

Memorandum

To Roderick A. St. Pierre, Roderick A. St. Pierre dba The Pointe at Hills Farm
Fran Zarette, Smart Growth Design, LLC
Wayne Belec, Waterman Design Associates, Inc.

Subject **Update No. 2 to Proposed Sewer Service Connection - Hydraulic Capacity Study & Report for the Pointe at Hills Farm Chapter 40B Development, Shrewsbury, Massachusetts**

Project Number 60341898

From Thomas Parece, P.E., AECOM Project Manager

Date May 5, 2016

1. Summary

This is an update to the original Capacity Analysis Report dated September 2015 and subsequent Capacity Analysis Update dated March 2016. This update uses recent field investigation data and various communications regarding the type and quality of the information available regarding the existing wastewater infrastructure and analysis approach.

This Capacity Analysis Update using existing Average Daily Flow (ADF) and Infiltration/Inflow values provided by Weston& Sampson plus the proposed ADF with Infiltration/Inflow from the development indicates that no capacity issues were identified except for Segment 2B-23 to 2B-21. This segment which crosses under Route 9 consists of an existing 10-inch Cast Iron pipe laid at less than minimum slope (0.00052 versus 0.0028). In addition, it appears that significant tuberculation exists in the pipe that further reduces the pipe's carrying capacity.

It should be noted that this pipe segment is currently over capacity based on existing flows. Although it does totally eliminate the over capacity issue, the pumping rate at the Cherry Street Pump Station should be reduced in order to minimize the capacity issue in Segment 2B-23 to 2B-21 and utilizing the expanded wetwell in order to handle the peak flow from the station's tributary area.

As part of normal operation and maintenance of the pumping stations and collection system various corrective actions items were identified that should be taken by the Town including: (a) place pump back into service at the Quail Hollow Pump Station; (b) perform repairs to restore the pumps rated capacity; (c) address rag issues at the Cherry Street Pump Station; (d) conduct a comprehensive review and develop a Capital Improvement List of maintenance requirements at the Quail Hollow Pump Station, Stoney Hill Pump Station and Cherry Street Pump Station; (e) install a "governor system" (ie VFDs) at the Cherry Street Pump Station; (f) utilize the expanded wetwell and (g) clean pipe segments, specifically Segment 2B-23 to 2B-21, and manholes to maximize the pipe's carrying capacity and to eliminate odor / potential for odor generation caused by a buildup of solids and other debris in the manholes.

2. Introduction

Since the submittal of the original Capacity Analysis Report dated September 2015 and subsequent Capacity Analysis Update dated March 2016, the Applicant, the Town of Shrewsbury and its wastewater consultant, Weston & Sampson, have had various communications regarding the type and quality of the information available regarding the existing wastewater infrastructure and analysis approach.

Based on the above, the Capacity Analysis has been updated using the following:

- Topographic Survey – Available capacity based on rim and invert elevations obtained by Weston & Sampson for: (a) Segment 2B-25 to 2B-23; and (b) Segment 2B-9 to 2B-5.
- Topographic Survey - Rim and invert information could not be obtained for Segment 2B-21 to 2B-9 and therefore the capacity analysis used the hydraulic grade line for this segment.
- Capacity Correction – Available capacity based on 80 percent of the theoretical pipe capacity as required by Weston & Sampson.
- Peaking Factor – Peaking Factors based upon “Tr-16, Guides for the Design of Wastewater Treatment Works” by New England Interstate Water Pollution Control Commission.
- Pumping Stations – Estimated Average Daily Flows with Infiltration/Inflow based on the April 6, 2016 Wetwell Draw Tests by Weston & Sampson for Quail Hollow Pump Station, Stoney Book Pumping Station, and Cherry Street Pumping Station.
- Existing Average Daily Flow – Existing Average Daily Flows with Infiltration/Inflow for existing development/parcels based on data developed by Weston & Sampson and received on April 12, 2016 and summarized as follows:
 - Industrial Park PS (11,078 gpd);
 - 55 Buildings at 2E-9 (21,091 gpd);
 - 19 Building North of 2E-9 (3,891 gpd);
 - Adams Farm Senior Housing (18,242 gpd);
 - Wagner BMW and Kia (6,333 gpd);
 - Yorkshire Terrace and Proposed Ashford Crossing (49,766 gpd);
 - Maplewood Drive (9,009 gpd);
 - Floral Street West of Fruit Street (3,981 gpd); and
 - 4 Existing Developments (161,773, gpd).
- Proposed Development – Average Daily Flow plus an infiltration/inflow allowance of for a total of approximately 36,000 gpd.

3. Analysis

3.1 Pumping Stations

For the Quail Hollow Pump Station, Stoney Hill Pumping Station, and Cherry Street Pumping Station, estimated Average Daily Flows with Infiltration/Inflow was based on the April 6, 2016 Wetwell Draw Tests by Weston & Sampson. The Average Daily Flow was determined by applying a Peak Factor (“TR-16, Guides for the Design of Wastewater Treatment Works” by New England Interstate Water Pollution Control Commission). The following summarizes the analysis:

3.1.1 Quail Hollow Pump Station

- Design Capacity 250 gpm
- Drawdown Test = 233 gpm by Weston & Sampson
- PDF = 335,520 gpd
- Peaking Factor (TR-16) = 6.45
- ADF and I/I = 52,000 gpd
- Remarks: (a) Pump No. 2 Out of Service; (b) System is pumping under its rated capacity of 250 gpm; and (c) Proposed Development increases pumping duration.

3.1.2 Stoney Hill Pump Station

- Design Capacity = 250 gpm
- Drawdown Test = 168 gpm by Weston & Sampson
- PDF = 241,300 gpd
- Peaking Factor (TR-16) = 7.06
- ADF and I/I = 34,200 gpd
- Remarks: (a) System is pumping under its rated capacity of 250 gpm; and (b) Proposed Development increases pumping duration.

3.1.3 Cherry Street Pump Station

- Design Capacity = 200 gpm
- Drawdown Test = 415 gpm by Weston & Sampson
- PDF = 596,100 gpd
- Peaking Factor (TR-16) = 5.53
- ADF and I/I = 108,000 gpd
- Remarks: (a) System is pumping over its rated capacity of 200 gpm causing possible surcharging downstream into Segment 2B-23 to 2B-21; (b) Expanded wetwell not in use; (c) Town noted issues of rag buildup causing operational issues / added maintenance; and (d) Proposed Development increases pumping duration.

3.2 Pipe Segments

3.2.1 Proposed Development to Quail Hollow Pump Station - Segment 2E-967 to 2E-80E

- Estimated ADF with I/I based on Quail Hollow PS (52,000 gpd) and Proposed Development (21,550 gpd).
- Peaking Factor based on TR-16 = 6.17
- Capacity evaluated based on 80% of calculated pipe capacity.
- No Capacity Issues Identified or Report by the Town.

3.2.2 Proposed Development to Stoney Hill Pump Station - Segment 2E-127 to 2E-122

- Estimated ADF with I/I based on Stoney Hill PS (34,200 gpd) and Proposed Development (14,327 gpd).
- Peaking Factor based on TR-16 = 6.63
- Capacity evaluated based on 80% of calculated pipe capacity.
- No Capacity Issues Identified or Report by the Town.

3.2.3 Stoney Hill Pump Station to Cherry Street Pump Station - Segment 2E-16A to 2E-1A

- Estimated ADF with I/I based on Quail Hollow PS (52,000 gpd); Industrial Park PS (11,078 gpd); 55 Buildings at 2E-9 (21,091 gpd); 19 Building North of 2E-9 (3,891 gpd); Adams Farm Senior Housing (18,242 gpd); and Proposed Development (36,150 gpd).
- Peaking Factor based on TR-16 = 5.42 to 5.81
- Capacity evaluated based on 80% of calculated pipe capacity.
- No Capacity Issues Identified or Report by the Town.

3.2.4 Cherry Street Pump Station to Interceptor (4A-45)

Segment 2B-25 to 2B- 23

- Estimated ADF with I/I based on Cherry Street PS (108,000 gpd); Wagner BMW and Kia (6,333 gpd); and Proposed Development (36,150 gpd).
- Peaking Factor based on TR-16 =
- Capacity evaluated based on 80% of calculated pipe capacity.
- No Capacity Issues Identified or Report by the Town.

Segment 2B-23 to 2B-21

- Estimated ADF with I/I based on Cherry Street PS (108,000 gpd); Wagner BMW and Kia (6,333 gpd); Yorkshire Terrace and Proposed Ashford Crossing (49,766 gpd); and Proposed Development (36,150 gpd).
- Peaking Factor based on TR-16 = 5.45
- Capacity evaluated based on 80% of calculated pipe capacity.
- Pipe Segment 2B-23 to 2B-22 appears, by calculations, to be over capacity with and without the Proposed Development.

Segment 2B-21 to 2B-10

- Estimated ADF with I/I based on Cherry Street PS (108,000 gpd); Wagner BMW and Kia (6,333 gpd); Yorkshire Terrace and Proposed Ashford Crossing (49,766 gpd); Maplewood Drive (9,009 gpd); and Proposed Development (36,150 gpd).
- Peaking Factor based on TR-16 = 5.13
- Capacity evaluated based on 80% of calculated pipe capacity.
- Pipe Line Reach cannot be field verified. Slope based on hydraulic grade line.
- No Capacity Issues Identified or Report by the Town.

Segment 2B-10 to 2B-9

- Estimated ADF with I/I based on Cherry Street PS (108,000 gpd); Wagner BMW and Kia (6,333 gpd); Yorkshire Terrace and Proposed Ashford Crossing (49,766 gpd); Maplewood Drive (9,009 gpd); Floral Street West of Fruit Street (3,981 gpd); and Proposed Development (36,150 gpd)
- Peaking Factor based on TR-16 = 5.08
- Capacity evaluated based on 80% of calculated pipe capacity.
- Pipe Line Reach cannot be field verified. Slope based on hydraulic grade line.
- No Capacity Issues Identified or Report by the Town.

Segment 2B-9 to 2B-5

- Estimated ADF with I/I based on Cherry Street PS (108,000 gpd); Wagner BMW and Kia (6,333 gpd); Yorkshire Terrace and Proposed Ashford Crossing (49,766 gpd); Maplewood Drive (9,009 gpd); Floral Street West of Fruit Street (3,981 gpd); and Proposed Development (36,150 gpd).
- Peaking Factor based on TR-16 = 5.09
- Capacity evaluated based on 80% of calculated pipe capacity.
- No Capacity Issues Identified or Report by the Town.

Segment 2B-5 to 4A-45

- Estimated ADF with I/I based on Cherry Street PS (108,000 gpd); Wagner BMW and Kia (6,333 gpd); Yorkshire Terrace and Proposed Ashford Crossing (49,766 gpd); Maplewood Drive (9,009 gpd); Floral Street West of Fruit Street (3,981 gpd); 4 Existing Developments (161,773, gpd); and Proposed Development (36,150 gpd).
- Peaking Factor based on TR-16 = 4.55
- Capacity evaluated based on 80% of calculated pipe capacity.
- No Capacity Issues Identified or Report by the Town.

4. Summary

4.1 As part of normal operation and maintenance of the pumping stations, the following is a summary of corrective actions that should be taken by the Town.

4.1.1 Quail Hollow Pump Station

- Perform the necessary repairs in order to place Pump No. 2 back into service.
- Perform the necessary repairs in order to restore the pumps rated capacity.
- Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements.
- Perform post repairs wetwell drawdown tests.

4.1.2 Stoney Hill Pump Station

- Perform the necessary repairs in order to restore the pumps rated capacity.
- Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements.
- Perform post repairs wetwell drawdown tests.

4.1.3 Cherry Street Pump Station

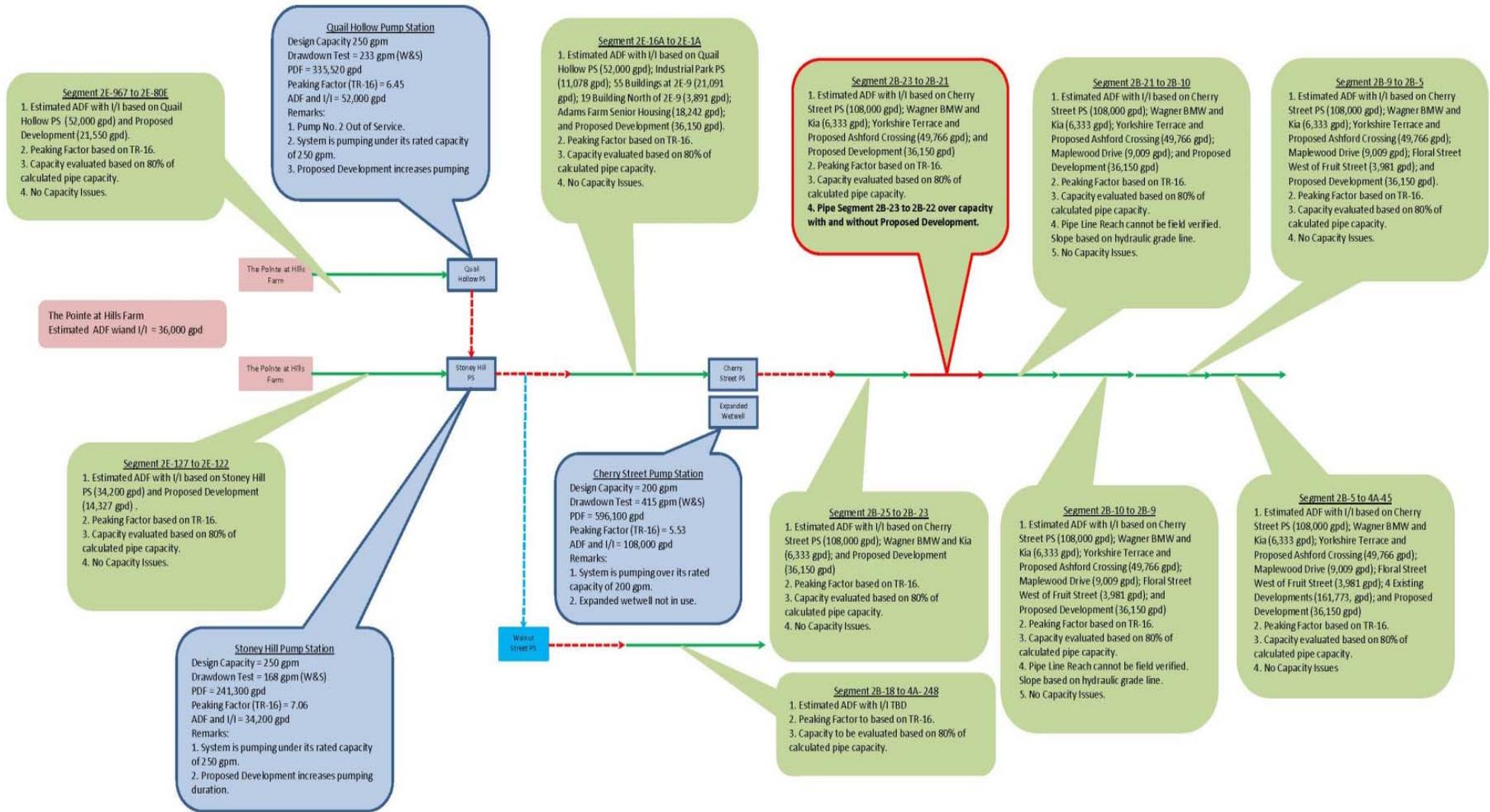
- Perform the necessary repairs in order to reduce the pumps current pump rate to its rated design capacity.
- Utilize the expended wetwell in order to handle the peak flow from the tributary area.
- Install “governor system” (ie VFDs) for pump controller.
- Address excessive rag buildup problem.
- Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements.
- Perform post repairs wetwell drawdown tests.

- 4.2 As part of normal operation and maintenance of the collection system, the following is a summary of corrective actions that should be taken by the Town.
 - 4.2.1 Clean the pipe segments and manholes in order to maximize the carrying capacity of the pipes and to eliminate order / potential for odor generation caused by a buildup of solids and other debris in the manholes.
 - 4.2.2 Segment 2B-23 to 2B-21 – Mechanically remove tuberculation from the pipe walls. Clean and TV to verify results.

5. Attachments

- 4.1 Capacity Analysis Schematic at 80% Full - Proposed Development to Manhole 4A-452A**
- 4.2 Capacity Analysis at 80% Full - Proposed Development to Manhole 2E-1A (Cherry Street Pump Station)**
- 4.3 Capacity Analysis at 80% Full - Cherry Street Pump Station Discharge at Manhole 2B-25 to Manhole 4A-452A**

Capacity Analysis Schematic at 80% Full Proposed Development to Manhole 4A-452A



**Capacity Analysis at 80% Full
Proposed Development to Manhole 2E-1A (Cherry Street Pump Station)**

Start	End	Slope (s)	Size (in)	Material	n	Capacity Correction	Design Capacity (gpd) PDF	Estimated Flows (gpd) ADF	I/I (gpd)	Estimated Flows (gpd) PDF	Q Flow (gpd) with I/I PDF	Capacity Delta (gpd)
2E-96	2E-95	0.0200	8	Polyvinyl Chloride	0.010	0.80	1,148,627	63,777	9,773	393,505	403,277	745,350
2E-95	2E-94	0.0620	8	Polyvinyl Chloride	0.010	0.80	2,022,366	63,777	9,773	393,505	403,277	1,619,089
2E-94	2E-93	0.0620	8	Polyvinyl Chloride	0.010	0.80	2,022,366	63,777	9,773	393,505	403,277	1,619,089
2E-93	2E-92	0.0530	8	Polyvinyl Chloride	0.010	0.80	1,869,829	63,777	9,773	393,505	403,277	1,466,552
2E-92	2E-91	0.0290	8	Polyvinyl Chloride	0.010	0.80	1,383,130	63,777	9,773	393,505	403,277	979,853
2E-91	2E-90	0.0240	8	Polyvinyl Chloride	0.010	0.80	1,258,258	63,777	9,773	393,505	403,277	854,980
2E-90	2E-89	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	63,777	9,773	393,505	403,277	171,036
2E-89	2E-87	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	63,777	9,773	393,505	403,277	171,036
2E-87	2E-256	0.0100	8	Polyvinyl Chloride	0.010	0.80	812,202	63,777	9,773	393,505	403,277	408,925
2E-256	2E-255	0.0150	8	Polyvinyl Chloride	0.010	0.80	994,740	63,777	9,773	393,505	403,277	591,463
2E-255	2E-254	0.0100	8	Polyvinyl Chloride	0.010	0.80	812,202	63,777	9,773	393,505	403,277	408,925
2E-254	2E-253	0.0510	8	Polyvinyl Chloride	0.010	0.80	1,834,210	63,777	9,773	393,505	403,277	1,430,933
2E-253	2E-252	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	63,777	9,773	393,505	403,277	171,036
2E-252	2E-80A	0.0120	8	Polyvinyl Chloride	0.010	0.80	889,723	63,777	9,773	393,505	403,277	486,445
2E-80A	Quail Hollow PS	0.0110	8	Polyvinyl Chloride	0.010	0.80	851,845	63,777	9,773	393,505	403,277	448,567
2E-127	2E-126	0.0257	8	Polyvinyl Chloride	0.010	0.80	1,302,059	45,573	2,955	302,147	305,102	996,957
2E-126	2E-125	0.0153	8	Polyvinyl Chloride	0.010	0.80	1,004,638	45,573	2,955	302,147	305,102	699,537
2E-125	2E-124	0.2950	8	Polyvinyl Chloride	0.010	0.80	4,411,385	45,573	2,955	302,147	305,102	4,106,284
2E-124	2E-123	0.2910	8	Polyvinyl Chloride	0.010	0.80	4,381,376	45,573	2,955	302,147	305,102	4,076,274
2E-123	2E-122	0.0199	8	Polyvinyl Chloride	0.010	0.80	1,145,752	45,573	2,955	302,147	305,102	840,650
2E-122	Stoney Hill PS	0.0199	8	Polyvinyl Chloride	0.010	0.80	1,145,752	45,573	2,955	302,147	305,102	840,650
2E-16A	2E-16	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-16	2E-15	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-15	2E-14	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-14	2E-13	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-13	2E-12	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-12	2E-11	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-11	2E-10	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	84,410	14,545	490,420	504,965	8,716
2E-10	2E-9	0.0049	8	Polyvinyl Chloride	0.010	0.80	568,541	84,410	14,545	490,420	504,965	63,576
2E-9	2E-8	0.0700	8	Polyvinyl Chloride	0.010	0.80	2,148,884	104,531	15,515	581,192	596,707	1,552,177
2E-8	2E-7	0.0300	8	Polyvinyl Chloride	0.010	0.80	1,406,775	104,531	15,515	581,192	596,707	810,068
2E-7	2E-6	0.0450	8	Polyvinyl Chloride	0.010	0.80	1,722,940	104,531	15,515	581,192	596,707	1,126,233
2E-6	2E-5	0.1000	8	Polyvinyl Chloride	0.010	0.80	2,568,408	104,531	15,515	581,192	596,707	1,971,701
2E-5	2E-4	0.0950	8	Polyvinyl Chloride	0.010	0.80	2,503,374	120,785	21,576	654,657	676,232	1,827,142
2E-4	2E-3	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	120,785	21,576	654,657	676,232	413,451
2E-3	2E-2	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	120,422	21,939	652,686	674,625	415,058
2E-2	2E-1	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	120,422	21,939	652,686	674,625	415,058
2E-1	Cherry Street PS	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	120,422	21,939	652,686	674,625	415,058

**Capacity Analysis at 80% Full
Cherry Street Pump Station Discharge at Manhole 2B-25 to Manhole 4A-452A**

Start	End	Slope (s)	Size (in)	Material	n	Capacity Correction	Design Capacity (gpd) PDF	Estimated Flows (gpd) ADF	I/I (gpd)	Estimated Flows (gpd) PDF	Q Flow (gpd) with I/I PDF	Capacity Delta (gpd)
2B-25	2B-24	0.03556	8	Polyvinyl Chloride	0.010	0.80	1,531,677	117,210	33,000	638,795	671,795	859,882
2B-24	2B-23	0.08785	10	Polyvinyl Chloride	0.010	0.80	4,364,677	117,210	33,000	638,795	671,795	3,692,882
2B-23	2B-22	0.00052	10	Cast Iron, Coated	0.013	0.80	258,315	165,840	34,136	850,758	884,894	(626,580)
2B-22	2B-21	0.0067	10	Polyvinyl Chloride	0.010	0.80	1,201,363	165,840	34,136	850,758	884,894	316,469
2B-21	2B-20	0.0060	10	Polyvinyl Chloride	0.010	0.80	1,139,810	170,758	38,227	870,865	909,092	230,718
2B-20	2B-19	0.0060	10	Polyvinyl Chloride	0.010	0.80	1,138,293	170,758	38,227	870,865	909,092	229,201
2B-19	2B-18	0.0062	10	Polyvinyl Chloride	0.010	0.80	1,161,707	170,758	38,227	870,865	909,092	252,615
2B-18	2B-17	0.0050	10	Polyvinyl Chloride	0.010	0.80	1,041,300	170,758	38,227	870,865	909,092	132,207
2B-17	2B-16	0.0062	10	Asbestos Cement	0.011	0.80	1,052,902	170,758	38,227	870,865	909,092	143,809
2B-16	2B-15	0.0048	10	Asbestos Cement	0.011	0.80	927,510	170,758	38,227	870,865	909,092	18,418
2B-15	2B-14	0.0048	10	Asbestos Cement	0.011	0.80	927,510	170,758	38,227	870,865	909,092	18,418
2B-14	2B-13	0.0048	10	Asbestos Cement	0.011	0.80	927,510	170,758	38,227	870,865	909,092	18,418
2B-12	2B-11	0.0048	10	Asbestos Cement	0.011	0.80	927,510	170,758	38,227	870,865	909,092	18,418
2B-11	2B-10	0.0048	10	Asbestos Cement	0.011	0.80	927,510	170,758	38,227	870,865	909,092	18,418
2B-10	2B-9	0.0048	10	Asbestos Cement	0.011	0.80	927,510	174,496	38,470	886,442	924,911	2,599
2B-9	2B-8	0.00574	10	Asbestos Cement	0.011	0.80	1,014,271	172,390	40,576	877,467	918,043	96,228
2B-8	2B-7B	0.00517	10	Asbestos Cement	0.011	0.80	962,594	172,390	40,576	877,467	918,043	44,552
2B-7B	2B-7	0.04241	8	Polyvinyl Chloride	0.010	0.80	1,672,623	172,390	40,576	877,467	918,043	754,581
2B-7	2B-6	0.03004	8	Polyvinyl Chloride	0.010	0.80	1,407,712	172,390	40,576	877,467	918,043	489,670
2B-6	2B-5	0.05424	8	Polyvinyl Chloride	0.010	0.80	1,891,576	172,390	40,576	877,467	918,043	973,534
2B-5	4A-45	0.0012	18	Polyvinyl Chloride	0.010	0.95	2,904,301	329,800	44,121	1,500,589	1,544,710	1,359,591

*Items in bold were field verified