529	0.190	0.4091	3.0122	441.00	496.988	55.988	4.012
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	4.46	0.69	0.69	4	0.38	0.17	11.77	2.1529	120.000	0.2495	3.2617	441.00	496.738	55.738	4.262
Pipe, Ductile Iron w/ CM Lining	FLOW METER	Class 250	8.33	4.46	0.69	0.69	1	0.38	0.17	11.77	2.1529	120.000	0.0624	3.3240	441.00	496.676	55.676	4.324
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	4.46	0.69	0.69	2	0.38	0.17	11.77	2.1529	120.000	0.1247	3.4488	441.00	496.551	55.551	4.449
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	3.5321	441.00	496.468	55.468	4.532
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	13	0.84	0.26	5.31	0.4385	120.000	0.1168	3.6489	441.00	496.351	55.351	4.649
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	3.7804	441.00	496.220	55.220	4.780
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	21	0.84	0.26	5.31	0.4385	120.000	0.1887	3.9691	441.00	496.031	55.031	4.969
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	4.1007	441.00	495.899	54.899	5.101
Pipe, Ductile Iron w/ CM Lining	MAIN DISCHARGE	Class 250	12.4	4.46	1.03	1.03	3000	0.84	0.26	5.31	0.4385	120.000	26.9581	31.0587	674.00	468.941	-205.059	265.059

Hydraulic Analysis

Project:	FPA BPS 5	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 5 Best Case (1 Pump)	**Calc By:**	ARB	1042	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																580.000	0.000	
Pipe, PVC		Class 250	24.85	2.32	2.07	2.07	11	3.37	0.52	0.69	0.0074	140.000	0.0008	0.0008	440.00	579.999	139.999	0.001
Valve, Gate		Class 250	24.85	2.32	2.07	2.07	0	3.37	0.52	0.69	0.0074	0.200	0.0015	0.0022	440.00	579.998	139.998	0.002
Pipe, PVC		Class 250	24.85	2.32	2.07	2.07	22	3.37	0.52	0.69	0.0074	140.000	0.0015	0.0037	440.00	579.996	139.996	0.004
90-deg bend, Standard		Class 250	24.85	2.32	2.07	2.07	0	3.37	0.52	0.69	0.0074	0.300	0.0022	0.0059	440.00	579.994	139.994	0.006
Pipe, PVC		Class 250	24.85	2.32	2.07	2.07	11	3.37	0.52	0.69	0.0074	140.000	0.0008	0.0067	440.00	579.993	139.993	0.007
90-deg bend, Standard		Class 250	24.85	2.32	2.07	2.07	0	3.37	0.52	0.69	0.0074	0.300	0.0022	0.0089	440.00	579.991	139.991	0.009
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.330	0.0393	0.0482	446.00	579.952	133.952	6.048
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	1	0.84	0.26	2.77	0.1190	140.000	0.0020	0.0502	450.00	579.950	129.950	10.050
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	0.0740	450.00	579.926	129.926	10.074
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.500	0.0595	0.1335	450.00	579.866	129.866	10.134
Pipe, PVC	PUMP	Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	140.000	0.0561	0.1897	450.00	579.810	129.810	10.190
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	2.500	1.4610	1.6507	450.00	578.349	128.349	11.651
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	140.000	0.0140	1.6647	450.00	578.335	128.335	11.665
Valve, Butterfly		Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.500	0.2922	1.9569	450.00	578.043	128.043	11.957
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	140.000	0.0140	1.9709	450.00	578.029	128.029	11.971
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	1.9936	441.00	578.006	137.006	2.994
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	2	0.84	0.26	2.77	0.1190	140.000	0.0040	1.9976	441.00	578.002	137.002	2.998
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.0333	441.00	577.967	136.967	3.033
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	5	0.84	0.26	2.77	0.1190	140.000	0.0101	2.0434	441.00	577.957	136.957	3.043
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.0791	441.00	577.921	136.921	3.079
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	25	0.84	0.26	2.77	0.1190	140.000	0.0506	2.1297	441.00	577.870	136.870	3.130
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.190	0.1110	2.2407	441.00	577.759	136.759	3.241
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	140.000	0.0561	2.2969	441.00	577.703	136.703	3.297
Pipe, PVC	FLOW METER	Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	140.000	0.0140	2.3109	441.00	577.689	136.689	3.311
Pipe, PVC		Class 250	8.33	2.32	0.69	0.69	2	0.38	0.17	6.13	0.5844	140.000	0.0281	2.3390	441.00	577.661	136.661	3.339
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	2.3616	441.00	577.638	136.638	3.362
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	268	0.84	0.26	2.77	0.1190	140.000	0.5420	2.9036	441.00	577.096	136.096	3.904
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.9393	441.00	577.061	136.061	3.939
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	2275	0.84	0.26	2.77	0.1190	140.000	4.6009	7.5402	441.00	572.460	131.460	8.540
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	7.5759	441.00	572.424	131.424	8.576
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	3000	0.84	0.26	2.77	0.1190	140.000	6.0672	13.6431	441.00	566.357	125.357	14.643
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	13.6669	441.00	566.333	125.333	14.667
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	400	0.84	0.26	2.77	0.1190	140.000	0.8090	14.4759	441.00	565.524	124.524	15.476
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	14.4997	441.00	565.500	124.500	15.500
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	950	0.84	0.26	2.77	0.1190	140.000	1.9213	16.4210	441.00	563.579	122.579	17.421
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	16.4567	441.00	563.543	122.543	17.457
Pipe, PVC		Class 250	12.4	2.32	1.03	1.03	1500	0.84	0.26	2.77	0.1190	140.000	3.0336	19.4903	441.00	560.510	119.510	20.490
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	19.5260	441.00	560.474	119.474	20.526
Pipe, Ductile Iron w/ Glass Lining	MAIN DISCHARGE	Class 250	12.4	2.32	1.03	1.03	575	0.84	0.26	2.77	0.1190	140.000	1.1629	20.6888	750.00	559.311	-190.689	330.689

Hydraulic Analysis

Project:	FPA BPS 5	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 5 Best Case (2 Pumps)	**Calc By:**	ARB	2000	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																580.000	0.000	
Pipe, PVC		Class 250	24.85	4.46	2.07	2.07	11	3.37	0.52	1.32	0.0272	140.000	0.0025	0.0025	440.00	579.997	139.997	0.003
Valve, Gate		Class 250	24.85	4.46	2.07	2.07	0	3.37	0.52	1.32	0.0272	0.200	0.0054	0.0080	440.00	579.992	139.992	0.008
Pipe, PVC		Class 250	24.85	4.46	2.07	2.07	22	3.37	0.52	1.32	0.0272	140.000	0.0050	0.0130	440.00	579.987	139.987	0.013
90-deg bend, Standard		Class 250	24.85	4.46	2.07	2.07	0	3.37	0.52	1.32	0.0272	0.300	0.0082	0.0211	440.00	579.979	139.979	0.021
Pipe, PVC		Class 250	24.85	4.46	2.07	2.07	11	3.37	0.52	1.32	0.0272	140.000	0.0025	0.0237	440.00	579.976	139.976	0.024
90-deg bend, Standard		Class 250	24.85	4.46	2.07	2.07	0	3.37	0.52	1.32	0.0272	0.300	0.0082	0.0318	440.00	579.968	139.968	0.032
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.330	0.0362	0.0680	446.00	579.932	133.932	6.068
Pipe, PVC		Class 250	12.4	2.23	1.03	1.03	1	0.84	0.26	2.66	0.1096	140.000	0.0019	0.0699	450.00	579.930	129.930	10.070
45-deg bend		Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.200	0.0219	0.0918	450.00	579.908	129.908	10.092
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.500	0.0548	0.1466	450.00	579.853	129.853	10.147
Pipe, PVC	PUMP	Class 250	8.33	2.23	0.69	0.69	4	0.38	0.17	5.89	0.5382	140.000	0.0520	0.1986	450.00	579.801	129.801	10.199
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	2.500	1.3456	1.5442	450.00	578.456	128.456	11.544
Pipe, PVC		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	140.000	0.0130	1.5572	450.00	578.443	128.443	11.557
Valve, Butterfly		Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	0.500	0.2691	1.8263	450.00	578.174	128.174	11.826
Pipe, PVC		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	140.000	0.0130	1.8394	450.00	578.161	128.161	11.839
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	1.9227	441.00	578.077	137.077	2.923
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	2	0.84	0.26	5.31	0.4385	140.000	0.0135	1.9362	441.00	578.064	137.064	2.936
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.0677	441.00	577.932	136.932	3.068
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	5	0.84	0.26	5.31	0.4385	140.000	0.0338	2.1015	441.00	577.899	136.899	3.101
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.2330	441.00	577.767	136.767	3.233
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	25	0.84	0.26	5.31	0.4385	140.000	0.1689	2.4019	441.00	577.598	136.598	3.402
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	4.46	0.69	0.69	0	0.38	0.17	11.77	2.1529	0.190	0.4091	2.8110	441.00	577.189	136.189	3.811
Pipe, PVC		Class 250	8.33	4.46	0.69	0.69	4	0.38	0.17	11.77	2.1529	140.000	0.1876	2.9986	441.00	577.001	136.001	3.999
Pipe, PVC	FLOW METER	Class 250	8.33	4.46	0.69	0.69	1	0.38	0.17	11.77	2.1529	140.000	0.0469	3.0455	441.00	576.955	135.955	4.045
Pipe, PVC		Class 250	8.33	4.46	0.69	0.69	2	0.38	0.17	11.77	2.1529	140.000	0.0938	3.1393	441.00	576.861	135.861	4.139
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	3.2226	441.00	576.777	135.777	4.223
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	268	0.84	0.26	5.31	0.4385	140.000	1.8107	5.0333	441.00	574.967	133.967	6.033
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	5.1648	441.00	574.835	133.835	6.165
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	2275	0.84	0.26	5.31	0.4385	140.000	15.3708	20.5357	441.00	559.464	118.464	21.536
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	20.6672	441.00	559.333	118.333	21.667
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	3000	0.84	0.26	5.31	0.4385	140.000	20.2692	40.9364	441.00	539.064	98.064	41.936
45-deg bend		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.200	0.0877	41.0241	441.00	538.976	97.976	42.024
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	400	0.84	0.26	5.31	0.4385	140.000	2.7026	43.7267	441.00	536.273	95.273	44.727
45-deg bend		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.200	0.0877	43.8144	441.00	536.186	95.186	44.814
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	950	0.84	0.26	5.31	0.4385	140.000	6.4186	50.2329	441.00	529.767	88.767	51.233
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	50.3645	441.00	529.636	88.636	51.364
Pipe, PVC		Class 250	12.4	4.46	1.03	1.03	1500	0.84	0.26	5.31	0.4385	140.000	10.1346	60.4991	441.00	519.501	78.501	61.499
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	60.6306	441.00	519.369	78.369	61.631
Pipe, Ductile Iron w/ Glass Lining	MAIN DISCHARGE	Class 250	12.4	4.46	1.03	1.03	575	0.84	0.26	5.31	0.4385	140.000	3.8849	64.5156	750.00	515.484	-234.516	374.516

Hydraulic Analysis

Project:	FPA BPS 5	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 5 Worst Case (1 Pump)	**Calc By:**	ARB	1042	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																500.000	0.000	
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	6.78	2.07	2.07	11	3.37	0.52	2.01	0.0629	120.000	0.0073	0.0073	440.00	499.993	59.993	0.007
Valve, Gate		Class 250	24.85	6.78	2.07	2.07	0	3.37	0.52	2.01	0.0629	0.200	0.0126	0.0198	440.00	499.980	59.980	0.020
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	6.78	2.07	2.07	22	3.37	0.52	2.01	0.0629	120.000	0.0145	0.0344	440.00	499.966	59.966	0.034
90-deg bend, Standard		Class 250	24.85	6.78	2.07	2.07	0	3.37	0.52	2.01	0.0629	0.300	0.0189	0.0533	440.00	499.947	59.947	0.053
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	6.78	2.07	2.07	11	3.37	0.52	2.01	0.0629	120.000	0.0073	0.0605	440.00	499.939	59.939	0.061
90-deg bend, Standard		Class 250	24.85	6.78	2.07	2.07	0	3.37	0.52	2.01	0.0629	0.300	0.0189	0.0794	440.00	499.921	59.921	0.079
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.330	0.0393	0.1187	446.00	499.881	53.881	6.119
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	1	0.84	0.26	2.77	0.1190	120.000	0.0027	0.1214	450.00	499.879	49.879	10.121
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	0.1452	450.00	499.855	49.855	10.145
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.500	0.0595	0.2047	450.00	499.795	49.795	10.205
Pipe, Ductile Iron w/ CM Lining	PUMP	Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	120.000	0.0747	0.2794	450.00	499.721	49.721	10.279
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	2.500	1.4610	1.7403	450.00	498.260	48.260	11.740
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	120.000	0.0187	1.7590	450.00	498.241	48.241	11.759
Valve, Butterfly		Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.500	0.2922	2.0512	450.00	497.949	47.949	12.051
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	120.000	0.0187	2.0699	450.00	497.930	47.930	12.070
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	2.0925	441.00	497.908	56.908	3.092
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	2	0.84	0.26	2.77	0.1190	120.000	0.0054	2.0979	441.00	497.902	56.902	3.098
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.1336	441.00	497.866	56.866	3.134
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	5	0.84	0.26	2.77	0.1190	120.000	0.0134	2.1470	441.00	497.853	56.853	3.147
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	2.1827	441.00	497.817	56.817	3.183
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	25	0.84	0.26	2.77	0.1190	120.000	0.0672	2.2500	441.00	497.750	56.750	3.250
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	2.32	0.69	0.69	0	0.38	0.17	6.13	0.5844	0.190	0.1110	2.3610	441.00	497.639	56.639	3.361
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	4	0.38	0.17	6.13	0.5844	120.000	0.0747	2.4357	441.00	497.564	56.564	3.436
Pipe, Ductile Iron w/ CM Lining	FLOW METER	Class 250	8.33	2.32	0.69	0.69	1	0.38	0.17	6.13	0.5844	120.000	0.0187	2.4544	441.00	497.546	56.546	3.454
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.32	0.69	0.69	2	0.38	0.17	6.13	0.5844	120.000	0.0373	2.4917	441.00	497.508	56.508	3.492
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.190	0.0226	2.5143	441.00	497.486	56.486	3.514
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	268	0.84	0.26	2.77	0.1190	120.000	0.7209	3.2352	441.00	496.765	55.765	4.235
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	3.2709	441.00	496.729	55.729	4.271
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	2275	0.84	0.26	2.77	0.1190	120.000	6.1193	9.3901	441.00	490.610	49.610	10.390
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	9.4258	441.00	490.574	49.574	10.426
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	3000	0.84	0.26	2.77	0.1190	120.000	8.0693	17.4952	441.00	482.505	41.505	18.495
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	17.5190	441.00	482.481	41.481	18.519
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	400	0.84	0.26	2.77	0.1190	120.000	1.0759	18.5949	441.00	481.405	40.405	19.595
45-deg bend		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.200	0.0238	18.6187	441.00	481.381	40.381	19.619
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	950	0.84	0.26	2.77	0.1190	120.000	2.5553	21.1740	441.00	478.826	37.826	22.174
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	21.2097	441.00	478.790	37.790	22.210
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.32	1.03	1.03	1500	0.84	0.26	2.77	0.1190	120.000	4.0347	25.2444	441.00	474.756	33.756	26.244
90-deg bend, Standard		Class 250	12.4	2.32	1.03	1.03	0	0.84	0.26	2.77	0.1190	0.300	0.0357	25.2801	441.00	474.720	33.720	26.280
Pipe, Ductile Iron w/ CM Lining	MAIN DISCHARGE	Class 250	12.4	2.32	1.03	1.03	575	0.84	0.26	2.77	0.1190	120.000	1.5466	26.8267	774.00	473.173	-300.827	360.827

Hydraulic Analysis

Project:	FPA BPS 5	**Date:**	14-Aug-14	Flow (gpm)	
Case:	Zone 5 Worst Case (2 Pumps)	**Calc By:**	ARB	2000	

Hydraulic Element	Further Description	Pipe Class	Inside Dia (in)	Flow, cfs	Inside Diameter, ft	Water Depth, ft	Length, ft	Area, sf	Hyd. Radius, ft	Velocity, fps	Vel. Head, ft	Coefficient (n, K or C)	Head Loss, ft	Cum. Head Loss, ft	Invert EL, ft	Water Surface EL or HGL, ft	Pressure Head, ft	Total Dynamic Head, ft
Starting W.S. Elevation																500.000	0.000	
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	8.91	2.07	2.07	11	3.37	0.52	2.65	0.1087	120.000	0.0121	0.0121	440.00	499.988	59.988	0.012
Valve, Gate		Class 250	24.85	8.91	2.07	2.07	0	3.37	0.52	2.65	0.1087	0.200	0.0217	0.0338	440.00	499.966	59.966	0.034
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	8.91	2.07	2.07	22	3.37	0.52	2.65	0.1087	120.000	0.0241	0.0579	440.00	499.942	59.942	0.058
90-deg bend, Standard		Class 250	24.85	8.91	2.07	2.07	0	3.37	0.52	2.65	0.1087	0.300	0.0326	0.0906	440.00	499.909	59.909	0.091
Pipe, Ductile Iron w/ CM Lining		Class 250	24.85	8.91	2.07	2.07	11	3.37	0.52	2.65	0.1087	120.000	0.0121	0.1026	440.00	499.897	59.897	0.103
90-deg bend, Standard		Class 250	24.85	8.91	2.07	2.07	0	3.37	0.52	2.65	0.1087	0.300	0.0326	0.1353	440.00	499.865	59.865	0.135
Reducer, d/D=1/2	24" TO 12"	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.330	0.0362	0.1714	446.00	499.829	53.829	6.171
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	2.23	1.03	1.03	1	0.84	0.26	2.66	0.1096	120.000	0.0025	0.1739	450.00	499.826	49.826	10.174
45-deg bend		Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.200	0.0219	0.1958	450.00	499.804	49.804	10.196
Valve, Butterfly	SUCTION SIDE OF PUMP	Class 250	12.4	2.23	1.03	1.03	0	0.84	0.26	2.66	0.1096	0.500	0.0548	0.2506	450.00	499.749	49.749	10.251
Pipe, Ductile Iron w/ CM Lining	PUMP	Class 250	8.33	2.23	0.69	0.69	4	0.38	0.17	5.89	0.5382	120.000	0.0692	0.3199	450.00	499.680	49.680	10.320
Valve, Check (Swing)	DISCHARGE SIDE OF PUMP	Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	2.500	1.3456	1.6654	450.00	498.335	48.335	11.665
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	120.000	0.0173	1.6828	450.00	498.317	48.317	11.683
Valve, Butterfly		Class 250	8.33	2.23	0.69	0.69	0	0.38	0.17	5.89	0.5382	0.500	0.2691	1.9519	450.00	498.048	48.048	11.952
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	2.23	0.69	0.69	1	0.38	0.17	5.89	0.5382	120.000	0.0173	1.9692	450.00	498.031	48.031	11.969
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	2.0525	441.00	497.948	56.948	3.052
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	2	0.84	0.26	5.31	0.4385	120.000	0.0180	2.0704	441.00	497.930	56.930	3.070
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.2020	441.00	497.798	56.798	3.202
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	5	0.84	0.26	5.31	0.4385	120.000	0.0449	2.2469	441.00	497.753	56.753	3.247
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	2.3785	441.00	497.622	56.622	3.378
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	25	0.84	0.26	5.31	0.4385	120.000	0.2247	2.6031	441.00	497.397	56.397	3.603
Reducer, d/D=3/4	12" TO 8"	Class 250	8.33	4.46	0.69	0.69	0	0.38	0.17	11.77	2.1529	0.190	0.4091	3.0122	441.00	496.988	55.988	4.012
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	4.46	0.69	0.69	4	0.38	0.17	11.77	2.1529	120.000	0.2495	3.2617	441.00	496.738	55.738	4.262
Pipe, Ductile Iron w/ CM Lining	FLOW METER	Class 250	8.33	4.46	0.69	0.69	1	0.38	0.17	11.77	2.1529	120.000	0.0624	3.3240	441.00	496.676	55.676	4.324
Pipe, Ductile Iron w/ CM Lining		Class 250	8.33	4.46	0.69	0.69	2	0.38	0.17	11.77	2.1529	120.000	0.1247	3.4488	441.00	496.551	55.551	4.449
Increaser, d/D=3/4	8" TO 12"	Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.190	0.0833	3.5321	441.00	496.468	55.468	4.532
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	268	0.84	0.26	5.31	0.4385	120.000	2.4083	5.9403	441.00	494.060	53.060	6.940
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	6.0719	441.00	493.928	52.928	7.072
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	2275	0.84	0.26	5.31	0.4385	120.000	20.4432	26.5151	441.00	473.485	32.485	27.515
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	26.6466	441.00	473.353	32.353	27.647
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	3000	0.84	0.26	5.31	0.4385	120.000	26.9581	53.6046	441.00	446.395	5.395	54.605
45-deg bend		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.200	0.0877	53.6923	441.00	446.308	5.308	54.692
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	400	0.84	0.26	5.31	0.4385	120.000	3.5944	57.2867	441.00	442.713	1.713	58.287
45-deg bend		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.200	0.0877	57.3744	441.00	442.626	1.626	58.374
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	950	0.84	0.26	5.31	0.4385	120.000	8.5367	65.9112	441.00	434.089	-6.911	66.911
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	66.0427	441.00	433.957	-7.043	67.043
Pipe, Ductile Iron w/ CM Lining		Class 250	12.4	4.46	1.03	1.03	1500	0.84	0.26	5.31	0.4385	120.000	13.4790	79.5217	441.00	420.478	-20.522	80.522
90-deg bend, Standard		Class 250	12.4	4.46	1.03	1.03	0	0.84	0.26	5.31	0.4385	0.300	0.1315	79.6533	441.00	420.347	-20.653	80.653
Pipe, Ductile Iron w/ CM Lining	MAIN DISCHARGE	Class 250	12.4	4.46	1.03	1.03	575	0.84	0.26	5.31	0.4385	120.000	5.1670	84.8202	774.00	415.180	-358.820	418.820

SYSTEM CURVES

Worst-Case Conditions

ZONE 4	
FLOW [GPM]	HEAD [FT]
0	174
200	174.523
400	175.815
600	177.838
800	180.558
1000	183.95
1042	184.747
1200	186.025
1400	190.008
1600	194.513
1800	199.533
2000	205.059

ZONE 5	
FLOW [GPM]	HEAD [FT]
0	274
200	275.281
400	278.548
600	283.627
800	290.417
1000	298.851
1042	300.827
1200	306.908
1400	317.787
1600	330.082
1800	343.768
2000	358.82

Best-Case Conditions

ZONE 4	
FLOW [GPM]	HEAD [FT]
0	70
200	70.382
400	71.408
600	73.024
800	75.203
1000	77.929
1042	78.569
1200	79.24
1400	82.322
1600	85.811
1800	89.7
2000	93.985

ZONE 5	
FLOW [GPM]	HEAD [FT]
0	170
200	170.953
400	173.467
600	177.386
800	182.633
1000	189.159
1042	190.689
1200	194.981
1400	203.261
1600	212.624
1800	223.048
2000	234.516

PUMP PERFORMANCE

ZONE 4 PACO PUMP 4015-9/0 KP (13.2 IN)	
FLOW [GPM]	HEAD [FT]
0	218
100	217
200	216
300	215
400	214
500	213
600	211
700	208
800	203
900	197
1000	190
1100	182
1200	170

ZONE 4 PACO PUMP TWO IN PARALLEL	
FLOW [GPM]	HEAD [FT]
0	218
200	217
400	216
600	215
800	214
1000	213
1200	211
1400	208
1600	203
1800	197
2000	190
2200	182
2400	170

ZONE 5 PACO PUMP 6019-7/8 KP (17.57 IN)	
FLOW [GPM]	HEAD [FT]
0	354
100	354
200	354
300	354
400	354
500	354
600	353
700	352
800	351
900	350
1000	348
1100	345
1200	342
1300	339
1400	335
1500	330
1600	324
1700	318
1800	311
1900	303
2000	295

ZONE 5 PACO PUMP TWO IN PARALLEL	
FLOW [GPM]	HEAD [FT]
0	354
200	354
400	354
600	354
800	354
1000	354
1200	353
1400	352
1600	351
1800	350
2000	348
2200	345
2400	342
2600	339
2800	335
3000	330
3200	324
3400	318
3600	311
3800	303
4000	295

ZONE 4 PACO PUMP VFD - 67%	
FLOW [GPM]	HEAD [FT]
0	97.8602
67	97.4113
134	96.9624
201	96.5135
268	96.0646
335	95.6157
402	94.7179
469	93.3712
536	91.1267
603	88.4333
670	85.291
737	81.6998
830.8	74.0685

ZONE 4 PACO PUMP VFD - 73% (PARALLEL)	
FLOW [GPM]	HEAD [FT]
0	116.1722
146	115.6393
292	115.1064
438	114.5735
584	114.0406
730	113.5077
876	112.4419
1022	110.8432
1168	108.1787
1314	104.9813
1460	101.251
1606	96.9878
1810.4	87.9285

ZONE 5 PACO PUMP VFD - 75%	
FLOW [GPM]	HEAD [FT]
0	199.125
75	199.125
150	199.125
225	199.125
300	199.125
375	199.125
450	198.5625
525	198
600	197.4375
675	196.875
750	195.75
825	194.0625
900	192.375
975	190.6875
1050	188.4375
1125	185.625
1200	182.25
1275	178.875
1350	174.9375
1425	170.4375
1500	165.9375

ZONE 5 PACO PUMP VFD - 93%	
FLOW [GPM]	HEAD [FT]
0	309.47565
93.5	309.47565
187	309.47565
280.5	309.47565
374	309.47565
467.5	309.47565
561	308.60143
654.5	307.7272
748	306.85298
841.5	305.97875
935	304.2303
1028.5	301.60763
1122	298.98495
1215.5	296.36228
1309	292.86538
1402.5	288.49425
1496	283.2489
1589.5	278.00355
1683	271.88398
1776.5	264.89018
1870	257.89638

ZONE 5 PACO PUMP VFD - 80% (PARALLEL)	
FLOW [GPM]	HEAD [FT]
0	226.56
160	226.56
320	226.56
480	226.56
640	226.56
800	226.56
960	225.92
1120	225.28
1280	224.64
1440	224
1600	222.72
1760	220.8
1920	218.88
2080	216.96
2240	214.4
2400	211.2
2560	207.36
2720	203.52
2880	199.04
3040	193.92
3200	188.8

REDUCED SPEED PUMP PERFORMANCE - ZONE 4

		90%	speed	80%	speed	73%	speed	67%	speed	50%	speed	40%	speed	30%	speed	20%	speed	10%	speed	0%	speed
Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head
gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft
1240	165	1116	133.65	992	105.6	905.2	87.9285	830.8	74.0685	620	41.25	496	26.4	372	14.85	248	6.6	124	1.65	0	0
1200	170	1080	137.7	960	108.8	876	90.593	804	76.313	600	42.5	480	27.2	360	15.3	240	6.8	120	1.7	0	0
1100	182	990	147.42	880	116.48	803	96.9878	737	81.6998	550	45.5	440	29.12	330	16.38	220	7.28	110	1.82	0	0
1000	190	900	153.9	800	121.6	730	101.251	670	85.291	500	47.5	400	30.4	300	17.1	200	7.6	100	1.9	0	0
900	197	810	159.57	720	126.08	657	104.9813	603	88.4333	450	49.25	360	31.52	270	17.73	180	7.88	90	1.97	0	0
800	203	720	164.43	640	129.92	584	108.1787	536	91.1267	400	50.75	320	32.48	240	18.27	160	8.12	80	2.03	0	0
700	208	630	168.48	560	133.12	511	110.8432	469	93.3712	350	52	280	33.28	210	18.72	140	8.32	70	2.08	0	0
600	211	540	170.91	480	135.04	438	112.4419	402	94.7179	300	52.75	240	33.76	180	18.99	120	8.44	60	2.11	0	0
500	213	450	172.53	400	136.32	365	113.5077	335	95.6157	250	53.25	200	34.08	150	19.17	100	8.52	50	2.13	0	0
400	214	360	173.34	320	136.96	292	114.0406	268	96.0646	200	53.5	160	34.24	120	19.26	80	8.56	40	2.14	0	0
300	215	270	174.15	240	137.6	219	114.5735	201	96.5135	150	53.75	120	34.4	90	19.35	60	8.6	30	2.15	0	0
200	216	180	174.96	160	138.24	146	115.1064	134	96.9624	100	54	80	34.56	60	19.44	40	8.64	20	2.16	0	0
100	217	90	175.77	80	138.88	73	115.6393	67	97.4113	50	54.25	40	34.72	30	19.53	20	8.68	10	2.17	0	0
0	218	0	176.58	0	139.52	0	116.1722	0	97.8602	0	54.5	0	34.88	0	19.62	0	8.72	0	2.18	0	0

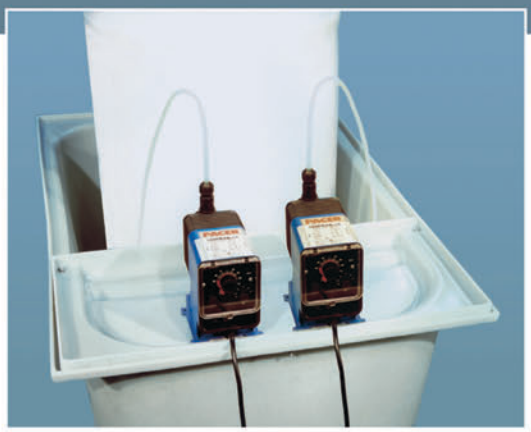
REDUCED SPEED PUMP PERFORMANCE - ZONE 5

		94% speed		80% speed		75% speed		60% speed		50% speed		40% speed		30% speed		20% speed		10% speed		0% speed	
Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head	Flow	Head
gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft
2000	295	1870	257.8964	1600	188.8	1500	165.9375	1200	106.2	1000	73.75	800	47.2	600	26.55	400	11.8	200	2.95	0	0
1900	303	1776.5	264.8902	1520	193.92	1425	170.4375	1140	109.08	950	75.75	760	48.48	570	27.27	380	12.12	190	3.03	0	0
1800	311	1683	271.884	1440	199.04	1350	174.9375	1080	111.96	900	77.75	720	49.76	540	27.99	360	12.44	180	3.11	0	0
1700	318	1589.5	278.0036	1360	203.52	1275	178.875	1020	114.48	850	79.5	680	50.88	510	28.62	340	12.72	170	3.18	0	0
1600	324	1496	283.2489	1280	207.36	1200	182.25	960	116.64	800	81	640	51.84	480	29.16	320	12.96	160	3.24	0	0
1500	330	1402.5	288.4943	1200	211.2	1125	185.625	900	118.8	750	82.5	600	52.8	450	29.7	300	13.2	150	3.3	0	0
1400	335	1309	292.8654	1120	214.4	1050	188.4375	840	120.6	700	83.75	560	53.6	420	30.15	280	13.4	140	3.35	0	0
1300	339	1215.5	296.3623	1040	216.96	975	190.6875	780	122.04	650	84.75	520	54.24	390	30.51	260	13.56	130	3.39	0	0
1200	342	1122	298.985	960	218.88	900	192.375	720	123.12	600	85.5	480	54.72	360	30.78	240	13.68	120	3.42	0	0
1100	345	1028.5	301.6076	880	220.8	825	194.0625	660	124.2	550	86.25	440	55.2	330	31.05	220	13.8	110	3.45	0	0
1000	348	935	304.2303	800	222.72	750	195.75	600	125.28	500	87	400	55.68	300	31.32	200	13.92	100	3.48	0	0
900	350	841.5	305.9788	720	224	675	196.875	540	126	450	87.5	360	56	270	31.5	180	14	90	3.5	0	0
800	351	748	306.853	640	224.64	600	197.4375	480	126.36	400	87.75	320	56.16	240	31.59	160	14.04	80	3.51	0	0
700	352	654.5	307.7272	560	225.28	525	198	420	126.72	350	88	280	56.32	210	31.68	140	14.08	70	3.52	0	0
600	353	561	308.6014	480	225.92	450	198.5625	360	127.08	300	88.25	240	56.48	180	31.77	120	14.12	60	3.53	0	0
500	354	467.5	309.4757	400	226.56	375	199.125	300	127.44	250	88.5	200	56.64	150	31.86	100	14.16	50	3.54	0	0
400	354	374	309.4757	320	226.56	300	199.125	240	127.44	200	88.5	160	56.64	120	31.86	80	14.16	40	3.54	0	0
300	354	280.5	309.4757	240	226.56	225	199.125	180	127.44	150	88.5	120	56.64	90	31.86	60	14.16	30	3.54	0	0
200	354	187	309.4757	160	226.56	150	199.125	120	127.44	100	88.5	80	56.64	60	31.86	40	14.16	20	3.54	0	0
100	354	93.5	309.4757	80	226.56	75	199.125	60	127.44	50	88.5	40	56.64	30	31.86	20	14.16	10	3.54	0	0
0	354	0	309.4757	0	226.56	0	199.125	0	127.44	0	88.5	0	56.64	0	31.86	0	14.16	0	3.54	0	0

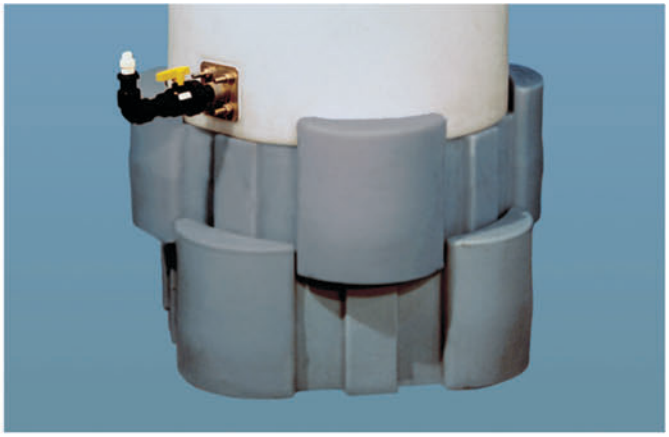
Appendix C – 550-gallon Sodium Hypochlorite Storage System

Chemical Feed Stations

Complete ready to use Chemical Feed Stations (CFS) allow you to handle small amounts of liquids and other chemicals without the handling costs and inconvenient disposal of drums. Lightweight, easy to handle, and self contained construction adds to the complete ready to use design. Added features such as molded pump shelves, polyethylene primary tank stands, custom design fittings, and accessories help to individualize any customer's needs. Chemical Feed Stations are constructed from high density crosslink polyethylene or FDA compliant linear polyethylene.



Polyethylene pump shelf supports most pumps and metering devices. Optional fiberglass shelves are available for pumps and metering devices totaling 25 pounds or more.



Optional polyethylene stands, which may be stacked 2-high, support the primary tank for gravity feed.

Model Number	Capacity (US Gallons)	Dimensions (inches)			Access Opening (inches)
		Length	Width	Height	
CFS 40	40	32	26	38	16
CFS 60	60	47	32	42	16
CFS 80	80	47	32	49	16
CFS 140	140	52	38	58	16
CFS 175	175	60	43	51	16
CFS 200	200	60	43	57	16
CFS 250	250	72	43	69	16
CFS 300	300	72	43	82	16
CFS 550	550	83	64	82	16

Model number availability and individual specifications subject to change without notice.
Gallonage and weights are approximate. All wall thicknesses conform to ASTM D-1998.

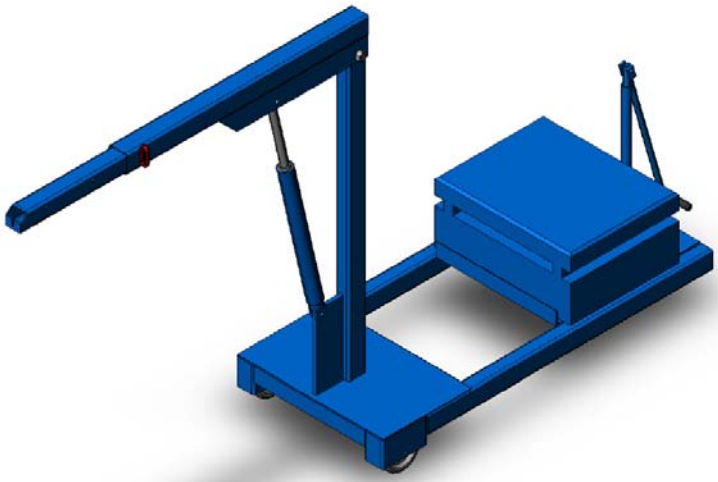
Assmann Corporation of America

Phone: 888-357-3181 • Fax: 888-Tank Fax (826-5329)
Phone: 260-357-3181 • Fax: 260-357-3738
E-mail: info@assmann-usa.com • www.assmann-usa.com

Appendix D – Portable Manual Floor Crane Information

David Round & Son, Inc.
Ruger Division
10200 Wellman Rd
Streetsboro, OH 44241
Phone: 330-656-1600
Fax: 330-656-1601
info@davidround.com
www.rugerindustries.com

Ruger® HP2000R



HP2000R
- 2000 lb. Capacity
- Reversed based allows for easier access to loads

OPTIONAL ACCESSORIES
- Floor Lock - Direct Bolt-On
- Polyurethane Wheels - Direct Bolt-On
- Phenolic Wheels - Direct Bolt-On
- Power-Pak - Direct Bolt-On AC/DC Operated Hydraulic Lifting
- Swivel Boom - Limited Swing Motion Design
- Manual Hand Winch - Rated for Lifting Design
- Power Assist –Direct Bolt-On DC Operated Drive Unit Attachment
- Available in Stainless Steel Construction

Meets ASME PALD standards for shop cranes.
Conforms to ANSI Z535 standards.

Standard Features

- Meets Ruger's structural engineering standards for 125% of rated lifting capacity
- Counterbalanced units are built to exceed 125% stability factor
- Double action manual hand pump operation
- Built-in hydraulic overload relief valve
- Needle type release valve permits pin-point control over lowering and holding of the heaviest or lightest loads
- Adjustable built-in telescopic boom
- Steel wheels with sleeve bearings
- Swivel hook with safety latch
- Steel construction & standard Ruger blue paint

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MODEL: HP2000R

Load Capacity 2000 lbs

Figure 1