



**WEST NORRITON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA**

**RITTENHOUSE PUMP STATION
FORCE MAIN ANALYSIS**

Prepared For:

**West Norriton Township
1630 W. Marshall Street
Jeffersonville, PA 19403**

November 2020

File No. 2016-02032T2

Prepared By:

**Gilmore & Associates, Inc.
Engineers ♦ Land Surveyors ♦ Planners ♦ GIS Consultants
65 E. Butler Avenue, Suite 100
New Britain, PA 18901
215-345-4330**



GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES



1918 TO 2008: CELEBRATING NINETY YEARS OF ENGINEERING EXCELLENCE

TABLE OF CONTENTS

		<u>Page No.</u>
1.0	Introduction	2
2.0	Background	3
3.0	Alternatives Evaluation	5
4.0	Conclusion	7

TABLES

Table 1:	Rittenhouse Boulevard Pump Station 20-Year Peak Flow Calculations	2
Table 2:	Rittenhouse Boulevard Pump Station Capacity History	4
Table 3:	Alternative Results Summary	7

APPENDICES

Appendix A:	Alternative #1 – Replacement of Existing Pumps: Calculations, and Opinion of Probable Cost	8
Appendix B:	Alternative #2 – Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers: Plans, Calculations, and Opinion of Probable Cost	15
Appendix C:	Alternative #3 – Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers to Upgraded Gravity Sewer within Washington Street to the NMWA WWTP: Plans, Calculations, and Opinion of Probable Cost	23
Appendix D:	Alternative #4 – Installation of 8,500 LF of 18-inch D.I.P. Parallel Force Main and New Pump Impellers: Plans, Calculations, and Opinion of Probable Cost	31

1.0 Introduction

This report has been prepared by Gilmore & Associates, Inc. (G&A), at the request of West Norriton Township, to review and analyze the existing operating conditions of the Rittenhouse Boulevard Pump Station and 18-inch cast iron (C.I.) force main, as well as evaluate several cost-effective alternatives for increasing the pump station's current capacity to meet the facility's projected 20-year peak flow. This report is also a follow-up to the Rettew Associates, Inc. (Rettew) settlement and field inspection, which was conducted in February of 2016. The field inspection concluded the flow capacity of the station, with two pumps operating, was approximately 3,200 gallons per minute (gpm) or 4.6 million gallons per day (MGD), which is less than half of the projected flow capacity of 6,600 gpm or 9.5 MGD as documented in the Rettew Design Engineer's Report dated August 2013. Additionally, the station's current flow capacity of 4.6 MGD is approximately 2.2 MGD lower than the previous flow capacity prior to the 2015 upgrade (6.8 MGD), as well as 4.14 MGD lower than the Pennsylvania Department of Environmental Protection (PA DEP) permitted capacity of 8.74 MGD.

The projected 20-year peak flow for the Rittenhouse Boulevard Pump Station was determined based on a review and analysis of the recorded historical flows at the station and the anticipated future developments and connections, including projections in the Township's Chapter 94 reporting and beyond (see Table 1). According to the recorded historical flows at the station, the average daily flow from January 2016 to September 2020, was approximately 2,106,900 gallons per day (gpd) and had an average daily dry weather peaking factor of 3.0. Additionally, according to the anticipated future developments/connections, it is projected that 960 new estimated dwelling units (EDUs) will be connected to the station within 20 years. Based on a standard 285 gpd/EDU, the projected 20-year flow addition to the station is 273,600 gpd. Summing the recorded historical average daily flow of 2,106,900 gpd with the projected 20-year flow addition of 273,600 gpd, the resulting flow is 2,380,500 gpd, which equates to a peak flow of 7,141,500 gpd (7.14 MGD) after multiplying by the average peaking factor of 3.0. Therefore, the projected 20-year peak flow and anticipated flow capacity need for the Rittenhouse Boulevard Pump Station is approximately 7.14 MGD or 4,960 gpm.

Table 1 below summarizes the 20-year peak flow calculations and analysis for the Rittenhouse Boulevard Pump Station.

Table 1						
Rittenhouse Boulevard Pump Station 20-Year Peak Flow Calculations						
Average Daily Flow (2016-Sept. 2020)				2,106,900		gpd
Projected 20-Year Flow Additions						
Riverview	330	EDU	285	gal/EDU	94,050	gpd
Main & Schyulkill	22	EDU	285	gal/EDU	6,270	gpd
Office Bldg @ Egypt	8	EDU	285	gal/EDU	2,280	gpd
Westover	500	EDU	285	gal/EDU	142,500	gpd
Miscellaneous	100	EDU	285	gal/EDU	28,500	gpd
Total Projected 20-Year Flow Addition					273,600	gpd
Total Projected 20-Year Average Daily Flow					2,380,511	gpd
Peaking Factor					3.00	PF
20-Year Peak Flow					7,141,500	gpd
					7.14	MGD
					4,960	gpm

Based on a projected 20-year peak flow of 7.14 MGD or 4,960 gpm for the station, several alternatives were evaluated. The projected discharge capacities for each alternative evaluated were determined by hydraulic calculations and the development of system head loss curves. The resulting system head loss curves were then compared to pump performance curves at their intersecting operational duty point to determine the new discharge capacity for the alternative. It is noted that all evaluated alternatives, except for Alternative #1, were compared to the existing pump performance curves with new 18-inch impellers (maximum size available for existing pumps). Our calculations determined that replacing the existing 17.25-inch impellers with new 18-inch impellers shortens the necessary force main replacement length by approximately 700 linear feet (LF), which is an estimated net construction savings of \$115,000.

The total head loss values were calculated using the Hazen-Williams equation, which involved quantifying the existing major and minor energy losses caused by various factors including, but not limited to, elevation changes and piping appurtenances such as bends, valves, expansions and contractions. Quantifying the existing major and minor energy losses involved using past construction drawings, including the force main design drawings developed by Albright & Friel, Inc., dated February 1965, the pump station upgrade drawings developed by Rettew, dated August 2013, and the force main survey drawings developed by Rettew, dated February 2013. All quantified minor energy losses caused by piping appurtenances were converted into equivalent pipe lengths using industry standard coefficients as part of the total head loss calculations.

A total of four (4) alternatives were considered and evaluated for the Rittenhouse Boulevard Pump Station to achieve or exceed the projected 20-year peak flow of 7.14 MGD or 4,960 gpm:

Alternative #1: Replacement of Existing Pumps

Alternative #2: Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers

Alternative #3: Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers to Upgraded Gravity Sewer within Washington Street to the NMWA WWTP

Alternative #4: Installation of 8,500 LF of 18-inch D.I.P. Parallel Force Main and New Pump Impellers

2.0 Background

The Rittenhouse Boulevard Pump Station was originally constructed circa 1965. It is located on a 1.4-acre parcel accessed through an easement located off of the intersection of Rittenhouse Boulevard and Beaver Hollow Drive (Road). The property is designated as Parcel # 630007243011, Block 33, Unit 75, Lot 96A. The pump station was designed and built as a conventional wet well/dry well triplex pump station. It was originally comprised of three 75 hp pumps, each capable of delivering 1,750 gpm (2.5 MGD). A 24-inch cast iron gravity pipe discharged into the wetwell, which was approximately 37 feet below grade. The sewage from the pump station is pumped directly to the headworks of the Norristown Municipal Wastewater Authority (NMWA) Wastewater Treatment Plant (WWTP) located at 368 E. Washington Street via approximately 13,500 LF of 18-inch cast iron force main. The force main generally runs parallel to the Schuylkill River.

The pump station was first upgraded around 1983 with new enlarged pumps, each rated at 100 hp, and capable of 2,000 gpm (2.9 MGD). The Plans for the upgrade were prepared by SMC Martin, Inc. The station had a capacity of approximately 3,200 gpm (4.6 MGD) with all three pumps operating. The recorded pump capacity was measured during a field test conducted on June 19, 1992.

The pump station was then upgraded for the second time in 1995 with newer enlarged pumps, each rated at 200 hp, and capable of 3,700 gpm (5.3 MGD). The Plans were prepared by G&A. The station had a capacity of approximately 4,700 gpm (6.8 MGD) with two pumps operating and 5,000 gpm (7.2 MGD) with all three pumps operating. The pump capacities from the upgrade are recorded in the PA DEP (former Pennsylvania Department of Environmental Resources) permit.

Finally, the pump station was upgraded for a third time in 2015 with a new submersible pump station, which replaced the existing wet well/drywell pump station. The old wet well/dry well pump station was abandoned in place and filled with concrete to finished grade. The new submersible pump station is located on the opposite side of the driveway and is equipped with three submersible pumps, each rated at 125 hp, and capable of 2,500 gpm (3.6 MGD). The Plans were prepared by Rettew. The current pump station has a capacity of 3,200 gpm (4.6 MGD) with two pumps operating and 3,940 gpm (5.7 MGD) with all three pumps operating. The recorded pump capacities were measured from the station’s magnetic flow meter during a site inspection on February 16, 2016 and are corroborated by the calculation results provided in this report.

Table 2 below summarizes the recorded discharge capacities after each upgrade/modification to the Rittenhouse Boulevard Pump Station.

Table 2							
Rittenhouse Boulevard Pump Station Capacity History							
Number of Pumps Operating	Year	1965	1983	1992	1993	1995	2015
	Flow	75 HP	100 HP			200 HP	125 HP
1	gpm	1,750	2,000	2,200	2,650	3,700	2,500
	mgd	2.5	2.9	3.2	3.8	5.3	3.6
2	gpm		2,850	3,100	3,900	4,700	3,200
	mgd		4.1	4.5	5.6	6.8	4.6
3	gpm		3,200	3,500	4,500	5,000	3,940
	mgd		4.6	5.0	6.5	7.2	5.7
1965	Original Installation - 75 HP Pumps.						
1983	Upgrade to 100 HP Pumps. Flow test conducted on June 19, 1992.						
1992	Full Speed Contactors Installed - Testing conducted on August 5, 1992.						
1993	Force Main Cleaned- Testing conducted on January 27, 1992.						
1995	Upgrade to 200 HP pumps. Per PA DER Permit Application						
2015	New Pump Station with 125 Submersible pumps. Per site visit 2/16/2016						

Based on the information provided in the table above, the pump station’s current discharge capacity with two pumps operating (4.6 MGD) is a reduction of approximately 33% from its previous rated capacity prior to the 2015 upgrade (6.8 MGD).

3.0 Alternatives Evaluation:

Alternative #1 – Replacement of Existing Pumps:

This alternative consists of replacing all three existing 125 hp submersible pumps with new pumps that are capable of achieving the projected 20-year peak flows of 4,960 gpm (7.14 MGD) under the existing force main operating conditions. According to Part III, Section 32.21, of the PA DEP Domestic Wastewater Manual, a minimum of three pumps should be provided for stations designed to handle maximum monthly average flows greater than 1.0 MGD. Additionally, it states that where three or more units are provided, they should be designed to fit actual flow conditions and must be of such capacity that with any one unit out of service, the remaining units will have capacity to handle peak instantaneous flows. Therefore, submersible pump replacements must be capable of achieving 4,960 gpm (7.14 MGD) with only two of three pumps in operation.

The analysis projects the total head loss in the existing force main, at the 20-year projected peak flow of 4,960 gpm (7.14 MGD), to be approximately 235 feet of total dynamic head (TDH) with two pumps in operation. Based on this result, the calculated maximum operating pressure in the force main would be approximately 102 psi at the 20-year projected peak flow. It is noted that the existing force main has broken previously at 90 psi. Therefore, this alternative is not recommended from an operational perspective because it increases the Township's risk of additional force main failures. The estimated construction total is \$2,618,400; however, the projected 20-year maintenance cost of the existing force main system, which includes an anticipated existing force main replacement due to the high maximum operating pressure, is approximately \$2,295,000, for a total life cycle cost of \$4,920,000.

Appendix A shows the existing system curve with two pumps in operation. The targeted operating point with two pumps in operation (4,960 gpm at 235 feet of TDH), based on the 20-year projected peak flow, is also shown. Additionally, the existing pump performance curves with one and two pumps in operation are shown. It is noted that the existing operating point is shown around 3,200 gpm at 120 feet of TDH with two pumps in operation, which matches the actual field measurement of 3,200 gpm with two pumps in operation taken on February 16, 2016.

Alternative #2 – Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P and New Pump Impellers:

This alternative consists of replacing approximately 8,500 LF of existing 18-inch C.I.P. force main between the pump station and Stoney Creek with 24-inch D.I.P. force main, and the replacement of the existing 17.25-inch pump impellers with new 18-inch pump impellers. The analysis projects the resulting operating point to be approximately 5,000 gpm (7.2 MGD) at 120 feet of TDH with two existing pumps in operation with new 18-inch impellers. The estimated construction total is \$2,918,280; however, the projected 20-year maintenance cost of the remaining 5,000 LF of existing force main, which includes anticipated cleanings and repairs with bypass pumping, is approximately \$150,000, for a total life cycle cost of \$3,070,000.

Appendix B shows the new system curve with two pumps in operation. Additionally, the modified existing pump performance curves with one and two pumps in operation are also shown. It is noted the new operating point is shown at approximately 5,000 gpm at 120 feet of TDH with two existing pumps in operation with new 18-inch impellers.

Alternative #3 – Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers to Upgraded Gravity Sewer within Washington Street to the NMWA WWTP:

This alternative consists replacing approximately 8,500 LF of existing 18-inch C.I.P. force main with 24-inch D.I.P. force main to Stoney Creek, the addition of approximately 1,500 LF of 24-inch D.I.P. force main from Stoney Creek to Washington Street, the replacement of approximately 3,600 LF of existing 24-inch R.C.P. gravity sewer and manholes within Washington Street to the NMWA WWTP, and the replacement of the existing 17.25-inch pump impellers with new 18-inch pump impellers. The analysis projects the resulting operating point to be approximately 8,600 gpm (12.38 MGD) at 96 feet of TDH with two existing pumps in operation. It is noted that sanitary flow data for the existing 24-inch R.C.P. gravity sewer within Washington Street would need to be obtained and analyzed to properly size the new gravity sewer responsible for the conveyance of the combined Rittenhouse Pump Station and existing Norristown flows. Additionally, the full extent of the gravity sewer replacement and discharge point would have to be further discussed with NMWA personal. This alternative could be implemented as a supplement or second phase to Alternative #2 or #4 at a later time for the net cost of the gravity sewer improvements. The estimated construction total, assuming 3,600 LF of new 48-inch D.I.P. gravity sewer for the combined flow within Washington Street, is approximately \$9,360,000. It is noted that the costs for Alternative #4 (18-inch parallel D.I.P. force main) were not evaluated with Alternative #3 at this time because it would be higher than when implemented with Alternative #2.

Appendix C shows the new system curve with two pumps in operation. Additionally, the modified existing pump performance curves with one and two pumps in operation are also shown. It is noted the new operating point is shown at approximately 8,600 gpm at 96 feet of TDH with two existing pumps in operation with new 18-inch impellers.

Alternative #4 – Installation of 8,500 LF of 18-inch D.I.P. Parallel Force Main and New Pump Impellers:

This alternative consists of installing approximately 8,500 LF of 18-inch D.I.P. force main in parallel to the existing 18-inch C.I.P force main, between the pump station and Stoney Creek, as well as the replacement of the existing 17.25-inch pump impellers with new 18-inch pump impellers. The analysis projects the resulting pump operating point to be approximately 5,200 gpm (7.49 MGD) at 120 feet of TDH with two existing pumps in operation with new 18-inch impellers. It is noted that operating two force mains in parallel requires more maintenance and detecting leaks or other problems in the existing 18-inch C.I.P. force main becomes difficult. The estimated construction total is \$2,642,280; however, the projected 20-year maintenance cost of the existing force main, which includes anticipated cleanings and repairs with bypass pumping, is approximately \$675,000, for a total life cycle cost of \$3,320,000.

Appendix D shows the new system curve with two pumps in operation. Additionally, the modified existing pump performance curves with one and two pumps in operation are also shown. It is noted the new operating point is shown at approximately 5,200 gpm at 120 feet of TDH with two existing pumps in operation with new 18-inch impellers.

4.0 Conclusion:

Based on the above evaluations of each alternative, it is recommended that Alternative #2 be implemented, which involves the replacement of approximately 8,500 LF of existing 18-inch C.I.P. force main between the pump station and Stoney Creek with 24-inch D.I.P. force main and the replacement of the existing 17.25-inch pump impellers with new 18-inch pump impellers to achieve an increased discharge capacity of approximately 5,000 gpm (7.2 MGD) with two existing pumps in operation. This recommendation is based on the construction costs associated with each alternative, as well as other considerations including, operational and maintenance costs, as detailed in the report.

Table 3 below summarizes the results of each alternative evaluated. It is noted that all flow data shown is for two pumps in operation:

Table 3			
Alternative Results Summary			
Alternative	Flow (MGD)	Flow (gpm)	Total Cost
<i>1995 Station</i>	<i>6.80</i>	<i>4,700</i>	
<i>Existing Station</i>	<i>4.60</i>	<i>3,200</i>	
1	7.14	4,960	\$ 4,920,000
2	7.20	5,000	\$ 3,070,000
3	12.38	8,600	\$ 9,360,000
4	7.49	5,200	\$ 3,320,000

APPENDIX A:

Alternative #1 - Replacement of Existing Pumps



SYSTEM HEAD LOSSES

Alternative #1 - Replacement of Existing Pumps
2 Pumps Operating

PROJECT:	Rittenhouse Pump Station
LOCATION:	West Norriton Township
EXISTING FORCE MAIN (STA. 0+00 TO 135+00)	
PIPE DIAMETER FM (in) =	18.24
LENGTH OF PIPE FM (ft) =	13,500
PIPE TYPE =	C.I.P.
C=	85
EXISTING FORCE MAIN (STA. -0+97 TO 0+00)	
PIPE DIAMETER PS (in) =	18.49
LENGTH OF PIPE PS (ft) =	97
PIPE TYPE =	DIP
C=	120
EXISTING FORCE MAIN (INSIDE PUMP STATION)	
PIPE DIAMETER PS (in) =	12.34
LENGTH OF PIPE PS (ft) =	32.3
PIPE TYPE =	DIP
C=	120
HIGH POINT ELEV. (ft)	73.9
LOW POINT ELEV. (ft)	44.55
STATIC HEAD (ft) =	29.35

Pump Off

		FROM TABLES	
BENDS & VALVES	TOTAL BENDS & VALVES	EQV. LENGTH (ft)	TOTAL EQV. LENGTH
18" Existing Ductile Iron Force Main (Sta. -0+97 to 0+00)			
18" Plug Valve	4	3	12
18" x 18" x 12" Tee (Thru)	2	7.2	14.4
18" x 18" x 18" Tee (Thru)	1	7.2	7.2
18" x 18" x 18" Tee (Branch)	1	44	44
18" 45° Bend	2	15	30
18" Mag Meter	1	3	3
18" x 24" Conc. Increaser	1	14	14
	TOTAL EQV. LENGTH (ft) =		124.6
18" Existing Cast Iron Force Main (Sta. 0+00 to 135+00)			
18" 90° Bend	3	22	66
18" 45° Bend	23	15	345
18" 22.5° Bend	12	10	120
18" 11.25° Bend	4	5	20
18" Air Release Valve Tee (Thru)	6	7.2	43.2
	TOTAL EQV. LENGTH (ft) =		594.2

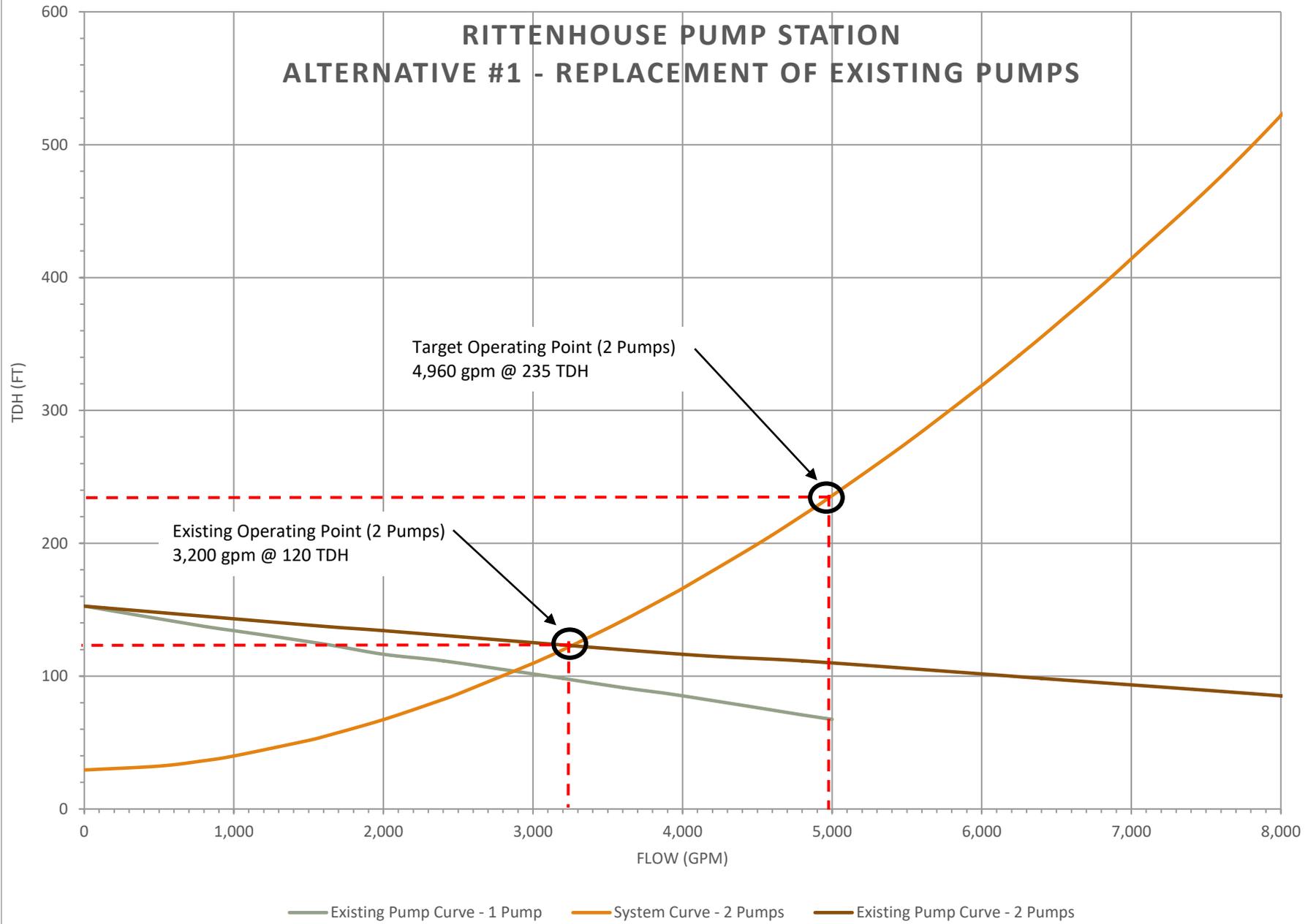
		FROM TABLES	
BENDS & VALVES	TOTAL BENDS & VALVES	EQV. LENGTH (ft)	TOTAL EQV. LENGTH
12" Existing Ductile Iron Force Main (Inside Pump Station)			
8" x 12" Ecc. Increaser	1	14	14
12" Swing Check Valve	1	120	120
12" Plug Valve	1	3	3
12" 45° Bend	2	9.7	19.4
	TOTAL EQV. LENGTH (ft) =		156.4

Total Equivalent Length of Pipe	14,505
--	---------------

SYSTEM HEAD LOSSES

PIPE SIZE (in)	FLOW (gpm)	LENGTH OF PIPE ft in 100'S	FITTINGS EQV. LENGTH ft in 100's	FRICTION LOSS per 100'	TOTAL FRICTION LOSS	TOTAL STATIC HEAD	VELOCITY ft/sec	Total Friction HEAD LOSS	TOTAL HEAD LOSS
18.24	0	135	5.942	0.00	0.00	29.35	0.00	0.00	29.35
18.49		0.97	1.25	0.00	0.00		0.00		
12.34		0.323	1.56	0.00	0.00		0.00		
18.24	500	135	5.942	0.02	2.86	29.35	0.61	2.92	32.27
18.49		0.97	1.25	0.01	0.02		0.60		
12.34		0.323	1.56	0.02	0.04		1.34		
18.24	800	135	5.942	0.05	6.82	29.35	0.98	6.96	36.31
18.49		0.97	1.25	0.02	0.05		0.96		
12.34		0.323	1.56	0.05	0.09		2.15		
18.24	1,000	135	5.942	0.07	10.30	29.35	1.23	10.51	39.86
18.49		0.97	1.25	0.04	0.08		1.19		
12.34		0.323	1.56	0.07	0.14		2.68		
18.24	1,500	135	5.942	0.15	21.81	29.35	1.84	22.26	51.61
18.49		0.97	1.25	0.08	0.17		1.79		
12.34		0.323	1.56	0.15	0.29		4.02		
18.24	1,600	135	5.942	0.17	24.57	29.35	1.96	25.08	54.43
18.49		0.97	1.25	0.09	0.19		1.91		
12.34		0.323	1.56	0.17	0.32		4.29		
18.24	2,000	135	5.942	0.26	37.13	29.35	2.46	37.90	67.25
18.49		0.97	1.25	0.13	0.29		2.39		
12.34		0.323	1.56	0.26	0.49		5.37		
18.24	2,400	135	5.942	0.37	52.02	29.35	2.95	53.11	82.46
18.49		0.97	1.25	0.18	0.40		2.87		
12.34		0.323	1.56	0.36	0.68		6.44		
18.24	2,500	135	5.942	0.40	56.10	29.35	3.07	57.28	86.63
18.49		0.97	1.25	0.20	0.44		2.99		
12.34		0.323	1.56	0.39	0.74		6.71		
18.24	3,000	135	5.942	0.56	78.61	29.35	3.68	80.25	109.60
18.49		0.97	1.25	0.28	0.61		3.58		
12.34		0.323	1.56	0.55	1.03		8.05		
18.24	3,034	135	5.942	0.57	80.26	29.35	3.73	81.94	111.29
18.49		0.97	1.25	0.28	0.62		3.63		
12.34		0.323	1.56	0.56	1.05		8.14		
18.24	3,200	135	5.942	0.63	88.58	29.35	3.93	90.43	119.78
18.49		0.97	1.25	0.31	0.69		3.82		
12.34		0.323	1.56	0.62	1.16		8.58		
18.24	3,500	135	5.942	0.74	104.55	29.35	4.30	106.73	136.08
18.49		0.97	1.25	0.37	0.81		4.18		
12.34		0.323	1.56	0.73	1.37		9.39		
18.24	3,600	135	5.942	0.78	110.14	29.35	4.42	112.44	141.79
18.49		0.97	1.25	0.39	0.86		4.30		
12.34		0.323	1.56	0.77	1.45		9.66		
18.24	3,680	135	5.942	0.81	114.71	29.35	4.52	117.11	146.46
18.49		0.97	1.25	0.40	0.89		4.40		
12.34		0.323	1.56	0.80	1.51		9.87		
18.24	3,940	135	5.942	0.92	130.15	29.35	4.84	132.88	162.23
18.49		0.97	1.25	0.46	1.01		4.71		
12.34		0.323	1.56	0.91	1.71		10.57		
18.24	4,000	135	5.942	0.95	133.84	29.35	4.91	136.64	165.99
18.49		0.97	1.25	0.47	1.04		4.78		
12.34		0.323	1.56	0.93	1.76		10.73		
18.24	4,500	135	5.942	1.18	166.43	29.35	5.53	169.91	199.26
18.49		0.97	1.25	0.58	1.29		5.38		
12.34		0.323	1.56	1.16	2.19		12.07		
18.24	4,800	135	5.942	1.33	187.54	29.35	5.89	191.46	220.81
18.49		0.97	1.25	0.66	1.46		5.74		
12.34		0.323	1.56	1.31	2.46		12.88		
18.24	5,000	135	5.942	1.43	202.25	29.35	6.14	206.48	235.83
18.49		0.97	1.25	0.71	1.57		5.97		
12.34		0.323	1.56	1.41	2.66		13.41		
18.24	5,500	135	5.942	1.71	241.25	29.35	6.75	246.29	275.64
18.49		0.97	1.25	0.85	1.88		6.57		
12.34		0.323	1.56	1.68	3.17		14.75		
18.24	6,000	135	5.942	2.01	283.38	29.35	7.37	289.31	318.66
18.49		0.97	1.25	0.99	2.20		7.17		
12.34		0.323	1.56	1.97	3.72		16.10		
18.24	6,069	135	5.942	2.05	289.44	29.35	7.45	295.49	324.84
18.49		0.97	1.25	1.02	2.25		7.25		
12.34		0.323	1.56	2.01	3.80		16.28		
18.24	6,250	135	5.942	2.17	305.61	29.35	7.67	312.00	341.35
18.49		0.97	1.25	1.07	2.38		7.47		
12.34		0.323	1.56	2.13	4.01		16.77		
18.24	6,500	135	5.942	2.33	328.61	29.35	7.98	335.48	364.83
18.49		0.97	1.25	1.15	2.55		7.77		
12.34		0.323	1.56	2.29	4.32		17.44		
18.24	7,000	135	5.942	2.67	376.89	29.35	8.59	384.78	414.13
18.49		0.97	1.25	1.32	2.93		8.36		
12.34		0.323	1.56	2.62	4.95		18.78		
18.24	8,000	135	5.942	3.42	482.51	29.35	9.82	492.60	521.95
18.49		0.97	1.25	1.69	3.75		9.56		
12.34		0.323	1.56	3.36	6.34		21.46		
18.24	10,000	135	5.942	5.17	729.10	29.35	12.28	744.35	773.70
18.49		0.97	1.25	2.56	5.67		11.95		
12.34		0.323	1.56	5.08	9.58		26.83		

RITTENHOUSE PUMP STATION ALTERNATIVE #1 - REPLACEMENT OF EXISTING PUMPS

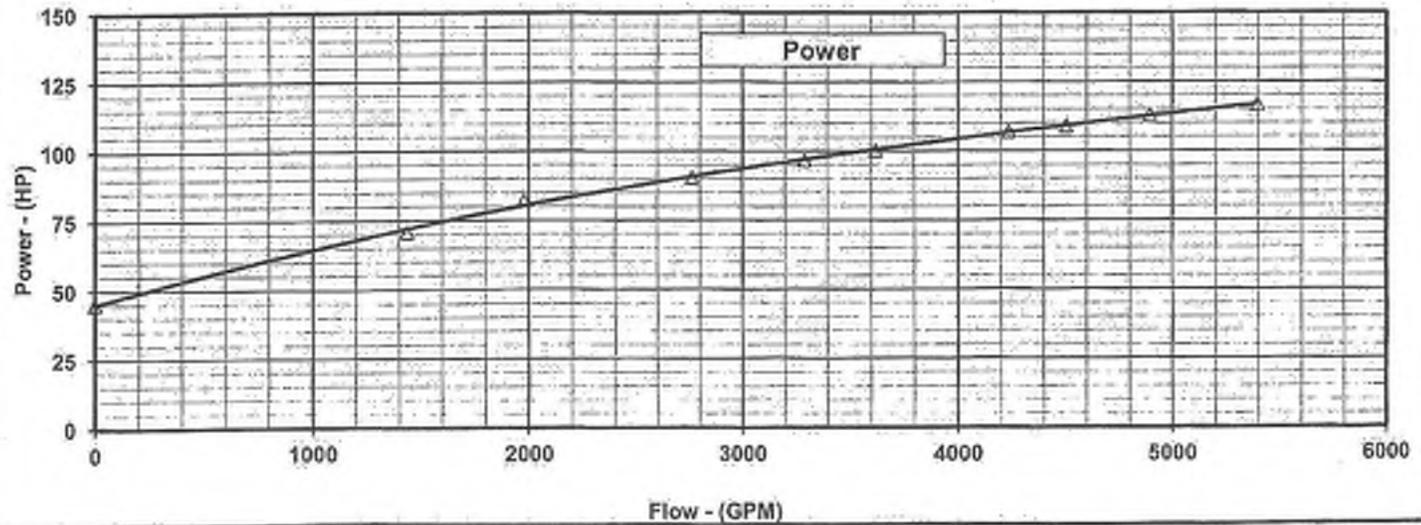
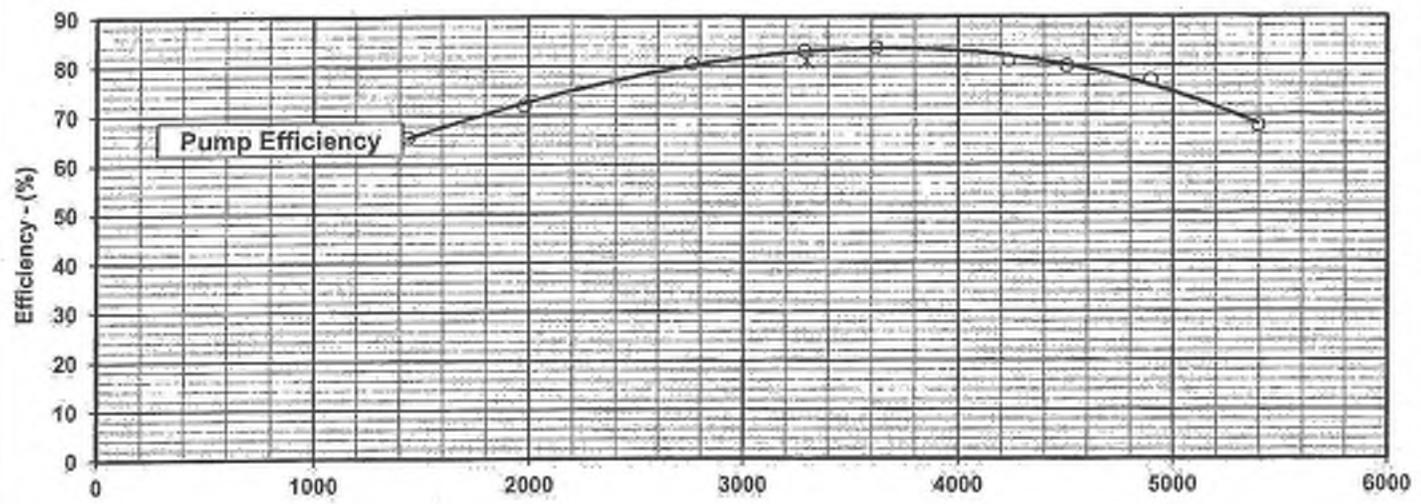
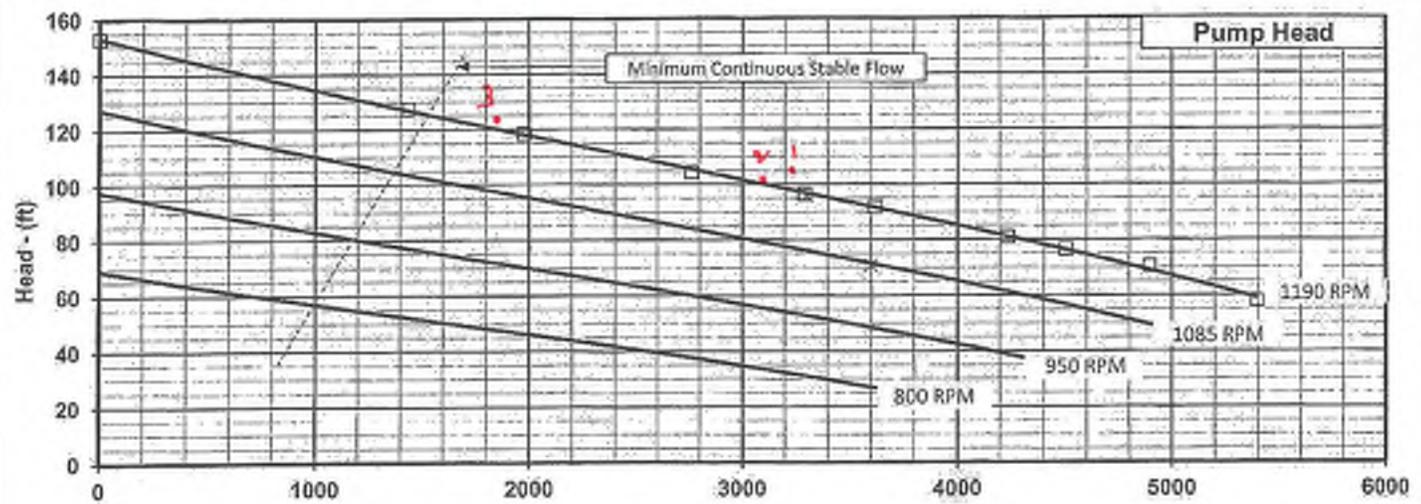


GRAPH DATA

Flow Rate GPM	Existing Pump Performance Curve (17.25" Impeller)					
	1 Pump	2 Pump	3 Pump	1 Pump	2 Pumps (Parallel)	3 Pumps (Parallel)
0	29.35	29.35	29.35	152.68	152.68	152.68
500	32.36	32.27	32.25			
800	36.54	36.31	36.26	137.48		
1000	40.22	39.86	39.79	134.23		
1500	52.36	51.61	51.46			
1600	55.27	54.43	54.26	124.22	137.48	
2000	68.52	67.25	67.00	116.44	134.23	
2400	84.24	82.46	82.10	111.47		137.48
2500	88.54	86.63	86.24			
3000	112.29	109.60	109.06	101.67		134.23
3034	114.04	111.29	110.74			
3200	122.81	119.78	119.16	98.27		
3500	139.66	136.08	135.36			
3600	145.56	141.79	141.03	91.33		
3680	150.39	146.46	145.67			
3940	166.68	162.23	161.32			
4000	170.57	165.99	165.07	85.17	116.44	
4500	204.96	199.26	198.11			
4800	227.23	220.81	219.51	70.80	111.47	124.22
5000	242.75	235.83	234.42	67.46		
5500	283.90	275.64	273.97			
6000	328.35	318.66	316.69		101.67	116.44
6069	334.75	324.84	322.83			
6250	351.81	341.35	339.23			
6400					98.27	
6500	376.08	364.83	362.55			
7000	427.02	414.13	411.51			
8000	538.46	521.95	518.60		85.17	
9000						101.67
9600						98.27
10000	798.65	773.70	768.64		67.46	
10800						91.33
12000						85.17
14400						70.8
15000						67.46

1-5-16

Certified Pump Performance Curve					PENTAIR FAIRBANKS NIJHUIS									
Customer:	JT SEEBLEY & CO INC.				Pump Details		Guaranteed Performance		Impeller Details					
End User:	RITTENHOUSE P.S.				Prefix:	D	Flow	Head	Power	Efficiency	Symbol: TAKE5JJ Design: TAKE5N			
Sales No.:	Proj. No.	Serial No.	Rev.	Test Date	Size:	8"	(GPM)	(ft)	(HP)	(%)	Diameter	Quantity	Underfile	Material
2659220	097230	2419825-1	0	5/5/2015	Model:	5435	3300	96.0		81.0	17.25"	1	None	0220
Certified By					Suffix:	MV	3600	71.0			Rotation			
John C. Mammie					Running Pos:	.016-.012					CW			
Product Engineer					Speed:	AS-TEST								Tested with the actual job motor.
5/6/2015					Reduced speed performance plotted per pump affinity laws.									
Date														





GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES

OPINION OF PROBABLE COST

Project Name: Rittenhouse - Sewer Options

Project Number: 16-02032T2

Client: West Norriton Township

Date: November 2020

Alternative #1: Replacement of Existing Pumps

Item	Description	Quantity	Unit	Unit Price	Total
1	Furnish and install new pumps capable of 7.14 MGD	1	LS	\$ 550,000.00	\$ 550,000.00
2	Complete Station Bypass Pumping				
	a Complete station bypass pumping	1	MO	\$ 100,000.00	\$ 100,000.00
	b Install / maintain two sewer plugs	1	MO	\$ 1,000.00	\$ 1,000.00
	c Diesel for Pumps	1500	GAL	\$ 4.00	\$ 6,000.00
	d Modification to upstream manhole and site to accommodate bypass pumps	1	LS	\$ 70,000.00	\$ 70,000.00
	e Install Bypass Connection	1	LS	\$ 35,000.00	\$ 35,000.00
3	Wet well modifications (excluding pumps)				
	a Pump out and cleaning of wet well	1	LS	\$ 7,500.00	\$ 7,500.00
	b Modification of piping/pump connection	1	LS	\$ 15,000.00	\$ 15,000.00
	c Furnish and installation of rails, hardware, guides and pipe supports	1	LS	\$ 15,000.00	\$ 15,000.00
	d Replace combination air valves and pressure gauges	1	LS	\$ 5,000.00	\$ 5,000.00
	e Install surge valve and pit	1	LS	\$ 20,000.00	\$ 20,000.00
4	Electrical Modifications				
	a Supply and Install Switchgear	1	LS	\$ 175,000.00	\$ 175,000.00
	b Supply and Install VFDs	1	LS	\$ 265,000.00	\$ 265,000.00
	c Supply and Install AC / Modify Exhaust Fans	1	LS	\$ 25,000.00	\$ 25,000.00
	d Supply and Install new generator, incl. pad	1	LS	\$ 400,000.00	\$ 400,000.00
	e Supply and Install new control panel	1	LS	\$ 100,000.00	\$ 100,000.00
	f Supply power to old pump station building	1	LS	\$ 10,000.00	\$ 10,000.00
5	20 Year Projected Maintenance Cost of Existing Force Main	13500	LF/YR	\$ 8.50	\$ 2,295,000.00
	Construction Total			\$	4,094,500.00
	20% Contingency			\$	818,900.00
	Subtotal			\$	4,913,400.00
	TOTAL PROBABLE CONSTRUCTION COST			\$	4,920,000.00

APPENDIX B:

Alternative #2 – Replacement of 8500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers



SYSTEM HEAD LOSSES

Alternative #2 - Replacement of 8500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers
2 Pumps Operating

PROJECT:	Rittenhouse Pump Station	
LOCATION:	West Norriton Township	
EXISTING FORCE MAIN (STA. 85+00 TO 135+00)		
PIPE DIAMETER FM (in) =	18.24	
LENGTH OF PIPE FM (ft) =	5,000	
PIPE TYPE =	C.I.P.	
C=	85	
PROPOSED FORCE MAIN (STA. 0+00 TO 85+00)		
PIPE DIAMETER FM (in) =	24.73	
LENGTH OF PIPE FM (ft) =	8500	
PIPE TYPE =	DIP	
C=	140	
EXISTING FORCE MAIN (STA. -0+97 TO 0+00)		
PIPE DIAMETER PS (in) =	18.49	
LENGTH OF PIPE PS (ft) =	97	
PIPE TYPE =	DIP	
C=	120	
EXISTING FORCE MAIN (INSIDE PUMP STATION)		
PIPE DIAMETER PS (in) =	12.34	
LENGTH OF PIPE PS (ft) =	32.3	
PIPE TYPE =	DIP	
C=	120	
HIGH POINT ELEV. (ft)	73.9	
LOW POINT ELEV. (ft)	44.55	
STATIC HEAD (ft) =	29.35	

Pump Off

BENDS & VALVES	TOTAL BENDS & VALVES	FROM TABLES	
		EQV. LENGTH (ft)	TOTAL EQV. LENGTH
18" Existing Ductile Iron Force Main (Sta. -0+97 to 0+00)			
18" Plug Valve	3	3	9
18" x 18" x 12" Tee (Thru)	2	7.2	14.4
18" x 18" x 18" Tee (Thru)	1	7.2	7.2
18" 45° Bend	2	15	30
18" Mag Meter	1	3	3
18" x 24" Conc. Increaser	1	14	14
TOTAL EQV. LENGTH (ft) =			77.6
24" Proposed Ductile Iron Force Main (Sta. 0+00 to 85+00)			
24" x 24" x 18" Tee (Thru)	2	8.8	17.6
24" x 24" x 18" Tee (Branch)	0	57	0
24" Air Release Valve Tee (Thru)	1	8.8	8.8
24" Plug valve	2	5	10
24" x 18" Reducer	2	18	36
24" 90° Bend	0	28	0
24" 45° Bend	8	20	160
24" 22.5° Bend	2	14	28
24" 11.25° Bend	6	10	60
TOTAL EQV. LENGTH (ft) =			320.4
18" Existing Cast Iron Force Main (Sta. 85+00 to 135+00)			
18" 90° Bend	2	22	44
18" 45° Bend	17	15	255
18" 22.5° Bend	12	10	120
18" 11.25° Bend	1	6	6
18" Air Release Valve Tee (Thru)	4	7.2	28.8
18" Tapping Sleeve & Valve	1	62	62
TOTAL EQV. LENGTH (ft) =			453.8

BENDS & VALVES	TOTAL BENDS & VALVES	FROM TABLES	
		EQV. LENGTH (ft)	TOTAL EQV. LENGTH
12" Existing Ductile Iron Force Main (Inside Pump Station)			
12" x 10" Ecc. Increaser	1	14	14
12" Swing Check Valve	1	120	120
12" Plug Valve	1	3	3
12" 45° Bend	2	9.7	19.4
12" 11.25° Bend	2	5	10
TOTAL EQV. LENGTH (ft) =			166.4

Total Equivalent Length of Pipe	14,648
---------------------------------	--------

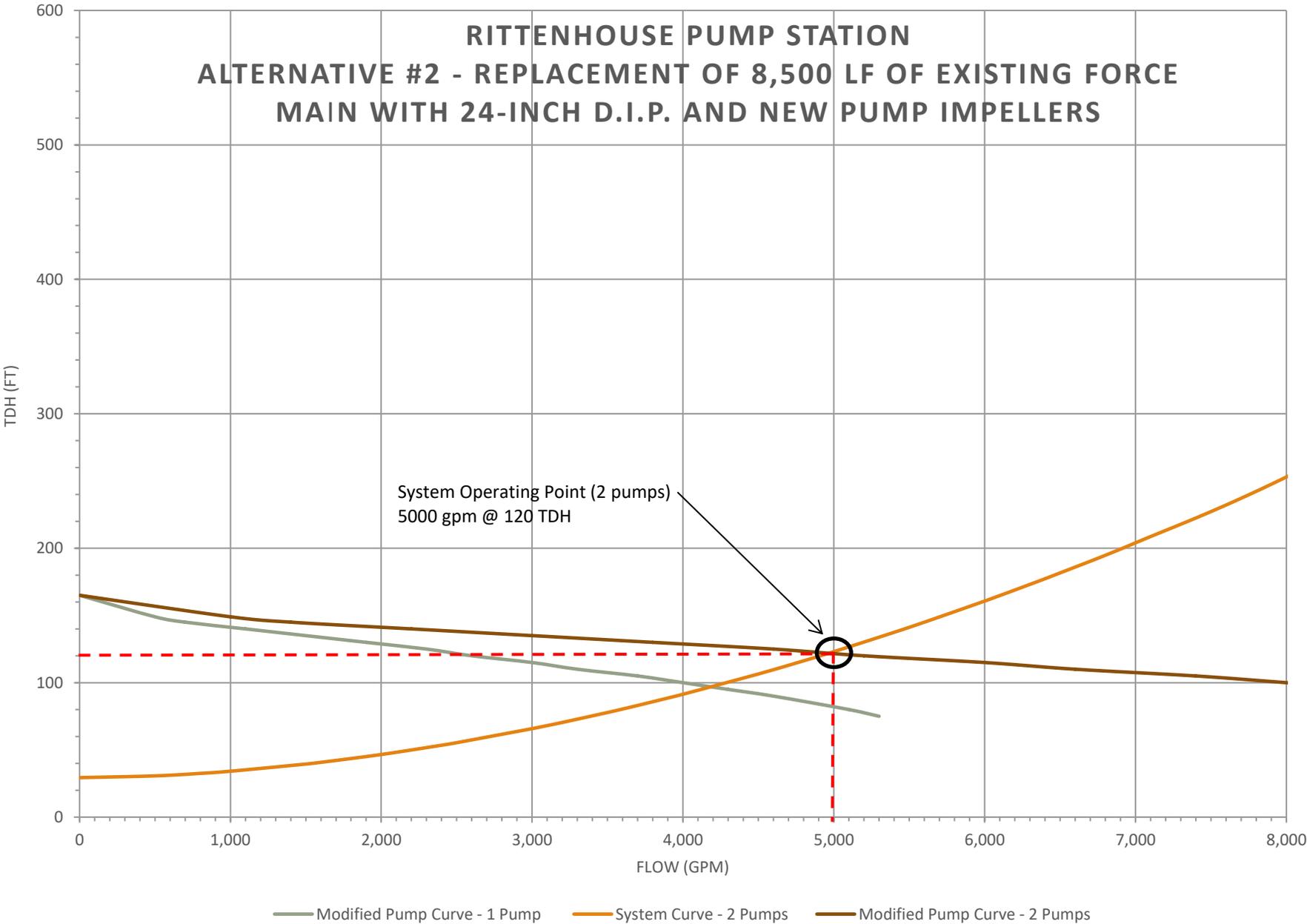
SYSTEM HEAD LOSSES

PIPE SIZE (in)	FLOW (gpm)	LENGTH OF PIPE ft in 100'S	FITTINGS EQV. LENGTH ft in 100's	FRICTION LOSS per 100'	TOTAL FRICTION LOSS	TOTAL STATIC HEAD	VELOCITY ft/sec	Total Friction HEAD LOSS	TOTAL HEAD LOSS
18.24	0	50	4.538	0.00	0.00	29.35	0.00	0.00	29.35
24.73		85	3.20	0.00	0.00		0.00		
18.49		0.97	0.78	0.00	0.00		0.00		
12.34		0.323	1.66	0.00	0.00		0.00		
18.24	500	50	4.538	0.02	1.11	29.35	0.61	1.32	30.67
24.73		85	3.20	0.00	0.16		0.33		
18.49		0.97	0.78	0.01	0.02		0.60		
12.34		0.323	1.66	0.02	0.04		1.34		
18.24	800	50	4.538	0.05	2.64	29.35	0.98	3.16	32.51
24.73		85	3.20	0.00	0.39		0.53		
18.49		0.97	0.78	0.02	0.04		0.96		
12.34		0.323	1.66	0.05	0.09		2.15		
18.24	1,000	50	4.538	0.07	3.99	29.35	1.23	4.77	34.12
24.73		85	3.20	0.01	0.58		0.67		
18.49		0.97	0.78	0.04	0.06		1.19		
12.34		0.323	1.66	0.07	0.14		2.68		
18.24	1,500	50	4.538	0.15	8.44	29.35	1.84	10.11	39.46
24.73		85	3.20	0.01	1.23		1.00		
18.49		0.97	0.78	0.08	0.13		1.79		
12.34		0.323	1.66	0.15	0.30		4.02		
18.24	1,600	50	4.538	0.17	9.51	29.35	1.96	11.39	40.74
24.73		85	3.20	0.02	1.39		1.07		
18.49		0.97	0.78	0.09	0.15		1.91		
12.34		0.323	1.66	0.17	0.34		4.29		
18.24	2,000	50	4.538	0.26	14.37	29.35	2.46	17.21	46.56
24.73		85	3.20	0.02	2.10		1.34		
18.49		0.97	0.78	0.13	0.23		2.39		
12.34		0.323	1.66	0.26	0.51		5.37		
18.24	2,400	50	4.538	0.37	20.13	29.35	2.95	24.11	53.46
24.73		85	3.20	0.03	2.94		1.60		
18.49		0.97	0.78	0.18	0.32		2.87		
12.34		0.323	1.66	0.36	0.72		6.44		
18.24	2,500	50	4.538	0.40	21.71	29.35	3.07	26.00	55.35
24.73		85	3.20	0.04	3.17		1.67		
18.49		0.97	0.78	0.20	0.34		2.99		
12.34		0.323	1.66	0.39	0.78		6.71		
18.24	3,000	50	4.538	0.56	30.42	29.35	3.68	36.43	65.78
24.73		85	3.20	0.05	4.44		2.00		
18.49		0.97	0.78	0.28	0.48		3.58		
12.34		0.323	1.66	0.55	1.09		8.05		
18.24	3,034	50	4.538	0.57	31.06	29.35	3.73	37.20	66.55
24.73		85	3.20	0.05	4.54		2.03		
18.49		0.97	0.78	0.28	0.49		3.63		
12.34		0.323	1.66	0.56	1.11		8.14		
18.24	3,200	50	4.538	0.63	34.27	29.35	3.93	41.05	70.40
24.73		85	3.20	0.06	5.01		2.14		
18.49		0.97	0.78	0.31	0.54		3.82		
12.34		0.323	1.66	0.62	1.23		8.58		
18.24	3,500	50	4.538	0.74	40.46	29.35	4.30	48.45	77.80
24.73		85	3.20	0.07	5.91		2.34		
18.49		0.97	0.78	0.37	0.64		4.18		
12.34		0.323	1.66	0.73	1.45		9.39		
18.24	3,600	50	4.538	0.78	42.62	29.35	4.42	51.04	80.39
24.73		85	3.20	0.07	6.23		2.40		
18.49		0.97	0.78	0.39	0.67		4.30		
12.34		0.323	1.66	0.77	1.52		9.66		
18.24	3,680	50	4.538	0.81	44.39	29.35	4.52	53.16	82.51
24.73		85	3.20	0.07	6.49		2.46		
18.49		0.97	0.78	0.40	0.70		4.40		
12.34		0.323	1.66	0.80	1.59		9.87		
18.24	3,940	50	4.538	0.92	50.36	29.35	4.84	60.32	89.67
24.73		85	3.20	0.08	7.36		2.63		
18.49		0.97	0.78	0.46	0.80		4.71		
12.34		0.323	1.66	0.91	1.80		10.57		
18.24	4,000	50	4.538	0.95	51.79	29.35	4.91	62.03	91.38
24.73		85	3.20	0.09	7.57		2.67		
18.49		0.97	0.78	0.47	0.82		4.78		
12.34		0.323	1.66	0.93	1.85		10.73		
18.24	4,500	50	4.538	1.18	64.40	29.35	5.53	77.13	106.48
24.73		85	3.20	0.11	9.41		3.01		
18.49		0.97	0.78	0.58	1.02		5.38		
12.34		0.323	1.66	1.16	2.30		12.07		
18.24	4,800	50	4.538	1.33	72.57	29.35	5.89	86.91	116.26
24.73		85	3.20	0.12	10.60		3.21		
18.49		0.97	0.78	0.66	1.15		5.74		
12.34		0.323	1.66	1.31	2.59		12.88		
18.24	5,000	50	4.538	1.43	78.26	29.35	6.14	93.73	123.08
24.73		85	3.20	0.13	11.43		3.34		
18.49		0.97	0.78	0.71	1.24		5.97		
12.34		0.323	1.66	1.41	2.80		13.41		
18.24	5,500	50	4.538	1.71	93.35	29.35	6.75	111.80	141.15
24.73		85	3.20	0.15	13.64		3.67		
18.49		0.97	0.78	0.85	1.48		6.57		
12.34		0.323	1.66	1.68	3.34		14.75		

SYSTEM HEAD LOSSES

18.24	6,000	50	4.538	2.01	109.65	29.35	7.37	131.33	160.68
24.73		85	3.20	0.18	16.02		4.01		
18.49		0.97	0.78	0.99	1.74		7.17		
12.34		0.323	1.66	1.97	3.92		16.10		
18.24	6,069	50	4.538	2.05	112.00	29.35	7.45	134.14	163.49
24.73		85	3.20	0.19	16.36		4.05		
18.49		0.97	0.78	1.02	1.77		7.25		
12.34		0.323	1.66	2.01	4.00		16.28		
18.24	6,250	50	4.538	2.17	118.26	29.35	7.67	141.63	170.98
24.73		85	3.20	0.20	17.28		4.17		
18.49		0.97	0.78	1.07	1.87		7.47		
12.34		0.323	1.66	2.13	4.23		16.77		
18.24	6,500	50	4.538	2.33	127.16	29.35	7.98	152.29	181.64
24.73		85	3.20	0.21	18.58		4.34		
18.49		0.97	0.78	1.15	2.01		7.77		
12.34		0.323	1.66	2.29	4.55		17.44		
18.24	7,000	50	4.538	2.67	145.84	29.35	8.59	174.67	204.02
24.73		85	3.20	0.24	21.31		4.68		
18.49		0.97	0.78	1.32	2.31		8.36		
12.34		0.323	1.66	2.62	5.21		18.78		
18.24	8,000	50	4.538	3.42	186.71	29.35	9.82	223.62	252.97
24.73		85	3.20	0.31	27.28		5.34		
18.49		0.97	0.78	1.69	2.96		9.56		
12.34		0.323	1.66	3.36	6.67		21.46		
18.24	10,000	50	4.538	5.17	282.13	29.35	12.28	337.90	367.25
24.73		85	3.20	0.47	41.22		6.68		
18.49		0.97	0.78	2.56	4.47		11.95		
12.34		0.323	1.66	5.08	10.09		26.83		

**RITTENHOUSE PUMP STATION
ALTERNATIVE #2 - REPLACEMENT OF 8,500 LF OF EXISTING FORCE
MAIN WITH 24-INCH D.I.P. AND NEW PUMP IMPELLERS**



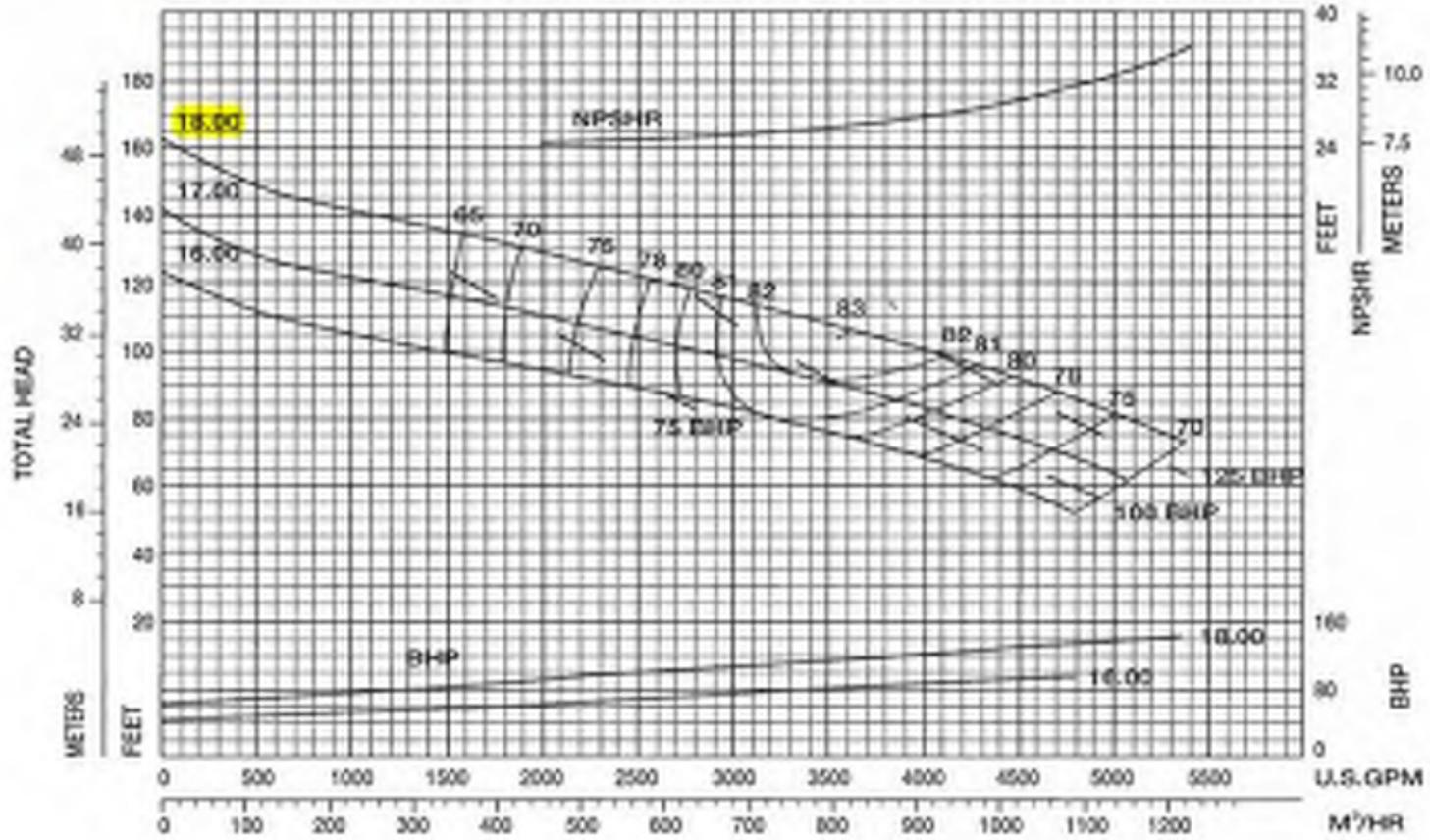
GRAPH DATA:

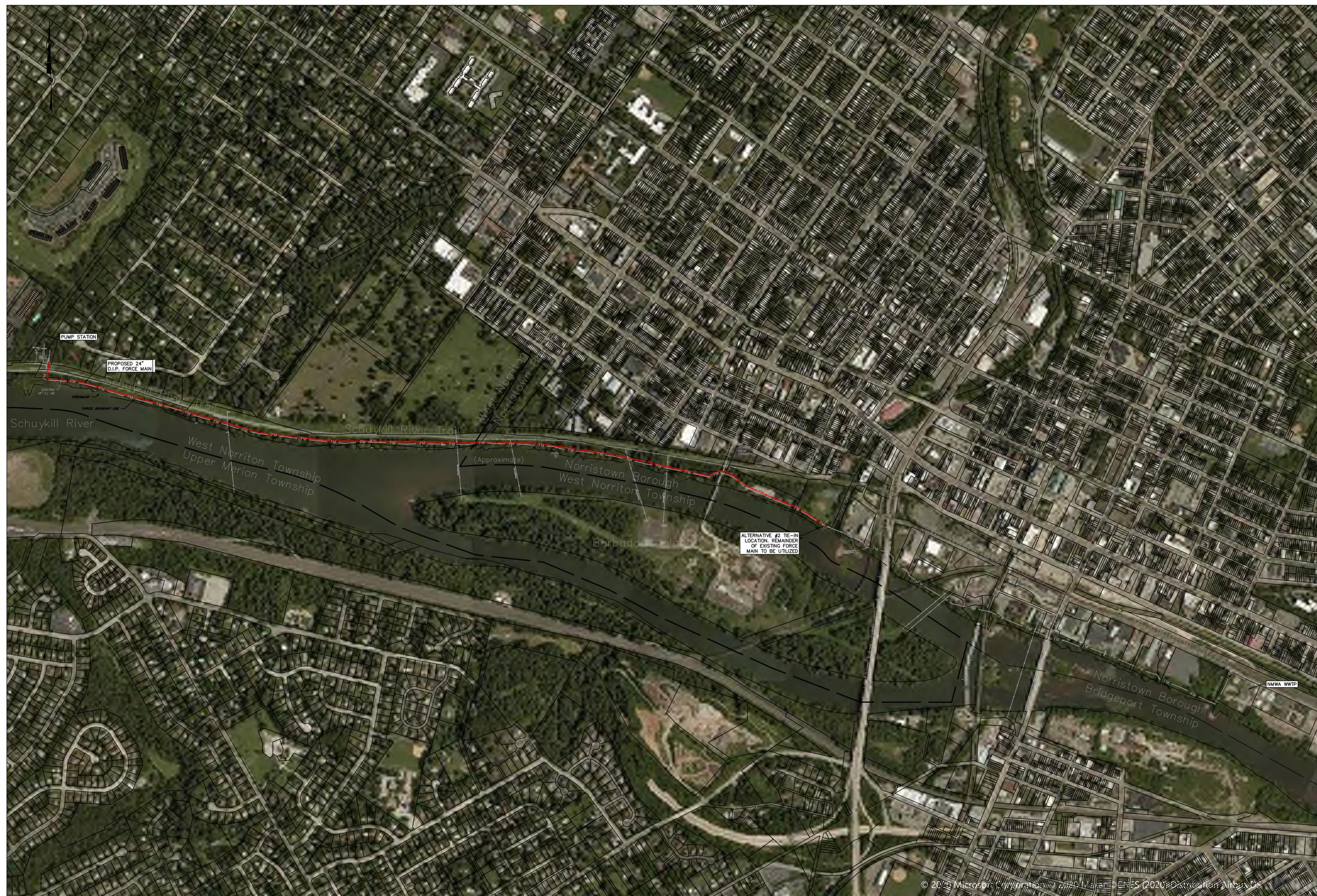
Flow Rate GPM	1 Pump			2 Pumps			Flow Rate GPM
	1 Pump	2 Pump	3 Pump	1 Pump	2 Pumps	3 Pumps	
0	29.35	29.35	29.35	165.00	165.00	165.00	0
500	30.78	30.67	30.77	149.00			500
800	32.75	32.51	32.75	145.00			700
1000	34.49	34.12	34.49		149.00		1000
1500	40.24	39.46	40.22	140.00			1100
1600	41.62	40.74	41.60		145.00		1400
2000	47.89	46.56	47.86	135.00		149.00	1500
2400	55.33	53.46	55.29	130.00			1900
2500	57.37	55.35	57.33			145.00	2100
3000	68.61	65.78	68.55		140.00		2200
3034	69.44	66.55	69.38	125.00			2300
3200	73.59	70.40	73.52	120.00			2600
3500	81.57	77.80	81.49	115.00	135.00		3000
3600	84.36	80.39	84.28	110.00		140.00	3300
3680	86.65	82.51	86.55	105.00			3700
3940	94.36	89.67	94.26		130.00		3800
4000	96.20	91.38	96.10	100.00			4000
4500	112.48	106.48	112.35	95.00			4300
4800	123.02	116.26	122.87			135.00	4500
5000	130.37	123.08	130.21	90.00	125.00		4600
5500	149.85	141.15	149.65	80.00			5100
6000	170.89	160.68	170.67		120.00		5200
6069	173.92	163.49	173.69	75.00			5300
6250	182.00	170.98	181.75			130.00	5700
6500	193.48	181.64	193.22		115.00		6000
7000	217.60	204.02	217.30		110.00		6600
8000	270.35	252.97	269.97			125.00	6900
10000	393.52	367.25	392.94		105.00		7400
						120.00	7800
					100.00		8000
					95.00		8600
						115.00	9000
					90.00		9200
						110.00	9900
					80.00		10200
					75.00		10600

Performance Curve - 8" 5435 MV

RPM: 1185 SOLIDS: 5"

IMPELLER: TAKEN, 2 VANE SUCTION: 8" INLET: 139.29 in³





GILMORE & ASSOCIATES, INC.
 ENGINEERING & CONSULTING SERVICES
16 EAST BUTLER AVENUE, SUITE 300, NEW BRITAIN, PA 19101 • 215 544-5300 • www.gilmore-associ.com



JOB NO.: 2016-0203272
 MUNICIPAL FILE NO.: 630007243011
 TAX MAP PARCEL NO.: XX
 SCALE: 1" = 400'
 0 400' 800'
 FEET
 IN
 DRAWN BY: TBE
 CHECKED BY: TUF
 DATE: 10/27/2020

OWNER:
 WEST NORRITON TOWNSHIP
 1530 PENNSYLVANIA AVE
 WEST NORRITON, PA 19403

**ALTERNATIVE #2 SITE MAP
 RITTENHOUSE PUMP STATION
 FORCE MAIN ANALYSIS**

WEST NORRITON TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA

SHEET NO.:



GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES

OPINION OF PROBABLE COST

Project Name: Rittenhouse - Sewer Options

Project Number: 16-02032T2

Client: West Norriton Township

Date: November 2020

Alternative #2: Replacement of 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers

Item	Description	Quantity	Unit	Unit Price	Total
1	Furnish and Install 24" DIP Force Main	8,500	LF	\$ 250.00	\$ 2,125,000.00
2	Furnish and Install 18" Pump Impellers	3	EA	\$ 20,000.00	\$ 60,000.00
3	Furnish and Install Air Release Valve Chamber	1	EA	\$ 10,000.00	\$ 10,000.00
4	Furnish and Install 18" Tapping Sleeve & Valve (SS)	1	EA	\$ 30,000.00	\$ 30,000.00
5	Furnish & Install 18" Line Stop	1	EA	\$ 25,000.00	\$ 25,000.00
6	Abandon Ex. Forcemain incl. Conc. Encase and Reinforce	1	LS	\$ 5,000.00	\$ 5,000.00
7	Furnish and Install 24" x 18" Reducer Fitting	2	EA	\$ 2,500.00	\$ 5,000.00
8	Furnish and Install 45° Fitting	8	EA	\$ 2,500.00	\$ 20,000.00
9	Furnish and Install 22.5° Fitting	2	EA	\$ 2,500.00	\$ 5,000.00
10	Furnish and Install 11.25° Fitting	6	EA	\$ 2,500.00	\$ 15,000.00
11	Bypass Pumping	1	LS	\$ 10,000.00	\$ 10,000.00
12	Pavement Restoration	40	SY	\$ 75.00	\$ 3,000.00
13	Final Grading and Seeding	9390	SY	\$ 10.00	\$ 93,900.00
14	20 Year Projected Maintenance Cost of Existing Force Main	5000	LF/YR	\$ 1.50	\$ 150,000.00

Construction Total \$ 2,556,900.00

20% Contingency \$ 511,380.00

Subtotal \$ 3,068,280.00

TOTAL PROBABLE CONSTRUCTION COST \$ 3,070,000.00

APPENDIX C:

Alternative #3 – Replacement of 8500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers to Upgraded Gravity Sewer within Washington Street to the NMWA WWTP



SYSTEM HEAD LOSSES

Alternative #3 - Replacement of 8500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers to Upgraded Gravity Sewer within Washington Street to the NMWA WWTP

2 Pumps Operating

PROJECT:	Rittenhouse Pump Station
LOCATION:	West Norriton Township
EXISTING FORCE MAIN (ABANDONED)	
PIPE DIAMETER FM (in) =	18.24
LENGTH OF PIPE FM (ft) =	0
PIPE TYPE =	C.I.P.
C=	85
PROPOSED FORCE MAIN (Sta. 0+00 to 100+00)	
PIPE DIAMETER FM (in) =	24.73
LENGTH OF PIPE FM (ft) =	10000
PIPE TYPE =	DIP
C=	140
EXISTING FORCE MAIN (STA. -0+97 TO 0+00)	
PIPE DIAMETER PS (in) =	18.49
LENGTH OF PIPE PS (ft) =	97
PIPE TYPE =	DIP
C=	120
EXISTING FORCE MAIN (INSIDE PUMP STATION)	
PIPE DIAMETER PS (in) =	12.34
LENGTH OF PIPE PS (ft) =	32.3
PIPE TYPE =	DIP
C=	120
HIGH POINT ELEV. (ft)	73.9
LOW POINT ELEV. (ft)	44.55
STATIC HEAD (ft) =	29.35

Pump Off

FROM TABLES			
BENDS & VALVES	TOTAL BENDS & VALVES	EQV. LENGTH (ft)	TOTAL EQV. LENGTH
18" Existing Ductile Iron Force Main (Sta. -0+97 to 0+00)			
18" Plug Valve	3	3	9
18" x 18" x 12" Tee (Thru)	2	7.2	14.4
18" x 18" x 18" Tee (Thru)	1	7.2	7.2
18" 45° Bend	2	15	30
18" Mag Meter	1	3	3
18" x 24" Conc. Increaser	1	14	14
TOTAL EQV. LENGTH (ft) =			77.6
24" Proposed Ductile Iron Force Main (Sta. 0+00 to 100+00)			
24" x 24" x 18" Tee (Thru)	2	8.8	17.6
24" x 24" x 18" Tee (Branch)	0	57	0
24" Air Release Valve Tee (Thru)	1	8.8	8.8
24" Plug valve	2	5	10
24" x 18" Reducer	2	18	36
24" 90° Bend	0	28	0
24" 45° Bend	18	20	360
24" 22.5° Bend	2	14	28
24" 11.25° Bend	6	10	60
TOTAL EQV. LENGTH (ft) =			520.4
18" Existing Cast Iron Force Main (ABANDONED)			
18" 90° Bend	2	22	44
18" 45° Bend	17	15	255
18" 22.5° Bend	12	10	120
18" 11.25° Bend	1	6	6
18" Air Release Valve Tee (Thru)	4	7.2	28.8
18" Tapping Sleeve & Valve	1	62	62
TOTAL EQV. LENGTH (ft) =			453.8

FROM TABLES			
BENDS & VALVES	TOTAL BENDS & VALVES	EQV. LENGTH (ft)	TOTAL EQV. LENGTH
12" Existing Ductile Iron Force Main (Inside Pump Station)			
12" x 10" Ecc. Increaser	1	14	14
12" Swing Check Valve	1	120	120
12" Plug Valve	1	3	3
12" 45° Bend	2	9.7	19.4
12" 11.25° Bend	2	5	10
TOTAL EQV. LENGTH (ft) =			166.4

Total Equivalent Length of Pipe	11,348
---------------------------------	--------

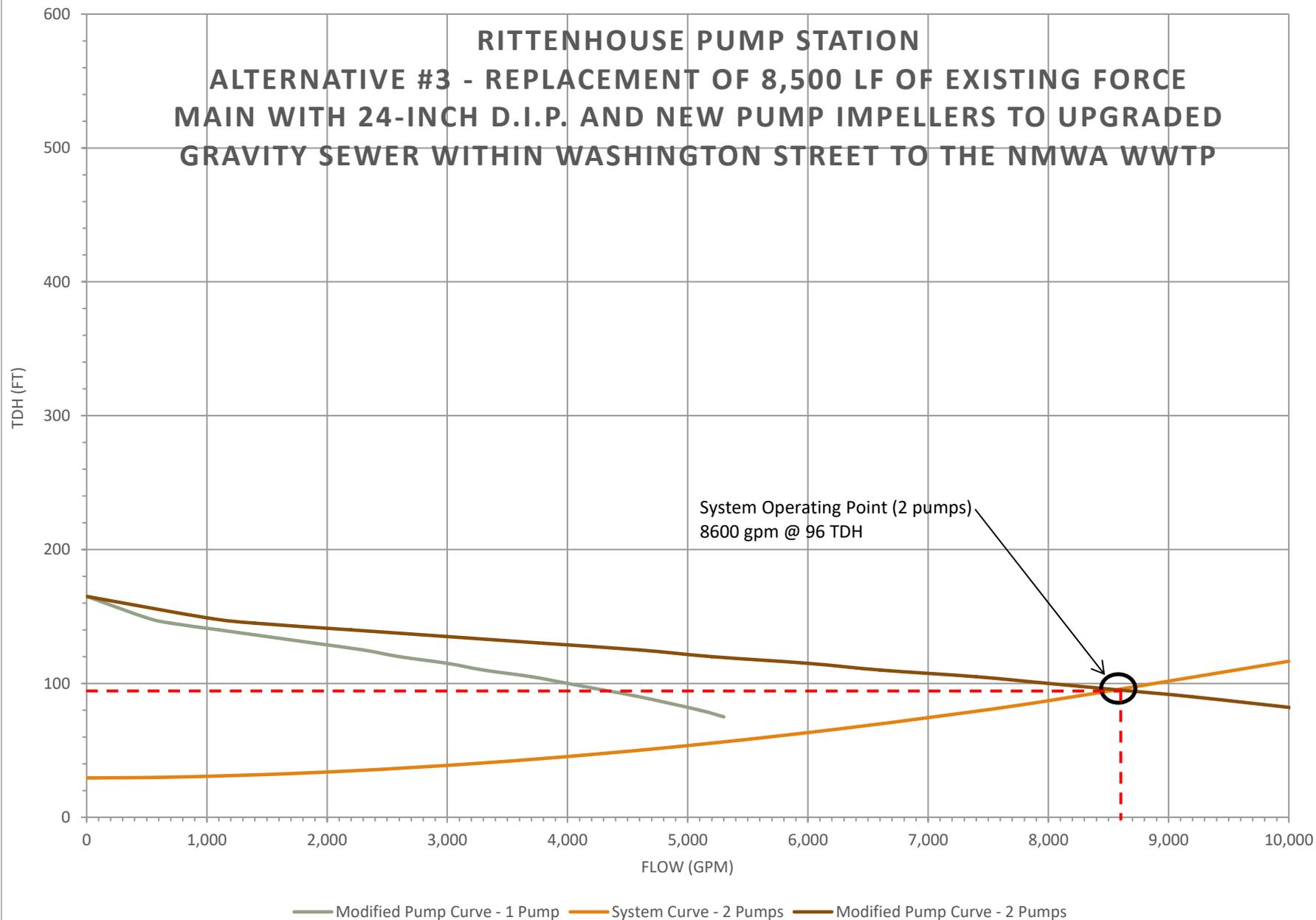
SYSTEM HEAD LOSSES

PIPE SIZE (in)	FLOW (gpm)	LENGTH OF PIPE ft in 100'S	FITTINGS EQV. LENGTH ft in 100's	FRICTION LOSS per 100'	TOTAL FRICTION LOSS	TOTAL STATIC HEAD	VELOCITY ft/sec	Total Friction HEAD LOSS	TOTAL HEAD LOSS
18.24	0	0	4.538	0.00	0.00	29.35	0.00	0.00	29.35
24.73		100	5.20	0.00	0.00		0.00		
18.49		0.97	0.78	0.00	0.00		0.00		
12.34		0.323	1.66	0.00	0.00		0.00		
18.24	500	0	4.538	0.02	0.09	29.35	0.61	0.34	29.69
24.73		100	5.20	0.00	0.19		0.33		
18.49		0.97	0.78	0.01	0.02		0.60		
12.34		0.323	1.66	0.02	0.04		1.34		
18.24	800	0	4.538	0.05	0.22	29.35	0.98	0.82	30.17
24.73		100	5.20	0.00	0.46		0.53		
18.49		0.97	0.78	0.02	0.04		0.96		
12.34		0.323	1.66	0.05	0.09		2.15		
18.24	1,000	0	4.538	0.07	0.33	29.35	1.23	1.23	30.58
24.73		100	5.20	0.01	0.69		0.67		
18.49		0.97	0.78	0.04	0.06		1.19		
12.34		0.323	1.66	0.07	0.14		2.68		
18.24	1,500	0	4.538	0.15	0.70	29.35	1.84	2.61	31.96
24.73		100	5.20	0.01	1.47		1.00		
18.49		0.97	0.78	0.08	0.13		1.79		
12.34		0.323	1.66	0.15	0.30		4.02		
18.24	1,600	0	4.538	0.17	0.79	29.35	1.96	2.94	32.29
24.73		100	5.20	0.02	1.66		1.07		
18.49		0.97	0.78	0.09	0.15		1.91		
12.34		0.323	1.66	0.17	0.34		4.29		
18.24	2,000	0	4.538	0.26	1.20	29.35	2.46	4.44	33.79
24.73		100	5.20	0.02	2.50		1.34		
18.49		0.97	0.78	0.13	0.23		2.39		
12.34		0.323	1.66	0.26	0.51		5.37		
18.24	2,400	0	4.538	0.37	1.67	29.35	2.95	6.22	35.57
24.73		100	5.20	0.03	3.51		1.60		
18.49		0.97	0.78	0.18	0.32		2.87		
12.34		0.323	1.66	0.36	0.72		6.44		
18.24	2,500	0	4.538	0.40	1.81	29.35	3.07	6.71	36.06
24.73		100	5.20	0.04	3.78		1.67		
18.49		0.97	0.78	0.20	0.34		2.99		
12.34		0.323	1.66	0.39	0.78		6.71		
18.24	3,000	0	4.538	0.56	2.53	29.35	3.68	9.40	38.75
24.73		100	5.20	0.05	5.30		2.00		
18.49		0.97	0.78	0.28	0.48		3.58		
12.34		0.323	1.66	0.55	1.09		8.05		
18.24	3,034	0	4.538	0.57	2.58	29.35	3.73	9.60	38.95
24.73		100	5.20	0.05	5.41		2.03		
18.49		0.97	0.78	0.28	0.49		3.63		
12.34		0.323	1.66	0.56	1.11		8.14		
18.24	3,200	0	4.538	0.63	2.85	29.35	3.93	10.59	39.94
24.73		100	5.20	0.06	5.97		2.14		
18.49		0.97	0.78	0.31	0.54		3.82		
12.34		0.323	1.66	0.62	1.23		8.58		
18.24	3,500	0	4.538	0.74	3.37	29.35	4.30	12.50	41.85
24.73		100	5.20	0.07	7.05		2.34		
18.49		0.97	0.78	0.37	0.64		4.18		
12.34		0.323	1.66	0.73	1.45		9.39		
18.24	3,600	0	4.538	0.78	3.55	29.35	4.42	13.17	42.52
24.73		100	5.20	0.07	7.43		2.40		
18.49		0.97	0.78	0.39	0.67		4.30		
12.34		0.323	1.66	0.77	1.52		9.66		
18.24	3,680	0	4.538	0.81	3.69	29.35	4.52	13.72	43.07
24.73		100	5.20	0.07	7.74		2.46		
18.49		0.97	0.78	0.40	0.70		4.40		
12.34		0.323	1.66	0.80	1.59		9.87		
18.24	3,940	0	4.538	0.92	4.19	29.35	4.84	15.56	44.91
24.73		100	5.20	0.08	8.78		2.63		
18.49		0.97	0.78	0.46	0.80		4.71		
12.34		0.323	1.66	0.91	1.80		10.57		
18.24	4,000	0	4.538	0.95	4.31	29.35	4.91	16.01	45.36
24.73		100	5.20	0.09	9.03		2.67		
18.49		0.97	0.78	0.47	0.82		4.78		
12.34		0.323	1.66	0.93	1.85		10.73		
18.24	4,500	0	4.538	1.18	5.36	29.35	5.53	19.90	49.25
24.73		100	5.20	0.11	11.22		3.01		
18.49		0.97	0.78	0.58	1.02		5.38		
12.34		0.323	1.66	1.16	2.30		12.07		
18.24	4,800	0	4.538	1.33	6.04	29.35	5.89	22.43	51.78
24.73		100	5.20	0.12	12.65		3.21		
18.49		0.97	0.78	0.66	1.15		5.74		
12.34		0.323	1.66	1.31	2.59		12.88		
18.24	5,000	0	4.538	1.43	6.51	29.35	6.14	24.19	53.54
24.73		100	5.20	0.13	13.64		3.34		
18.49		0.97	0.78	0.71	1.24		5.97		
12.34		0.323	1.66	1.41	2.80		13.41		
18.24	5,500	0	4.538	1.71	7.77	29.35	6.75	28.85	58.20
24.73		100	5.20	0.15	16.27		3.67		
18.49		0.97	0.78	0.85	1.48		6.57		
12.34		0.323	1.66	1.68	3.34		14.75		

SYSTEM HEAD LOSSES

18.24	6,000	0	4.538	2.01	9.12	29.35	7.37	33.89	63.24
24.73		100	5.20	0.18	19.11		4.01		
18.49		0.97	0.78	0.99	1.74		7.17		
12.34		0.323	1.66	1.97	3.92		16.10		
18.24	6,069	0	4.538	2.05	9.32	29.35	7.45	34.61	63.96
24.73		100	5.20	0.19	19.52		4.05		
18.49		0.97	0.78	1.02	1.77		7.25		
12.34		0.323	1.66	2.01	4.00		16.28		
18.24	6,250	0	4.538	2.17	9.84	29.35	7.67	36.55	65.90
24.73		100	5.20	0.20	20.61		4.17		
18.49		0.97	0.78	1.07	1.87		7.47		
12.34		0.323	1.66	2.13	4.23		16.77		
18.24	6,500	0	4.538	2.33	10.58	29.35	7.98	39.30	68.65
24.73		100	5.20	0.21	22.16		4.34		
18.49		0.97	0.78	1.15	2.01		7.77		
12.34		0.323	1.66	2.29	4.55		17.44		
18.24	7,000	0	4.538	2.67	12.14	29.35	8.59	45.07	74.42
24.73		100	5.20	0.24	25.41		4.68		
18.49		0.97	0.78	1.32	2.31		8.36		
12.34		0.323	1.66	2.62	5.21		18.78		
18.24	8,000	0	4.538	3.42	15.54	29.35	9.82	57.70	87.05
24.73		100	5.20	0.31	32.54		5.34		
18.49		0.97	0.78	1.69	2.96		9.56		
12.34		0.323	1.66	3.36	6.67		21.46		
18.24	10,000	0	4.538	5.17	23.48	29.35	12.28	87.19	116.54
24.73		100	5.20	0.47	49.16		6.68		
18.49		0.97	0.78	2.56	4.47		11.95		
12.34		0.323	1.66	5.08	10.09		26.83		

**RITTENHOUSE PUMP STATION
ALTERNATIVE #3 - REPLACEMENT OF 8,500 LF OF EXISTING FORCE
MAIN WITH 24-INCH D.I.P. AND NEW PUMP IMPELLERS TO UPGRADED
GRAVITY SEWER WITHIN WASHINGTON STREET TO THE NMWA WWTP**



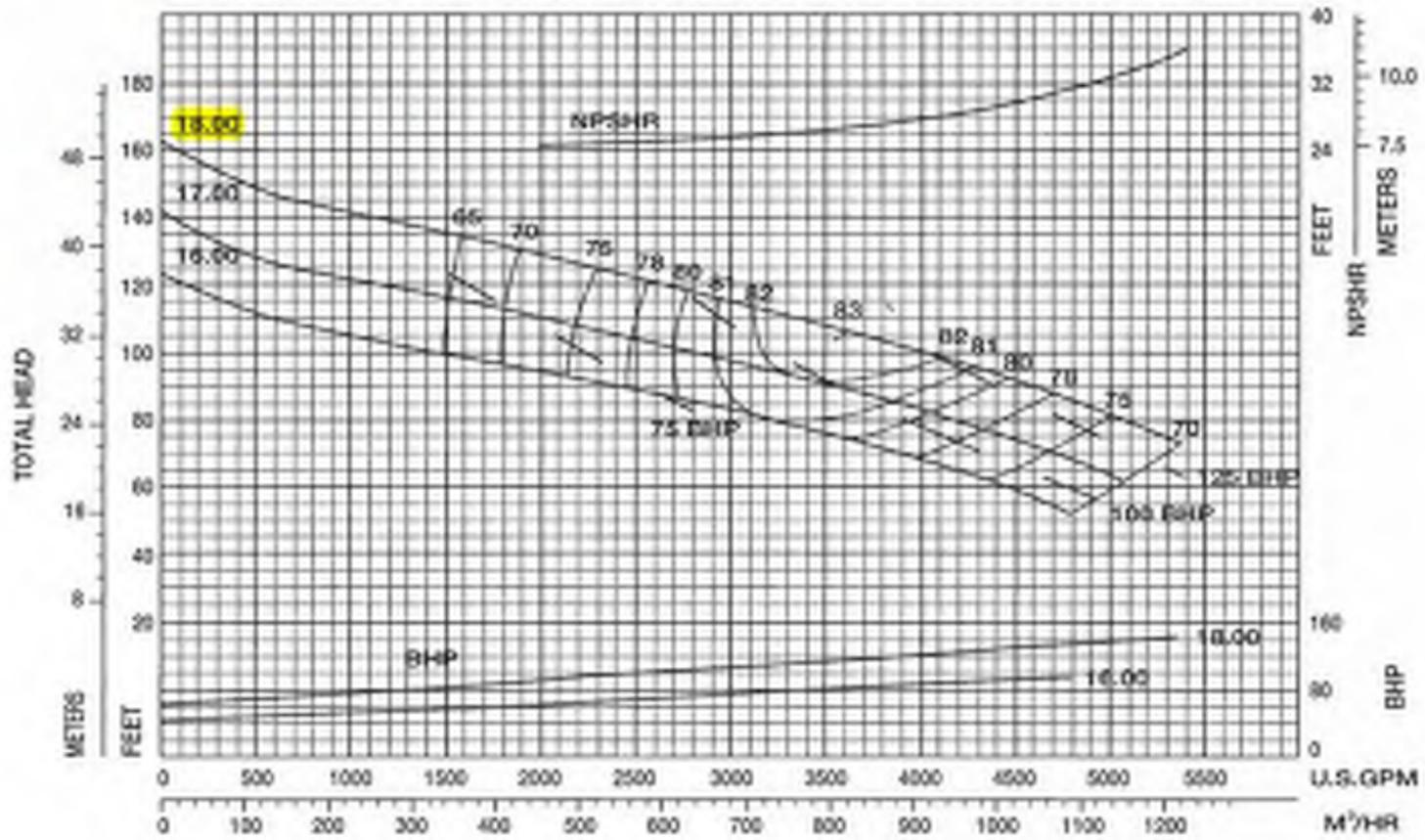
GRAPH DATA:

Flow Rate GPM	1 Pump			2 Pumps			Flow Rate GPM
	1 Pump	2 Pump	3 Pump	1 Pump	2 Pumps	3 Pumps	
0	29.35	29.35	29.35	165.00	165.00	165.00	0
500	29.86	29.69	29.73	149.00			500
800	30.56	30.17	30.27	145.00			700
1000	31.18	30.58	30.74		149.00		1000
1500	33.23	31.96	32.28	140.00			1100
1600	33.72	32.29	32.65		145.00		1400
2000	35.95	33.79	34.34	135.00		149.00	1500
2400	38.60	35.57	36.35	130.00			1900
2500	39.33	36.06	36.90			145.00	2100
3000	43.33	38.75	39.92		140.00		2200
3034	43.63	38.95	40.14	125.00			2300
3200	45.11	39.94	41.26	120.00			2600
3500	47.95	41.85	43.41	115.00	135.00		3000
3600	48.94	42.52	44.16	110.00		140.00	3300
3680	49.75	43.07	44.78	105.00			3700
3940	52.50	44.91	46.85		130.00		3800
4000	53.16	45.36	47.35	100.00			4000
4500	58.95	49.25	51.73	95.00			4300
4800	62.71	51.78	54.57			135.00	4500
5000	65.32	53.54	56.55	90.00	125.00		4600
5500	72.26	58.20	61.80	80.00	120.00		5100
6000	79.76	63.24	67.46				5200
6069	80.83	63.96	68.28	75.00			5300
6250	83.71	65.90	70.45			130.00	5700
6500	87.80	68.65	73.55		115.00		6000
7000	96.39	74.42	80.04		110.00		6600
8000	115.18	87.05	94.24			125.00	6900
10000	159.04	116.54	127.41		105.00		7400
						120.00	7800
					100.00		8000
					95.00		8600
						115.00	9000
					90.00		9200
						110.00	9900
					80.00		10200
					75.00		10600

Performance Curve - 8" 5435 MV

RPM: 1185 SOLIDS: 5"

IMPELLER: TAKEN, 2 VANE SUCTION: 8" INLET: 139.29 in³





GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES

OPINION OF PROBABLE COST

Project Name: Rittenhouse - Sewer Options

Project Number: 16-02032T2

Client: West Norriton Township

Date: November 2020

Alternative #3: Replacement 8,500 LF of Existing Force Main with 24-inch D.I.P. and New Pump Impellers to Upgraded Gravity Sewer within Washington Street to the NMWA WWTP

Item	Description	Quantity	Unit	Unit Price	Total
1	Furnish and Install 24" DIP Force Main	10000	LF	\$ 250.00	\$ 2,500,000.00
2	Furnish and Install 48" DIP Gravity Sewer with Manholes	3600	LF	\$ 1,300.00	\$ 4,680,000.00
3	Furnish and Install Force Main Heat Tracer Wire	550	LF	\$ 6.00	\$ 3,300.00
4	Furnish and Install 18" Pump Impellers	3	EA	\$ 20,000.00	\$ 60,000.00
6	Furnish and Install Air Release Valve Chamber	2	EA	\$ 10,000.00	\$ 20,000.00
7	Furnish and Install 18" Tapping Sleeve & Valve (SS)	1	EA	\$ 30,000.00	\$ 30,000.00
8	Furnish & Install 18" Line Stop	1	EA	\$ 25,000.00	\$ 25,000.00
9	Abandon Ex. Forcemain incl. Conc. Encase and Reinforce	1	LS	\$ 3,500.00	\$ 3,500.00
10	Furnish and Install 24" x 18" Reducer Fitting	2	EA	\$ 2,500.00	\$ 5,000.00
11	Furnish and Install 45° Fitting	18	EA	\$ 2,500.00	\$ 45,000.00
12	Furnish and Install 22.5° Fitting	5	EA	\$ 2,500.00	\$ 12,500.00
13	Furnish and Install 11.25° Fitting	7	EA	\$ 2,500.00	\$ 17,500.00
14	Bypass Pumping	1	LS	\$ 10,000.00	\$ 10,000.00
15	Pavement Restoration	3600	SY	\$ 75.00	\$ 270,000.00
16	Final Grading and Seeding	11120	SY	\$ 10.00	\$ 111,200.00
				Construction Total	\$ 7,793,000.00
				20% Contingency	\$ 1,558,600.00
				Subtotal	\$ 9,351,600.00
				TOTAL PROBABLE CONSTRUCTION COST	\$ 9,360,000.00

APPENDIX D:

**Alternative #4 – Installation of 8500 LF of 18-inch D.I.P. Parallel Force Main and New Pump
Impellers**



SYSTEM HEAD LOSSES

Alternative #4 - Installation of 8500 LF of 18-inch D.I.P. Parallel Force Main and New Pump Impellers
2 Pumps Operating

PROJECT:	Rittenhouse Pump Station
LOCATION:	West Norriton Township
EXISTING FORCE MAIN (STA. 85+00 TO 135+00)	
PIPE DIAMETER FM (in) =	18.24
LENGTH OF PIPE FM (ft) =	5,000
PIPE TYPE =	C.I.P.
C=	85
PARALLEL FORCE MAINS (EXISTING & PROPOSED) (STA. 0+00 TO 85+00)	
COMBINED FM PIPE DIAMETER (in) =	36.73
LENGTH OF PIPE FM's (ft) =	8500
PIPE TYPES =	DIP & CIP
AVERAGE C=	110
EXISTING FORCE MAIN (STA. -0+97 TO 0+00)	
PIPE DIAMETER PS (in) =	18.49
LENGTH OF PIPE PS (ft) =	97
PIPE TYPE =	DIP
C=	120
EXISTING FORCE MAIN (INSIDE PUMP STATION)	
PIPE DIAMETER PS (in) =	12.34
LENGTH OF PIPE PS (ft) =	32.3
PIPE TYPE =	DIP
C=	120
HIGH POINT ELEV. (ft)	73.9
LOW POINT ELEV. (ft)	44.55
STATIC HEAD (ft) =	29.35

Pump Off

FROM TABLES			
BENDS & VALVES	TOTAL BENDS & VALVES	EQV. LENGTH (ft)	TOTAL EQV. LENGTH
18" Existing Ductile Iron Force Main (Sta. -0+97 to 0+00)			
18" Plug Valve	3	3	9
18" x 18" x 12" Tee (Thru)	2	7.2	14.4
18" x 18" x 18" Tee (Thru)	1	7.2	7.2
18" 45° Bend	2	15	30
18" Mag Meter	1	0	0
18" x 24" Conc. Increaser	1	14	14
TOTAL EQV. LENGTH (ft) =			74.6
18" Proposed Ductile Iron Parallel Force Main (Sta. 0+00 to 85+00)			
18" x 18" x 18" Tee (Thru)	2	7.2	14.4
18" x 18" x 18" Tee (Branch)	0	42.75	0
18" Air Release Valve Tee (Thru)	1	7.2	7.2
18" Plug valve	2	3	6
18" 90° Bend	0	22	0
18" 45° Bend	8	15	120
18" 22.5° Bend	2	10	20
18" 11.25° Bend	6	6	36
TOTAL EQV. LENGTH (ft) = (EXISTING & PROPOSED)			348

18" Existing Cast Iron Force Main (Sta. 85+00 to 135+00)			
18" 90° Bend	2	22	44
18" 45° Bend	17	15	255
18" 22.5° Bend	12	10	120
18" 11.25° Bend	1	6	6
18" Air Release Valve Tee (Thru)	4	7.2	28.8
18" Tapping Sleeve & Valve	1	45.75	45.75
TOTAL EQV. LENGTH (ft) =			453.8

FROM TABLES			
BENDS & VALVES	TOTAL BENDS & VALVES	EQV. LENGTH (ft)	TOTAL EQV. LENGTH
12" Existing Ductile Iron Force Main (Inside Pump Station)			
12" x 10" Ecc. Increaser	1	14	14
12" Swing Check Valve	1	120	120
12" Plug Valve	1	3	3
12" 45° Bend	2	9.7	19.4
12" 11.25° Bend	2	5	10
TOTAL EQV. LENGTH (ft) =			166.4

18" Existing Cast Iron Parallel Force Main (Sta. 0+00 to 85+00)			
18" Air Release Valve Tee (Thru)	2	7.2	14.4
18" 90° Bend	1	22	22
18" 45° Bend	6	15	90
18" 22.5° Bend	0	10	0
18" 11.25° Bend	3	6	18

Total Equivalent Length of Pipe	14,672
--	---------------

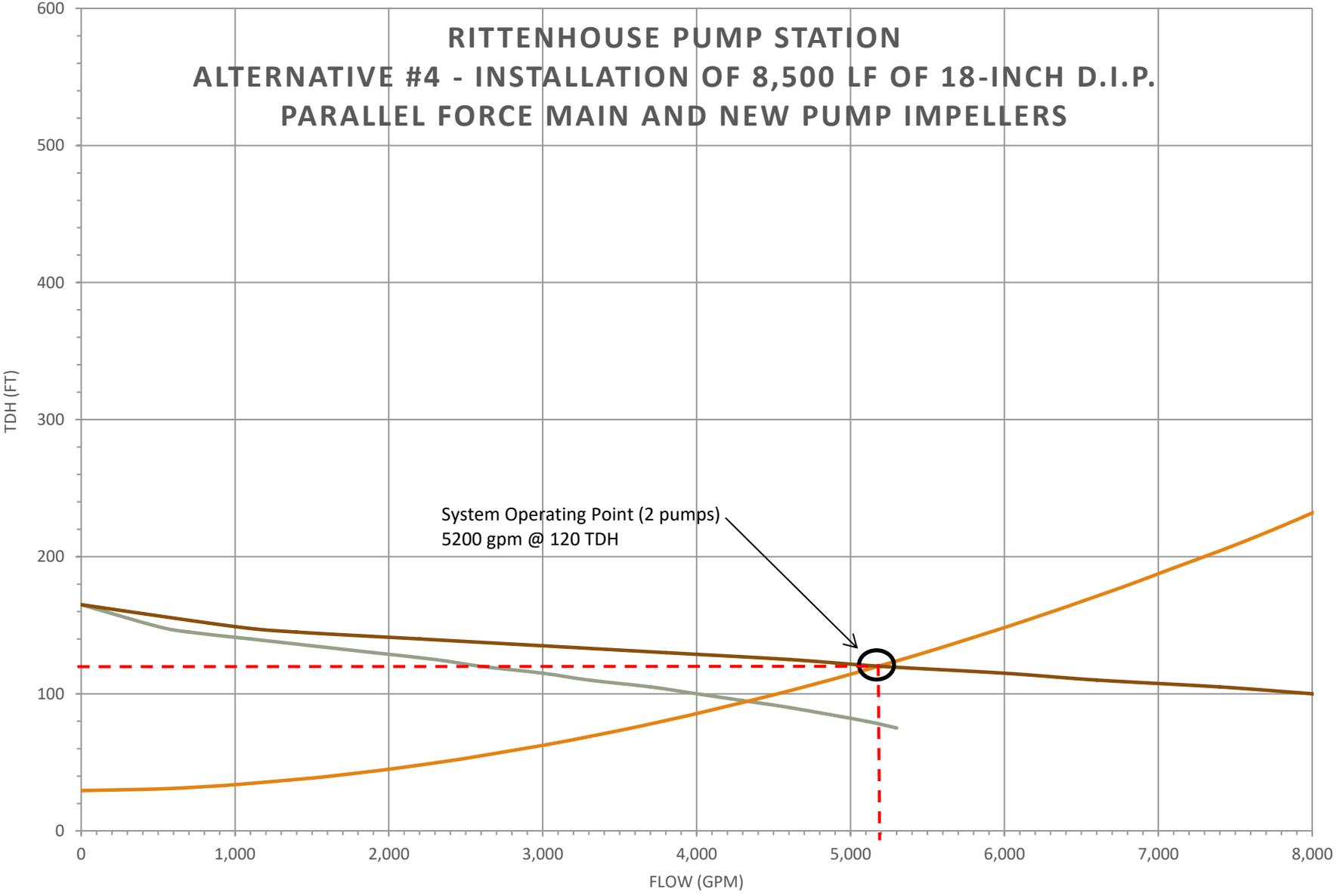
SYSTEM HEAD LOSSES

PIPE SIZE (in)	FLOW (gpm)	LENGTH OF PIPE ft in 100'S	FITTINGS EQV. LENGTH ft in 100's	FRICTION LOSS per 100'	TOTAL FRICTION LOSS	TOTAL STATIC HEAD	VELOCITY ft/sec	Total Friction HEAD LOSS	TOTAL HEAD LOSS
18.24	0	50	4.538	0.00	0.00	29.35	0.00	0.00	29.35
36.73		85	3.48	0.00	0.00		0.00		
18.49		0.97	0.75	0.00	0.00		0.00		
12.34		0.323	1.66	0.00	0.00		0.00		
18.24	500	50	4.538	0.02	1.11	29.35	0.61	1.20	30.55
36.73		85	3.48	0.00	0.04		0.15		
18.49		0.97	0.75	0.01	0.02		0.60		
12.34		0.323	1.66	0.02	0.04		1.34		
18.24	800	50	4.538	0.05	2.64	29.35	0.98	2.86	32.21
36.73		85	3.48	0.00	0.09		0.24		
18.49		0.97	0.75	0.02	0.04		0.96		
12.34		0.323	1.66	0.05	0.09		2.15		
18.24	1,000	50	4.538	0.07	3.99	29.35	1.23	4.32	33.67
36.73		85	3.48	0.00	0.13		0.30		
18.49		0.97	0.75	0.04	0.06		1.19		
12.34		0.323	1.66	0.07	0.14		2.68		
18.24	1,500	50	4.538	0.15	8.44	29.35	1.84	9.15	38.50
36.73		85	3.48	0.00	0.28		0.45		
18.49		0.97	0.75	0.08	0.13		1.79		
12.34		0.323	1.66	0.15	0.30		4.02		
18.24	1,600	50	4.538	0.17	9.51	29.35	1.96	10.31	39.66
36.73		85	3.48	0.00	0.32		0.48		
18.49		0.97	0.75	0.09	0.15		1.91		
12.34		0.323	1.66	0.17	0.34		4.29		
18.24	2,000	50	4.538	0.26	14.37	29.35	2.46	15.58	44.93
36.73		85	3.48	0.01	0.48		0.61		
18.49		0.97	0.75	0.13	0.22		2.39		
12.34		0.323	1.66	0.26	0.51		5.37		
18.24	2,400	50	4.538	0.37	20.13	29.35	2.95	21.84	51.19
36.73		85	3.48	0.01	0.67		0.73		
18.49		0.97	0.75	0.18	0.31		2.87		
12.34		0.323	1.66	0.36	0.72		6.44		
18.24	2,500	50	4.538	0.40	21.71	29.35	3.07	23.55	52.90
36.73		85	3.48	0.01	0.73		0.76		
18.49		0.97	0.75	0.20	0.34		2.99		
12.34		0.323	1.66	0.39	0.78		6.71		
18.24	3,000	50	4.538	0.56	30.42	29.35	3.68	32.99	62.34
36.73		85	3.48	0.01	1.02		0.91		
18.49		0.97	0.75	0.28	0.47		3.58		
12.34		0.323	1.66	0.55	1.09		8.05		
18.24	3,034	50	4.538	0.57	31.06	29.35	3.73	33.69	63.04
36.73		85	3.48	0.01	1.04		0.92		
18.49		0.97	0.75	0.28	0.48		3.63		
12.34		0.323	1.66	0.56	1.11		8.14		
18.24	3,200	50	4.538	0.63	34.27	29.35	3.93	37.18	66.53
36.73		85	3.48	0.01	1.15		0.97		
18.49		0.97	0.75	0.31	0.53		3.82		
12.34		0.323	1.66	0.62	1.23		8.58		
18.24	3,500	50	4.538	0.74	40.46	29.35	4.30	43.88	73.23
36.73		85	3.48	0.02	1.35		1.06		
18.49		0.97	0.75	0.37	0.63		4.18		
12.34		0.323	1.66	0.73	1.45		9.39		
18.24	3,600	50	4.538	0.78	42.62	29.35	4.42	46.23	75.58
36.73		85	3.48	0.02	1.42		1.09		
18.49		0.97	0.75	0.39	0.66		4.30		
12.34		0.323	1.66	0.77	1.52		9.66		
18.24	3,680	50	4.538	0.81	44.39	29.35	4.52	48.15	77.50
36.73		85	3.48	0.02	1.48		1.11		
18.49		0.97	0.75	0.40	0.69		4.40		
12.34		0.323	1.66	0.80	1.59		9.87		
18.24	3,940	50	4.538	0.92	50.36	29.35	4.84	54.63	83.98
36.73		85	3.48	0.02	1.68		1.19		
18.49		0.97	0.75	0.46	0.78		4.71		
12.34		0.323	1.66	0.91	1.80		10.57		
18.24	4,000	50	4.538	0.95	51.79	29.35	4.91	56.18	85.53
36.73		85	3.48	0.02	1.73		1.21		
18.49		0.97	0.75	0.47	0.81		4.78		
12.34		0.323	1.66	0.93	1.85		10.73		
18.24	4,500	50	4.538	1.18	64.40	29.35	5.53	69.86	99.21
36.73		85	3.48	0.02	2.15		1.36		
18.49		0.97	0.75	0.58	1.00		5.38		
12.34		0.323	1.66	1.16	2.30		12.07		
18.24	4,800	50	4.538	1.33	72.57	29.35	5.89	78.72	108.07
36.73		85	3.48	0.03	2.42		1.45		
18.49		0.97	0.75	0.66	1.13		5.74		
12.34		0.323	1.66	1.31	2.59		12.88		
18.24	5,000	50	4.538	1.43	78.26	29.35	6.14	84.89	114.24
36.73		85	3.48	0.03	2.61		1.51		
18.49		0.97	0.75	0.71	1.22		5.97		
12.34		0.323	1.66	1.41	2.80		13.41		
18.24	5,500	50	4.538	1.71	93.35	29.35	6.75	101.26	130.61
36.73		85	3.48	0.04	3.12		1.67		
18.49		0.97	0.75	0.85	1.45		6.57		
12.34		0.323	1.66	1.68	3.34		14.75		

SYSTEM HEAD LOSSES

18.24	6,000	50	4.538	2.01	109.65	29.35	7.37	118.94	148.29
36.73		85	3.48	0.18	16.02		1.82		
18.49		0.97	0.75	0.99	1.74		7.17		
12.34		0.323	1.66	1.97	3.92		16.10		
18.24	6,069	50	4.538	2.05	112.00	29.35	7.45	121.49	150.84
36.73		85	3.48	0.04	3.74		1.84		
18.49		0.97	0.75	1.02	1.74		7.25		
12.34		0.323	1.66	2.01	4.00		16.28		
18.24	6,250	50	4.538	2.17	118.26	29.35	7.67	128.28	157.63
36.73		85	3.48	0.04	3.95		1.89		
18.49		0.97	0.75	1.07	1.84		7.47		
12.34		0.323	1.66	2.13	4.23		16.77		
18.24	6,500	50	4.538	2.33	127.16	29.35	7.98	137.93	167.28
36.73		85	3.48	0.05	4.25		1.97		
18.49		0.97	0.75	1.15	1.98		7.77		
12.34		0.323	1.66	2.29	4.55		17.44		
18.24	7,000	50	4.538	2.67	145.84	29.35	8.59	158.20	187.55
36.73		85	3.48	0.06	4.87		2.12		
18.49		0.97	0.75	1.32	2.27		8.36		
12.34		0.323	1.66	2.62	5.21		18.78		
18.24	8,000	50	4.538	3.42	186.71	29.35	9.82	202.53	231.88
36.73		85	3.48	0.07	6.24		2.42		
18.49		0.97	0.75	1.69	2.91		9.56		
12.34		0.323	1.66	3.36	6.67		21.46		
18.24	10,000	50	4.538	5.17	282.13	29.35	12.28	306.03	335.38
36.73		85	3.48	0.11	9.43		3.03		
18.49		0.97	0.75	2.56	4.39		11.95		
12.34		0.323	1.66	5.08	10.09		26.83		

**RITTENHOUSE PUMP STATION
ALTERNATIVE #4 - INSTALLATION OF 8,500 LF OF 18-INCH D.I.P.
PARALLEL FORCE MAIN AND NEW PUMP IMPELLERS**



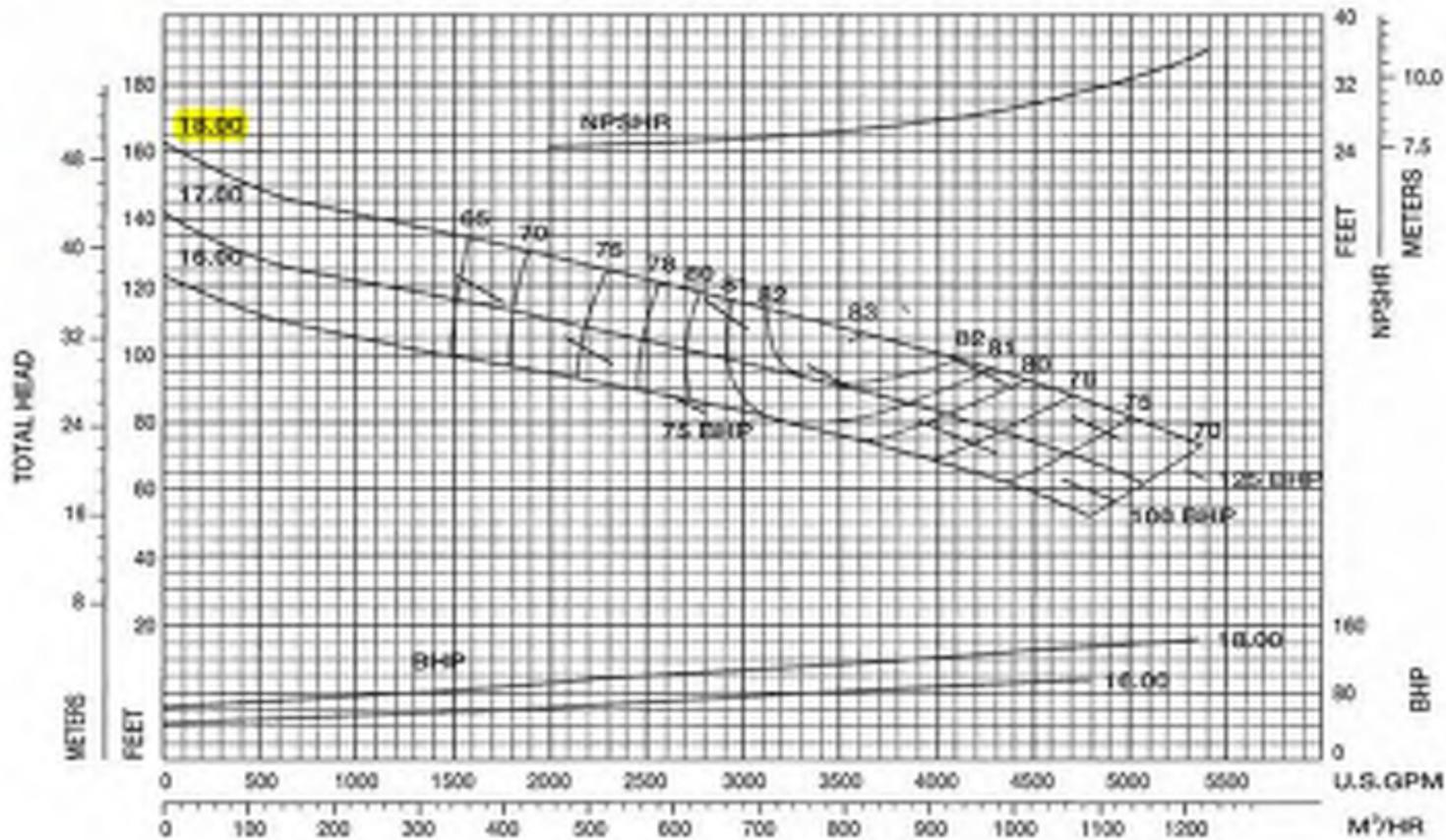
Modified Pump Curve - 1 Pump System Curve - 2 Pumps Modified Pump Curve - 2 Pumps

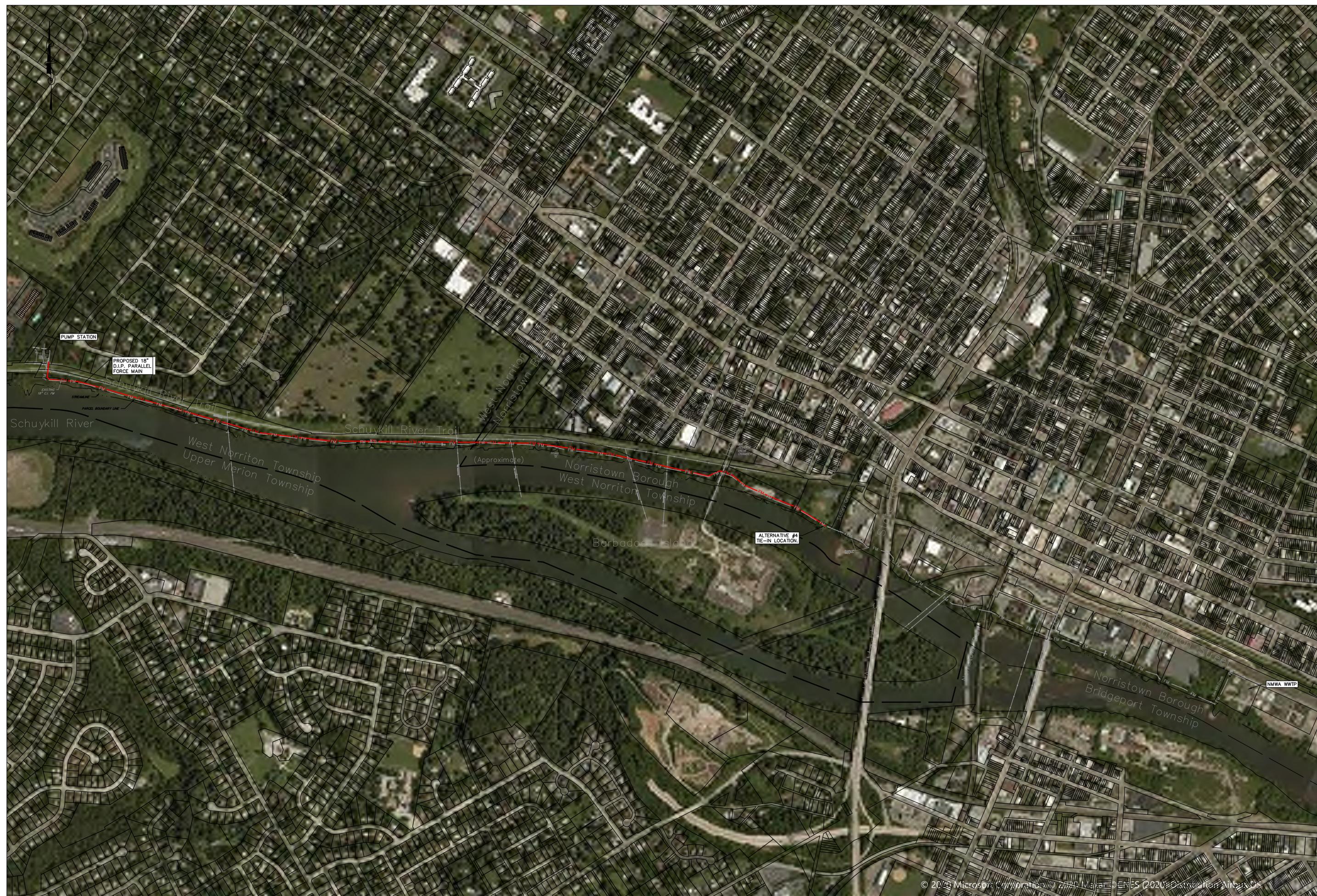
Flow Rate GPM	Pump Performance Curve (18" Impeller)						Flow Rate GPM
	1 Pump	2 Pump	3 Pump	1 Pump	2 Pumps	3 Pumps	
0	29.35	29.35	29.35	165.00	165.00	165.00	0
500	30.65	30.55	30.61	149.00			500
800	32.46	32.21	32.35	145.00			700
1000	34.04	33.67	33.88		149.00		1000
1500	39.29	38.50	38.94	140.00			1100
1600	40.55	39.66	40.16		145.00		1400
2000	46.27	44.93	45.69	135.00		149.00	1500
2400	53.06	51.19	52.24	130.00			1900
2500	54.92	52.90	54.03			145.00	2100
3000	65.18	62.34	63.94		140.00		2200
3034	65.93	63.04	64.66	125.00			2300
3200	69.72	66.53	68.32	120.00			2600
3500	77.00	73.23	75.35	115.00	135.00		3000
3600	79.55	75.58	77.81	110.00		140.00	3300
3680	81.63	77.50	79.82	105.00			3700
3940	88.67	83.98	86.62		130.00		3800
4000	90.35	85.53	88.24	100.00			4000
4500	105.20	99.21	102.58	95.00			4300
4800	114.82	108.07	111.86			135.00	4500
5000	121.53	114.24	118.34	90.00	125.00		4600
5500	139.30	130.61	135.49	80.00	120.00		5100
6000	158.51	148.29	154.03		115.00		5200
6069	161.27	150.84	156.70	75.00			5300
6250	168.64	157.63	163.81			130.00	5700
6500	179.12	167.28	173.93		110.00		6000
7000	201.13	187.55	195.18		105.00	125.00	6600
8000	249.26	231.88	241.65			120.00	7400
10000	361.65	335.38	350.15		100.00	115.00	7800
					95.00	110.00	8000
						115.00	8600
					90.00	110.00	9000
							9200
					80.00		9900
					75.00		10200
							10600

Performance Curve - 8" 5435 MV

RPM: 1185 SOLIDS: 5"

IMPELLER: TAKESN, 2 VANE SUCTION: 8" INLET: 139.29 in³





GILMORE & ASSOCIATES, INC.
 ENGINEERING & CONSULTING SERVICES
16 EAST BUTLER AVENUE, SUITE 300, NEW BRITAIN, PA 17051 • 717-534-5300 • www.gilmore-associ.com



JOB NO.: 2016-0203272
 MUNICIPAL FILE NO.: 630007243011
 TAX MAP PARCEL NO.: XX
 SCALE: 1" = 400'
 DESIGN BY: TBE
 DRAWN BY: TBE
 CHECKED BY: TUF
 DATE: 10/27/2020
 OWNER: WEST NORRITON TOWNSHIP
 1530 PENNSYLVANIA STREET
 18080 PENNSYLVANIA, PA 19060

ALTERNATIVE #4 SITE MAP
RITTENHOUSE PUMP STATION
FORCE MAIN ANALYSIS
 WEST NORRITON TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA

SHEET NO.:



GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES

OPINION OF PROBABLE COST

Project Name: Rittenhouse - Sewer Options

Project Number: 16-02032T2

Client: West Norriton Township

Date: November 2020

Alternative #4: Installation of 8,500 LF of 18-inch DIP Parallel Force Main and New Pump Impellers

Item	Description	Quantity	Unit	Unit Price	Total
1	Furnish and Install 18" DIP Force Main	8500	LF	\$ 215.00	\$ 1,827,500.00
2	Furnish and Install 18" Pump Impellers	3	EA	\$ 20,000.00	\$ 60,000.00
3	Furnish and Install Air Release Valve Chamber	1	EA	\$ 10,000.00	\$ 10,000.00
4	Furnish and Install Force Main Cleanout Chamber	1	EA	\$ 10,000.00	\$ 10,000.00
5	Furnish and Install 18" Tapping Sleeve & Valve (SS)	1	EA	\$ 30,000.00	\$ 30,000.00
6	Furnish and Install 24" x 18" Reducer Fitting	2	EA	\$ 2,500.00	\$ 5,000.00
7	Furnish and Install 45° Fitting	8	EA	\$ 2,500.00	\$ 20,000.00
8	Furnish and Install 22.5° Fitting	2	EA	\$ 2,500.00	\$ 5,000.00
9	Furnish and Install 11.25° Fitting	6	EA	\$ 2,500.00	\$ 15,000.00
10	Bypass Pumping	1	LS	\$ 10,000.00	\$ 10,000.00
11	Pavement Restoration	40	SY	\$ 75.00	\$ 3,000.00
12	Final Grading and Seeding	9390	SY	\$ 10.00	\$ 93,900.00
13	20 Year Projected Maintenance Cost of Existing Force Main	13500	LF/YR	\$ 2.50	\$ 675,000.00

Construction Total \$ 2,764,400.00

20% Contingency \$ 552,880.00

Subtotal \$ 3,317,280.00

TOTAL PROBABLE CONSTRUCTION COST \$ 3,320,000.00