

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. 3 to Proposed Sewer Service Connection - Hydraulic Capacity Study & Report for the Pointe at Hills Farm Chapter 40B Development, Shrewsbury, Massachusetts - Final**

Project Number 60341898

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

Date June 28, 2016

1. Summary

This is an update to the previous Capacity Analysis completed between September 2015 and May 2016. This update uses recent field investigation data, various communications regarding the type and quality of the information available regarding the existing wastewater infrastructure, updates to the Town's record information, technical workshops, and agreement on the analysis approach.

At the June 9, 2016 technical workshop it was requested by the Town of Shrewsbury and its wastewater consultant, Weston & Sampson, that capacity analysis for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station be based on preparing a preliminary design for each pump station as well as the collection system tributary to and downstream of the pump stations. Therefore, a preliminary design for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station was prepared without and with the Proposed Development. In addition, the collection system capacity analysis was updated without and with the Proposed Development.

Based on the updated capacity analysis the following summarizes the capacity without and with the Proposed Development:

- Proposed Development to Quail Hollow Pump Station – Segment 2E-96 to 2E-80A
 - No Capacity Issues without the Proposed Development.
 - No Capacity Issues with the Proposed Development.
- Proposed Development to Stoney Hill Pump Station – Segment 2E-127 to 2E-122
 - No Capacity Issues without the Proposed Development.
 - No Capacity Issues with the Proposed Development.
- Stoney Hill Pump Station to Cherry Street Pump Station – Segment 2E-16A to 2E-1A
 - No Capacity Issues without the Proposed Development.
 - Capacity Issues with the Proposed Development.
 - 2E-16A to 2E-10 appears, by calculations, to be over capacity by approximately 4,800 gpd.
 - 2E-9 to 2E-8 appears, by calculations, to be over capacity by approximately 89,800 gpd.
 - 2E-8 to 2E-7 appears, by calculations, to be over capacity by approximately 35,000 gpd.

- Cherry Street Pump Station to Interceptor (4A-45) – Segment 2B-25 to 2B-23
 - No Capacity Issues without the Proposed Development.
 - No Capacity Issues with the Proposed Development.
- Cherry Street Pump Station to Interceptor (4A-45) – Segment 2B-23 to 2B-21
 - Capacity Issues without the Proposed Development.
 - 2B-23 to 2B-22 appears, by calculations, to be over capacity by approximately 527,700 gpd.
 - Capacity Issues with the Proposed Development.
 - 2B-23 to 2B-22 appears, by calculations, to be over capacity by approximately 677,100 gpd.
- Cherry Street Pump Station to Interceptor (4A-45) – Segment 2B-21 to 2B-12
 - No Capacity Issues without the Proposed Development.
 - Capacity Issues with the Proposed Development.
 - 2B-17 to 2B-16 appears, by calculations, to be over capacity by approximately 103,300 gpd.
 - 2B-16 to 2B-16A appears, by calculations, to be over capacity by approximately 53,100 gpd.
 - 2B-16A to 2B-15 appears, by calculations, to be over capacity by approximately 124,200 gpd.
- Cherry Street Pump Station to Interceptor (4A-45) – Segment 2B-12 to 2B-9
 - Capacity Issues without the Proposed Development.
 - 2B-11 to 2B-9 appears, by calculations, to be over capacity by approximately 264,300 gpd.
 - Capacity Issues with the Proposed Development.
 - 2B-12 to 2B-11 appears, by calculations, to be over capacity by approximately 37,600 gpd.
 - 2B-11 to 2B-9 appears, by calculations, to be over capacity by approximately 412,300 gpd.
- Cherry Street Pump Station to Interceptor (4A-45) – Segment 2B-9 to 2B-5
 - Capacity Issues without the Proposed Development.
 - 2B-9 to 2B-8 appears, by calculations, to be over capacity by approximately 14,500 gpd.
 - 2B-8 to 2B-7 appears, by calculations, to be over capacity by approximately 66,200 gpd.
 - Capacity Issues with the Proposed Development.
 - 2B-9 to 2B-8 appears, by calculations, to be over capacity by approximately 158,600 gpd.
 - 2B-8 to 2B-7 appears, by calculations, to be over capacity by approximately 210,300 gpd.
- Cherry Street Pump Station to Interceptor (4A-45) – Segment 2B-5 to 4A-45
 - No Capacity Issues without the Proposed Development.
 - No Capacity Issues with the Proposed Development.
- Pump Stations
 - At their useful life, experiencing Some Operational Issues and approaching or at their capacity without the Proposed Development.
 - Over Capacity with the Proposed Development.

The following is a summary of corrective actions required to address the capacity issues with and without the Proposed Development:

- Collection System
 - Replace the existing 10-inch DI gravity sewer with a 16-inch PVC gravity sewer or Extend the Cherry Street Force Main from 2B-25 to 2B-22.

- Replace the existing 8-inch AC gravity sewer with a 10-inch PVC gravity sewer in the following pipe segments: (a) 2B-11 to 2B-9.
- Replace the existing 10-inch AC gravity sewer with a 10-inch PVC gravity sewer in the following pipe segments: (a) 2B-9 to 2B-8; and (b) 2B-8 to 2B-7.
- Allow a capacity correction of 81% to be used for Segment 2E-16A to 2E-10.
- Replace the existing 8-inch PVC gravity sewer with a 10-inch PVC gravity sewer in the following pipe segments: (a) 2E-9 to 2E-8; and (b) 2E-8 to 2E-7.
- Replace the existing 10-inch AC gravity sewer with a 12-inch PVC gravity sewer in the following pipe segments: (a) 2B-17 to 2B-16; (b) 2B-16 to 2B-16A; and (c) 2B-16A to 2B-15.
- Replace the existing 10-inch AC gravity sewer with a 12-inch PVC gravity sewer in the following pipe segments: (a) 2B-12 to 2B-11.
- Replace the existing 10-inch PVC gravity sewer with a 12-inch PVC gravity sewer in the following pipe segments: (a) 2B-9 to 2B-8; and (b) 2B-8 to 2B-7.

- Pump Stations
 - Quail Hollow Pump Station
 - Perform the necessary repairs in order to place Pump No. 2 back into service.
 - Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements regarding its useful life.
 - Confirm Preliminary Design upgrades to meet current capacity requirements and its useful life plus capacity for the Proposed Development.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.

 - Stoney Hill Pump Station
 - Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements regarding its useful life.
 - Confirm Preliminary Design upgrades to meet current capacity requirements and its useful life plus capacity for the Proposed Development.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.

 - Cherry Street Pump Station
 - Address excessive rag buildup problem.
 - Address excessive pump starts and stops.
 - Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements regarding its useful life.
 - Confirm Preliminary Design upgrades to meet current capacity requirements and its useful life plus capacity for the Proposed Development.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.

- As part of normal operation and “preventive” and “predictive” maintenance of the collection system, scheduled as funding allows, the following items that should be addressed by the Town:
 - Clean the pipe segments and manholes in order to maximize the carrying capacity of the pipes and to eliminate odor / potential for odor generation caused by a buildup of solids and other debris in the manholes.
 - Segment 2E-16A to 24A-45 – Clean and TV to identify existing I/I issues.
 - Utilize the expanded wetwell at the Cherry Street Pump Station to improve pump station performance (ie. reduce the number of pump starts and stops until the pump station and downstream collection system is upgraded).

2. Introduction

Since the original Capacity Analysis completed in September 2015, the analysis has been updated based on new field investigation data, various communications regarding the type and quality of the information available regarding the existing wastewater infrastructure, updates to the Town's record information, technical workshops, and agreement on the 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 – Available capacity based on rim and invert elevations obtained by Waterman Design Associates, Inc. Segment 2B-21 to 2B-9.
- Wetwell drawdown tested conducted by Weston & Sampson on April 6, 2016.
- Capacity Correction – Available capacity based on 80 percent of the theoretical pipe capacity as required by Weston & Sampson.
- The average household size of 2.6 was obtained from the 2010 US Census data. <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>. ADF calculations were rounded conservatively higher ($2.62 * 70 \text{ gpd/person} = 183.4 \text{ gpd}$ vs. 190 gpd utilized). It should be noted that the value of 70 gpd/person is greater than the water management act value of 65 gpd per person.
- Infiltration/Inflow value of 400 gpd/idm was based on a midpoint of the range of infiltration per TR-16 (Paragraph 2.2.3.3 Infiltration), “An allowance of 250–500 gpd/in. diameter/mile of sewer (0.24–0.48 m³/cm of pipe diam/km/day) is suggested as a normal range of infiltration.”
- Infiltration/Inflow values for the tributary area to the Cherry Street Pump Station based on “Final Report - Cherry Street Project Area - Hydraulic Capacity Analysis & Odor Management, by Weston & Sampson dated 02/17/10. These values were based on 500 gpd/idm with system lengths adjusted to reflect an overall average of 400 gpd/idm.
- Peaking Factor – Peaking Factors based upon “TR-16, Guides for the Design of Wastewater Treatment Works” by New England Interstate Water Pollution Control Commission.
- Preliminary Design for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station without and with the Proposed Development.
- Existing Average Daily Flow – Existing Average Daily Flows with Infiltration/Inflow for existing development/parcels based on data developed by Weston & Sampson and is summarized as follows:
 - Industrial Park PS (11,078 gpd = 9,866 gpd plus I/I of 1,212, gpd);
 - 55 Buildings at 2E-9 and Farmington PS (21,091 gpd = 17,758 gpd plus I/I of 3,333 gpd);
 - 19 Buildings North of 2E-9 (3,891 gpd = 2,527 gpd plus I/I of 1,364 gpd);
 - Adams Farm Senior Housing (18,424 gpd = 13,500 gpd plus I/I of 4,924 gpd);
 - Former Hewlett Packard Building Flow (8,333 gpd = 6,955 gpd plus I/I of 1,378 gpd);
 - Wagner BMW and Kia (6,333 gpd = 5,000 gpd plus I/I of 1,333 gpd);
 - Yorkshire Terrace and Ashford Crossing (49,766 gpd = 45,685 gpd plus I/I of 4,081 gpd);
 - Maplewood Drive (9,009 gpd = 8,403 gpd plus I/I of 606 gpd);

- Floral Street West of Fruit Street (3,981 gpd = 3,323 gpd plus I/I of 658 gpd); and
- 4 Existing Developments (161,773, gpd = 135,045 gpd plus I/I of 26,728 gpd).
- Proposed Development – Average Daily Flow (248 units at 141 gpd per unit) plus an infiltration/inflow allowance of 1,212 gpd based on 400 gpd/idm for a total of approximately 36,200 gpd.

3. Analysis

3.1 Pumping Stations

As was requested by the Town of Shrewsbury and its wastewater consultant, Weston & Sampson, previous capacity analysis for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station, used estimated Average Daily Flows with Infiltration/Inflow based on the April 6, 2016 Wetwell Draw Tests conducted 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). This analysis indicated the following:

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.

At the June 9, 2016 technical workshop it was requested by the Town of Shrewsbury and its wastewater consultant, Weston & Sampson, that capacity analysis for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station be based on preparing a preliminary design for each pump station. Therefore, the estimated Average Daily Flow and infiltration/inflow was determined based upon the following:

3.1.4 Quail Hollow Pump Station

- Average Daily Flow = Approximately 175 properties, 70 gpd per person and 2.62 persons per property.
- Infiltration/Inflow = 9,100 gpd based on at 400 gpd/idm.

3.1.5 Stoney Hill Pump Station

- Average Daily Flow = Approximately 50 properties, 70 gpd per person and 2.62 persons per property plus ADF from the Quail Hollow Pump Station.
- Infiltration/Inflow = 400 gpd/idm based on 400 gpd/idm plus I/I from the Quail Hollow Pump Station tributary area.

3.1.6 Cherry Street Pump Station

- Average Daily Flow = ADF from the Industrial PS at 9,866 gpd; 55 buildings on Cherry Street and Farmington PS at 17,758 gpd; 19 buildings on Cherry Street north of 2E-9 at 2,527 gpd; Adams Farms at 13,500 gpd; and Former Hewlett Packard Building at 8,333 gpd = 50,606 gpd.
- Infiltration/Inflow = I/I from the Quail Hollow Pump Station and Stoney Hill Pump Station tributary areas plus previously I/I identified by Weston & Sampson (February 17, 2010 report to the Town of Shrewsbury, MA) PS at Industrial PS at 1,212 gpd; 55 buildings on Cherry Street and Farmington PS at 3,333 gpd; 19 buildings on Cherry Street north of 2E-9 at 1,364 gpd; Adams Farms at 4,924 gpd; and Former Hewlett Packard Building at 1,378 gpd = 12,211 at 500 gpd/idm or an equivalent of about 20,150 lf of 8-inch gravity sewer at 400 gpd/idm.

Based on the above, a preliminary design with and without the Proposed Development was completed for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station and is summarized as follows:

3.1.7 Quail Hollow Pump Station

Description	Preliminary Design without the Proposed Development	Preliminary Design with the Proposed Development
ADF (gpd)	33,250	54,200
Peaking Factor	7.10	6.39
PDF (gpd)	236,100	345,800
I/I (gpd)	9,000	10,200
PDF (gpd) with I/I	245,100	356,000
Pump Capacity (gpm)	170	250
6" FM Velocity (fps)	1.93	2.84

3.1.8 Stoney Hill Pump Station

Description	Preliminary Design without the Proposed Development	Preliminary Design with the Proposed Development
ADF (gpd)	42,800	77,700
Peaking Factor	6.73	5.91
PDF (gpd)	287,700	459,300
I/I (gpd)	11,900	13,100
PDF (gpd) with I/I	299,600	472,400
Pump Capacity (gpm)	210	330
6" FM Velocity (fps)	2.38	3.74

3.1.9 Cherry Street Pump Station

Description	Preliminary Design without the Proposed Development	Preliminary Design with the Proposed Development
ADF (gpd)	93,400	128,300
Peaking Factor	5.68	5.36
PDF (gpd)	530,300	687,800
I/I (gpd)	24,100	25,300
PDF (gpd) with I/I	554,400	713,100
Pump Capacity (gpm)	385	495
6" FM Velocity (fps)	4.37	5.62

3.2 Pipe Segments

Utilizing the preliminary design with and without the Proposed Development for the Quail Hollow Pump Station, Stoney Hill Pump Station, and Cherry Street Pump Station a capacity analysis was performed on the gravity collection system and is summarized as follows:

3.2.1 Proposed Development to Quail Hollow Pump Station - Segment 2E-96 to 2E-80A

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 245,200 gpd.
 - Peaking Factor based on TR-16 = 7.10.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.

- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 355,600 gpd.
 - Peaking Factor based on TR-16 = 6.39.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.

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

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 299,526 gpd.
 - Peaking Factor based on TR-16 = 6.73.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.
- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 472,100 gpd.
 - Peaking Factor based on TR-16 = 5.91.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.

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

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 318,200 to 493,300 gpd.
 - Peaking Factor based on TR-16 = 5.80 to 5.43.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.
- Capacity Analysis with the Proposed Development
 - Estimated ADF with I/I = 518,500 to 681,700 gpd.
 - Peaking Factor based on TR-16 = 5.76 to 5.41.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2E-16A to 2E-10 appears, by calculations, to be over capacity by approximately 4,800 gpd.
 - 2E-9 to 2E-8 appears, by calculations, to be over capacity by approximately 89,800 gpd.
 - 2E-8 to 2E-7 appears, by calculations, to be over capacity by approximately 35,000 gpd.

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

Segment 2B-25 to 2B- 23

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 577,900 gpd.
 - Peaking Factor based on TR-16 = 5.62.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.
- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 737,000 gpd.
 - Peaking Factor based on TR-16 = 5.33.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.

Segment 2B-23 to 2B-21

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 786,000 gpd.
 - Peaking Factor based on TR-16 = 5.26.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-23 to 2B-22 appears, by calculations, to be over capacity by approximately 527,700 gpd.
- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 935,400 gpd.
 - Peaking Factor based on TR-16 = 5.06.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-23 to 2B-22 appears, by calculations, to be over capacity by approximately 677,100 gpd.

Segment 2B-21 to 2B-12

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 821,600 gpd.
 - Peaking Factor based on TR-16 = 5.20.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.
- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 970,900 gpd.
 - Peaking Factor based on TR-16 = 5.02.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-17 to 2B-16 appears, by calculations, to be over capacity by approximately 103,300 gpd.
 - 2B-16 to 2B-16A appears, by calculations, to be over capacity by approximately 53,100 gpd.
 - 2B-16A to 2B-15 appears, by calculations, to be over capacity by approximately 124,200 gpd.

Segment 2B-12 to 2B-9

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 836,300 gpd.
 - Peaking Factor based on TR-16 = 5.18.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-11 to 2B-9 appears, by calculations, to be over capacity by approximately 264,300 gpd.

- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 984,300 gpd.
 - Peaking Factor based on TR-16 = 5.00.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-12 to 2B-11 appears, by calculations, to be over capacity by approximately 37,600 gpd.
 - 2B-11 to 2B-9 appears, by calculations, to be over capacity by approximately 412,300 gpd.

Segment 2B-9 to 2B-5

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 1,028,800 gpd.
 - Peaking Factor based on TR-16 = 4.96.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-9 to 2B-8 appears, by calculations, to be over capacity by approximately 14,500 gpd.
 - 2B-8 to 2B-7 appears, by calculations, to be over capacity by approximately 66,200 gpd.

- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 1,172,900 gpd.
 - Peaking Factor based on TR-16 = 4.83.
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - Capacity Issues
 - 2B-9 to 2B-8 appears, by calculations, to be over capacity by approximately 158,600 gpd
 - 2B-8 to 2B-7 appears, by calculations, to be over capacity by approximately 210,300 gpd.

Segment 2B-5 to 4A-45

- Capacity Analysis without the Proposed Development
 - Estimated PDF with I/I = 1,403,100 gpd
 - Peaking Factor based on TR-16 = 4.65
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.

- Capacity Analysis with the Proposed Development
 - Estimated PDF with I/I = 1,537,500 gpd
 - Peaking Factor based on TR-16 = 4.56
 - Capacity evaluated based on 80% of calculated pipe capacity.
 - No Capacity Issues Identified or Reported by the Town.

4. Upgrade Requirements

4.1 Collection System

4.1.1 Without Proposed Development

- Replace the existing 10-inch DI gravity sewer with a 16-inch PVC gravity sewer or Extend the Cherry Street Force Main Discharge from 2B-25 to 2B-22.
- Replace the existing 8-inch AC gravity sewer with a 10-inch PVC gravity sewer in the following pipe segments: (a) 2B-11 to 2B-9.
- Replace the existing 10-inch AC gravity sewer with a 10-inch PVC gravity sewer in the following pipe segments: (a) 2B-9 to 2B-8; and (b) 2B-8 to 2B-7.

4.1.2 With Proposed Development

- Allow a capacity correction of 81% to be used for Segment 2E-16A to 2E-10;
- Replace the existing 8-inch PVC gravity sewer with a 10-inch PVC gravity sewer in the following pipe segments: (a) 2E-9 to 2E-8; and (b) 2E-8 to 2E-7.
- Replace the existing 10-inch AC gravity sewer with a 12-inch PVC gravity sewer in the following pipe segments: (a) 2B-17 to 2B-16; (b) 2B-16 to 2B-16A; and (c) 2B-16A to 2B-15.
- Replace the existing 10-inch AC gravity sewer with a 12-inch PVC gravity sewer in the following pipe segments: (a) 2B-12 to 2B-11.
- Replace the existing 10-inch PVC gravity sewer with a 12-inch PVC gravity sewer in the following pipe segments: (a) 2B-9 to 2B-8; and (b) 2B-8 to 2B-7.

4.2 Pump Stations

4.2.1 Without Proposed Development

- Quail Hollow Pump Station
 - Perform the necessary repairs in order to place Pump No. 2 back into service.
 - Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements regarding its useful life.
 - Confirm Preliminary Design upgrades to meet current capacity requirements.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.
- Stoney Hill Pump Station
 - Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements regarding its useful life.
 - Confirm Preliminary Design upgrades to meet current capacity requirements.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.
- Cherry Street Pump Station
 - Address excessive rag buildup problem.
 - Address excessive pump starts and stops.
 - Conduct a comprehensive review of the pump station and develop a Capital Improvement List of maintenance requirements regarding its useful life.
 - Confirm Preliminary Design upgrades to meet current capacity requirements.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.

4.2.2 With Proposed Development

- Quail Hollow Pump Station
 - Confirm Preliminary Design upgrades to meet capacity requirements plus for the Proposed Development.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.
- Stoney Hill Pump Station
 - Confirm Preliminary Design upgrades to meet capacity requirements plus for the Proposed Development.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.
- Cherry Street Pump Station
 - Confirm Preliminary Design upgrades to meet capacity requirements plus for the Proposed Development.
 - Prepare final design and perform Pump Station Upgrades.
 - Perform post repairs/upgrade wetwell drawdown tests.

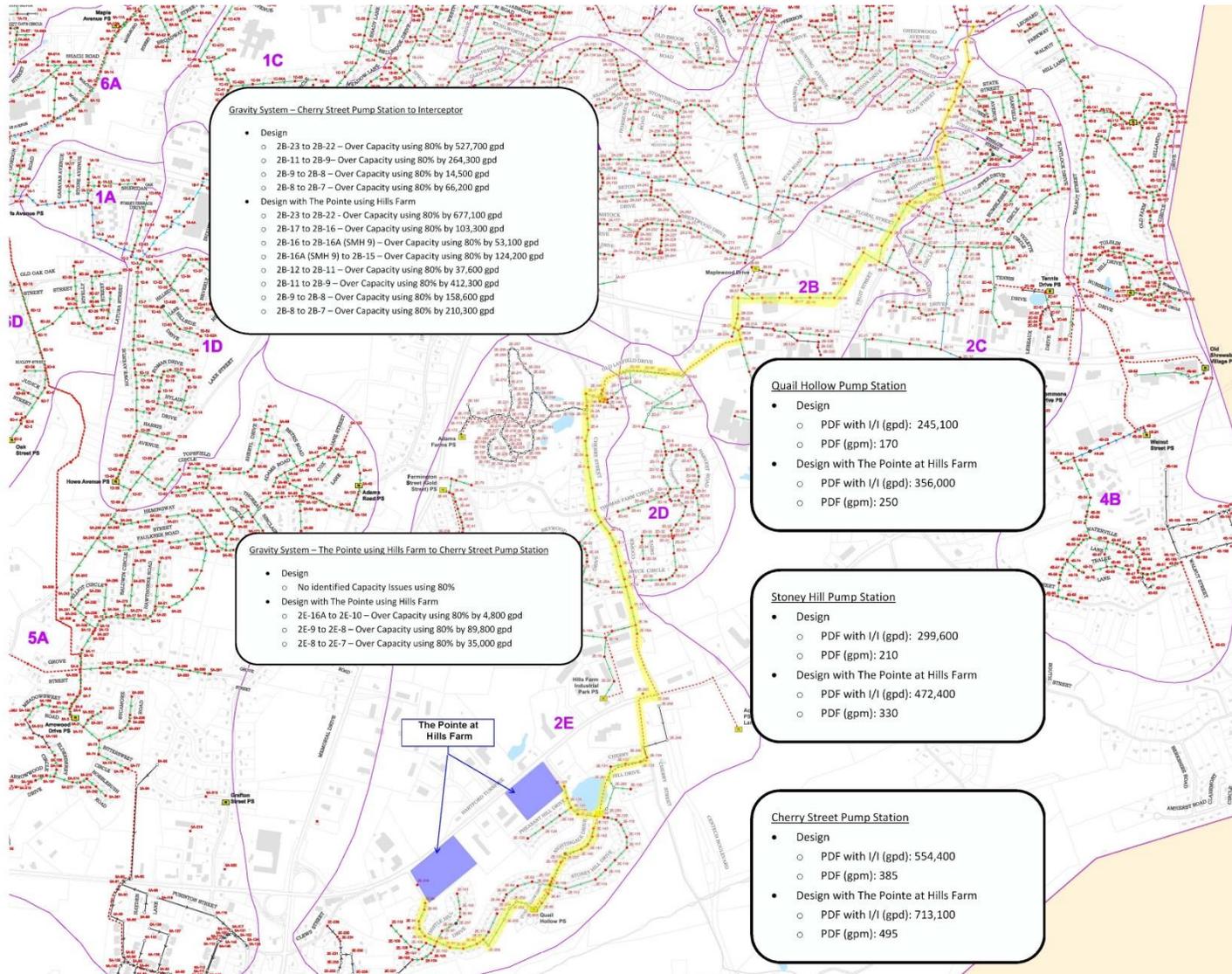
4.3 As part of normal operation and “preventive” and “predictive” maintenance of the collection system, scheduled as funding allows, the following items that should be addressed by the Town:

- 4.3.1 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;
- 4.3.2 Segment 2E-16A to 24A-45 – Clean and TV to identify existing I/I issues; and
- 4.3.3 Utilize the expanded wetwell at the Cherry Street Pump Station to improve pump station performance (ie. reduce the number of pump starts and stops until the pump station and downstream collection system is upgraded).

5. Attachments

- 5.1 System Map with Capacity Analysis Summary – Proposed Development to Manhole 4A-45.
- 5.2 Quail Hollow Pump Station Preliminary Design with and without the Proposed Development.
- 5.3 Stoney Hill Pump Station Preliminary Design with and without the Proposed Development.
- 5.4 Capacity Analysis at 80% Full – Proposed Development to Manhole 2E-1A (Cherry Street Pump Station) with and without the Proposed Development.
- 5.5 Cherry Street Pump Station Preliminary Design with and without the Proposed Development.
- 5.6 Capacity Analysis at 80% Full - Cherry Street Pump Station Discharge at Manhole 2B-25 to Manhole 4A-45 with and without the Proposed Development.

System Map with Capacity Analysis Summary Proposed Development to Manhole 4A-45



Pump Station Design

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
Pump		Wewell	
Flow: 170 gpm	Circular	Diameter:	6 feet
TDH: 119 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
Flow			
ADF: 33,250 gpd	without I/I	PF =	7.10
PDF: 236,075 gpd	without I/I		
PDF: 245,166 gpd	with I/I		

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General

Residential Flow

Total Number of Lots	175	
Total Number of Bedrooms Per Lot	-	(Avg = 3)
Total Number of Persons Per Lot	-	(Avg = 3.2)
Flow Per Bedroom	-	(Title 5 = 110 gpd)
Flow Per Person	-	(70 gpd per person)
Flow Per Lot - Based Upon Total Number of Bedrooms	-	
Flow Per Lot - Based Upon Total Number of Persons	-	
Total Flow Per Lot To Be Used	190	

Commercial/Industrial Flow

Total Number of Lots	-	
Flow Per Lot	-	(Avg /100 sf: Ret. = 8.5, Off./Ser. = 4.0, Mfg. = 3.5)

Infiltration Calculation

Infiltration Rate	400	gpd/idm	(Min = 100, Avg = 300, Max = 500)
System Information			

Size (inches)	Length (feet)
8	15,000
-	-
-	-
-	-
-	-
-	-

Total Infiltration	9,091	gpd
	6.3	gpm

School Flows	Number of Students	Flow Per Student (gpd)	Flow (gpd)
Elementary School			
W/O caf, gym & showers	-	5	-
W caf, no gym & showers	-	8	-
W caf, gym & showers	-	10	-
Secondary/Middle School			
W/O caf, gym & showers	-	10	-
W caf, no gym & showers	-	15	-
W caf, gym & showers	-	20	-
Boarding/College	-	65	-
Total			-

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>			
Flow: 170 gpm	Circular	<u>Wewell</u>	Diameter: 6 feet
TDH: 119 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 33,250 gpd	without I/I	PF =	7.10
PDF: 236,075 gpd	without I/I		
PDF: 245,166 gpd	with I/I		

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Flow Calculation

Total Number of Bedrooms	-	
Total Number of Persons	-	
Total Average Daily Residential Flow	33,250	gpd
	23.1	gpm
Total Average Commercial/Industrial Flow	-	gpd
	-	gpm
Total Average School Flow	-	gpd
	-	gpm
Total Average Flow	33,250	gpd
Total Average Flow with Infiltration	42,341	gpd
	29.4	gpm
Peaking Factor		
Using ASCE Manual No. 37	6.69	
Total Peak Daily Flow	222,547	gpd
	155	gpm
Using TR-16 (WPCF MOP9)	7.10	
Total Peak Daily Flow	236,099	gpd
	164	gpm
Peaking Factor To Be Used	7.10	
Total Peak Daily Flow	236,075	gpd
	164	gpm
Infiltration Flow	6.3	gpm
Total Peak Daily Flow With Infiltration	170	gpm
Total Peak Daily Flow To Be Used	170	gpm
Pump Run Time (10 min detention time)	2.09	min
Pump Run Time (30 min detention time)	6.27	min
Number of Pump Starts per Hour	3.48	

(Maximum 4 to 5 runs per pump per hour)

Remarks:

ADF to PS based on 70 gpd per person and 2.62 persons per property = 183.4 gpd, therefore use 190 gpd.

Client

Project Name

Contract No.

Date Created

Date Updated

Project No.

Prepared By

<u>SUMMARY</u>			
<u>Pump</u>		<u>Wewell</u>	
Flow: 170 gpm	Circular	Diameter:	6 feet
TDH: 119 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 7.10	
ADF: 33,250 gpd	without I/I		
PDF: 236,075 gpd	without I/I		
PDF: 245,166 gpd	with I/I		

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Force Main Sizing

Size	<input type="text" value="6.00"/>	inches	(Pipe Sizes: 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48)
Velocity	<input type="text" value="1.93"/>	fps	(Minimum = 3.0 fps Maximum = 5.0 fps)
Surface Roughness	<input type="text" value="140"/>		(D.I. = 130, PVC = 140)
Head Lost Per 100 l.f.	<input type="text" value="0.24"/>	feet	
Force Main Length	<input type="text" value="2,400"/>	feet	
Force Main Detention Time	<input type="text" value="119.89"/>	min	
	<input type="text" value="2.00"/>	hrs.	

Remarks:
 FM diameter and length based on existing record information from the Town of Shrewsbury, MA.

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Quail Hollow Pump Station - Design
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>			
Flow:	170 gpm	Circular	<u>Wetwell</u>
TDH:	119 feet		Diameter:
Static Head:	113 feet		6 feet
F.M. Size:	6 inch	Rectangular	Length:
			0 feet
			Width:
			0 feet
<u>Flow</u>			
ADF:	33,250 gpd	without I/I	PF = 7.10
PDF:	236,075 gpd	without I/I	
PDF:	245,166 gpd	with I/I	

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Total Dynamic Head

Force Main High Point Elevation	462.00	feet
Pump Off Elevation	348.75	feet
Static Head	113.25	feet
Pipe Friction Head	5.87	feet
Fitting Friction Head	-	feet
Total Friction Head	5.87	feet
Velocity Head	0.06	feet
Total Dynamic Head	119.18	feet

Remarks:
Elevation based on existing record information from the Town of Shrewsbury, MA.

Wetwell Sizing

Circular Wetwell

Wetwell Diameter	6.00	feet	(6', 8', 10', or 12'. If over 12' use a rectangular wetwell.)
Wetwell Capacity per foot	211.49	gallons	
Effective Volume at 10 minutes of ADF	294.03	gallons	
Effective Volume at 30 minutes of ADF	882.10	gallons	
Effective Depth at 10 minutes of ADF	1.39	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	4.17	feet	

Rectangular Wetwell

Wetwell Length	-	feet	
Wetwell Width	-	feet	
Wetwell Capacity per foot	-	gallons	
Effective Volume at 10 minutes of ADF	-	gallons	
Effective Volume at 30 minutes of ADF	-	gallons	
Effective Depth at 10 minutes of ADF	-	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	-	feet	

Effective Depth to be Used: 4.00 feet (Based on 30 minutes of ADF)

Remarks:
Wetwell diameter based on existing record information from the Town of Shrewsbury, MA.

Wetwell Settings

Distance Between Settings	7.55	inches	(Min = 3", Max = 12")
Influent Invert Elevation	354.64	feet	
Force Main Invert Elevation Leaving Station	357.00	feet	
Influent Diameter	8.00	inches	
High Water Alarm Elevation	354.01	feet	
Pump No. 2 ON Elevation	353.38	feet	
Pump No. 1 ON Elevation	352.75	feet	
Pumps OFF Elevation	348.75	feet	
Low Water Alarm Elevation	348.12	feet	
Grade Elevation at Pump Station	364.00	feet	
Submersible Station Depth	18.88	feet	
Suction Lift Station Depth	19.38	feet	
Depth to Groundwater at Pump Station	-	feet	

Remarks:
Elevations and influent diameter based on existing record information from the Town of Shrewsbury, MA.

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 170 gpm	Circular	Diameter:	6 feet
TDH: 119 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 7.10	
ADF: 33,250 gpd	without I/I		
PDF: 236,075 gpd	without I/I		
PDF: 245,166 gpd	with I/I		

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Pump Sizing

Pump Efficiency: 0.00% percent (Pump dependent - refer to pump manufacturer)
 Estimated Hydraulic Horsepower: 5.12 (Pump dependent - refer to pump manufacturer)
 Estimated Brake Horsepower: - (Pump dependent - refer to pump manufacturer)

Remarks:

System Curve

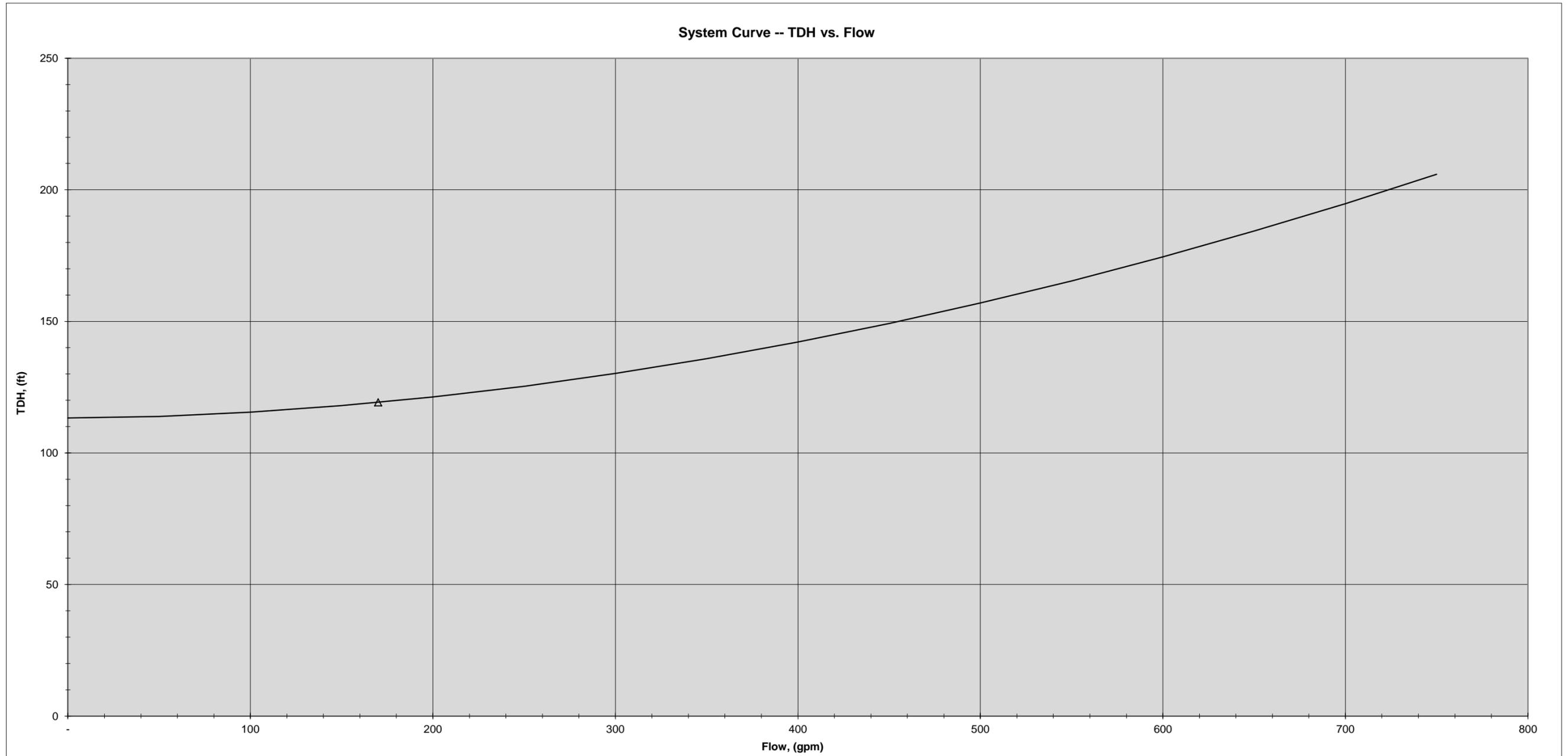
Curve Starting Point: 0
 Flow Increment: 50

Capacity	Static Head	Friction Head	Velocity Head	TDH
-	113.25	-	-	113.25
50	113.25	0.61	0.00	113.86
100	113.25	2.20	0.02	115.47
150	113.25	4.66	0.04	117.95
200	113.25	7.93	0.08	121.26
250	113.25	11.99	0.12	125.36
300	113.25	16.79	0.18	130.22
350	113.25	22.34	0.24	135.83
400	113.25	28.59	0.32	142.16
450	113.25	35.56	0.40	149.21
500	113.25	43.21	0.50	156.96
550	113.25	51.54	0.60	165.39
600	113.25	60.54	0.72	174.51
650	113.25	70.20	0.84	184.30
700	113.25	80.52	0.98	194.75
750	113.25	91.48	1.12	205.85
Design Point	Flow	170	TDH	119.18

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 170 gpm	Circular	Diameter:	6 feet
TDH: 119 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 7.10	
ADF: 33,250 gpd	without I/I		
PDF: 236,075 gpd	without I/I		
PDF: 245,166 gpd	with I/I		

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Pump Station Design

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design with The Pointe
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
Pump	Flow: 250 gpm	Circular	Wewell Diameter: 6 feet
	TDH: 125 feet		
	Static Head: 113 feet		
	F.M. Size: 6 inch	Rectangular	Length: 0 feet Width: 0 feet
Flow	ADF: 54,118 gpd	without I/I	PF = 6.39
	PDF: 345,814 gpd	without I/I	
	PDF: 355,814 gpd	with I/I	

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General

Residential Flow

Total Number of Lots	175		
Total Number of Bedrooms Per Lot	-		(Avg = 3)
Total Number of Persons Per Lot	-		(Avg = 3.2)
Flow Per Bedroom	-	gpd	(Title 5 = 110 gpd)
Flow Per Person	-	gpd	(70 gpd per person)
Flow Per Lot - Based Upon Total Number of Bedrooms	-		
Flow Per Lot - Based Upon Total Number of Persons	-		
Total Flow Per Lot To Be Used	190		

Commercial/Industrial Flow

Total Number of Lots	1		(Avg /100 sf: Ret. = 8.5, Off./Ser. = 4.0, Mfg. = 3.5)
Flow Per Lot	20,868	gpd	

Infiltration Calculation

Infiltration Rate	400	gpd/idm	(Min = 100, Avg = 300, Max = 500)
System Information	Size (inches)	Length (feet)	

8	15,000
8	1,500
-	-
-	-
-	-
-	-

Total Infiltration	10,000	gpd
	6.9	gpm

School Flows	Number of Students	Flow Per Student (gpd)	Flow (gpd)
Elementary School			
W/O caf, gym & showers	-	5	-
W caf, no gym & showers	-	8	-
W caf, gym & showers	-	10	-
Secondary/Middle School			
W/O caf, gym & showers	-	10	-
W caf, no gym & showers	-	15	-
W caf, gym & showers	-	20	-
Boarding/College	-	65	-
Total			-

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design with The Pointe
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 250 gpm	Circular	Diameter:	6 feet
TDH: 125 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 6.39	
ADF: 54,118 gpd	without I/I		
PDF: 345,814 gpd	without I/I		
PDF: 355,814 gpd	with I/I		

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Flow Calculation

Total Number of Bedrooms	-	
Total Number of Persons	-	
Total Average Daily Residential Flow	33,250	gpd
	23.1	gpm
Total Average Commercial/Industrial Flow	20,868	gpd
	14.5	gpm
Total Average School Flow	-	gpd
	-	gpm
Total Average Flow	54,118	gpd
Total Average Flow with Infiltration	64,118	gpd
	44.5	gpm
Peaking Factor		
Using ASCE Manual No. 37	5.88	
Total Peak Daily Flow	318,385	gpd
	221	gpm
Using TR-16 (WPCF MOP9)	6.39	
Total Peak Daily Flow	345,966	gpd
	240	gpm
Peaking Factor To Be Used	6.39	
Total Peak Daily Flow	345,814	gpd
	240	gpm
Infiltration Flow	6.9	gpm
Total Peak Daily Flow With Infiltration	247	gpm
Total Peak Daily Flow To Be Used	250	gpm
Pump Run Time (10 min detention time)	2.17	min
Pump Run Time (30 min detention time)	6.50	min
Number of Pump Starts per Hour	3.47	

(Maximum 4 to 5 runs per pump per hour)

Remarks:

ADF to PS based on 70 gpd per person and 2.62 persons per property = 183.4 gpd, therefore use 190 gpd.

plus

Wastewater flow from The Pointe at 148 units at 141 gallons per unit.

Client

Project Name

Contract No.

Date Created

Date Updated

Project No.

Prepared By

<u>SUMMARY</u>			
<u>Pump</u>		<u>Wewell</u>	
Flow: 250 gpm	Circular	Diameter:	6 feet
TDH: 125 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 54,118 gpd	without I/I	PF =	6.39
PDF: 345,814 gpd	without I/I		
PDF: 355,814 gpd	with I/I		

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Force Main Sizing

Size	<input type="text" value="6.00"/>	inches
Velocity	<input type="text" value="2.84"/>	fps
Surface Roughness	<input type="text" value="140"/>	
Head Lost Per 100 l.f.	<input type="text" value="0.50"/>	feet
Force Main Length	<input type="text" value="2,400"/>	feet
Force Main Detention Time	<input type="text" value="79.17"/>	min
	<input type="text" value="1.32"/>	hrs.

(Pipe Sizes: 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48)
 (Minimum = 3.0 fps Maximum = 5.0 fps)
 (D.I. = 130, PVC = 140)

Remarks:
 FM diameter and length based on existing record information from the Town of Shrewsbury, MA.

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Quail Hollow Pump Station - Design with The Pointe
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>		<u>Wetwell</u>	
Flow: 250 gpm	Circular	Diameter:	6 feet
TDH: 125 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 54,118 gpd	without I/I	PF =	6.39
PDF: 345,814 gpd	without I/I		
PDF: 355,814 gpd	with I/I		

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Total Dynamic Head

Force Main High Point Elevation	462.00	feet
Pump Off Elevation	348.75	feet
Static Head	113.25	feet
Pipe Friction Head	11.99	feet
Fitting Friction Head	-	feet
Total Friction Head	11.99	feet
Velocity Head	0.12	feet
Total Dynamic Head	125.36	feet

Remarks:
 Elevation based on existing record information from the Town of Shrewsbury, MA.

Wetwell Sizing

Circular Wetwell

Wetwell Diameter	6.00	feet	(6', 8', 10', or 12'. If over 12' use a rectangular wetwell.)
Wetwell Capacity per foot	211.49	gallons	
Effective Volume at 10 minutes of ADF	445.26	gallons	
Effective Volume at 30 minutes of ADF	1,335.79	gallons	
Effective Depth at 10 minutes of ADF	2.11	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	6.32	feet	

Rectangular Wetwell

Wetwell Length	-	feet	
Wetwell Width	-	feet	
Wetwell Capacity per foot	-	gallons	
Effective Volume at 10 minutes of ADF	-	gallons	
Effective Volume at 30 minutes of ADF	-	gallons	
Effective Depth at 10 minutes of ADF	-	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	-	feet	

Effective Depth to be Used: 4.00 feet (Based on 30 minutes of ADF)

Remarks:
 Wetwell diameter based on existing record information from the Town of Shrewsbury, MA.

Wetwell Settings

Distance Between Settings	7.55	inches	(Min = 3", Max = 12")
Influent Invert Elevation	354.64	feet	
Force Main Invert Elevation Leaving Station	357.00	feet	
Influent Diameter	8.00	inches	
High Water Alarm Elevation	354.01	feet	
Pump No. 2 ON Elevation	353.38	feet	
Pump No. 1 ON Elevation	352.75	feet	
Pumps OFF Elevation	348.75	feet	
Low Water Alarm Elevation	348.12	feet	
Grade Elevation at Pump Station	364.00	feet	
Submersible Station Depth	18.88	feet	
Suction Lift Station Depth	19.38	feet	
Depth to Groundwater at Pump Station	-	feet	

Remarks:
 Elevations and influent diameter based on existing record information from the Town of Shrewsbury, MA.

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design with The Pointe
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 250 gpm	Circular	Diameter:	6 feet
TDH: 125 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 54,118 gpd	without I/I	PF =	6.39
PDF: 345,814 gpd	without I/I		
PDF: 355,814 gpd	with I/I		

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Pump Sizing

Pump Efficiency: 0.00% percent (Pump dependent - refer to pump manufacturer)
 Estimated Hydraulic Horsepower: 7.91 (Pump dependent - refer to pump manufacturer)
 Estimated Brake Horsepower: - (Pump dependent - refer to pump manufacturer)

Remarks:

System Curve

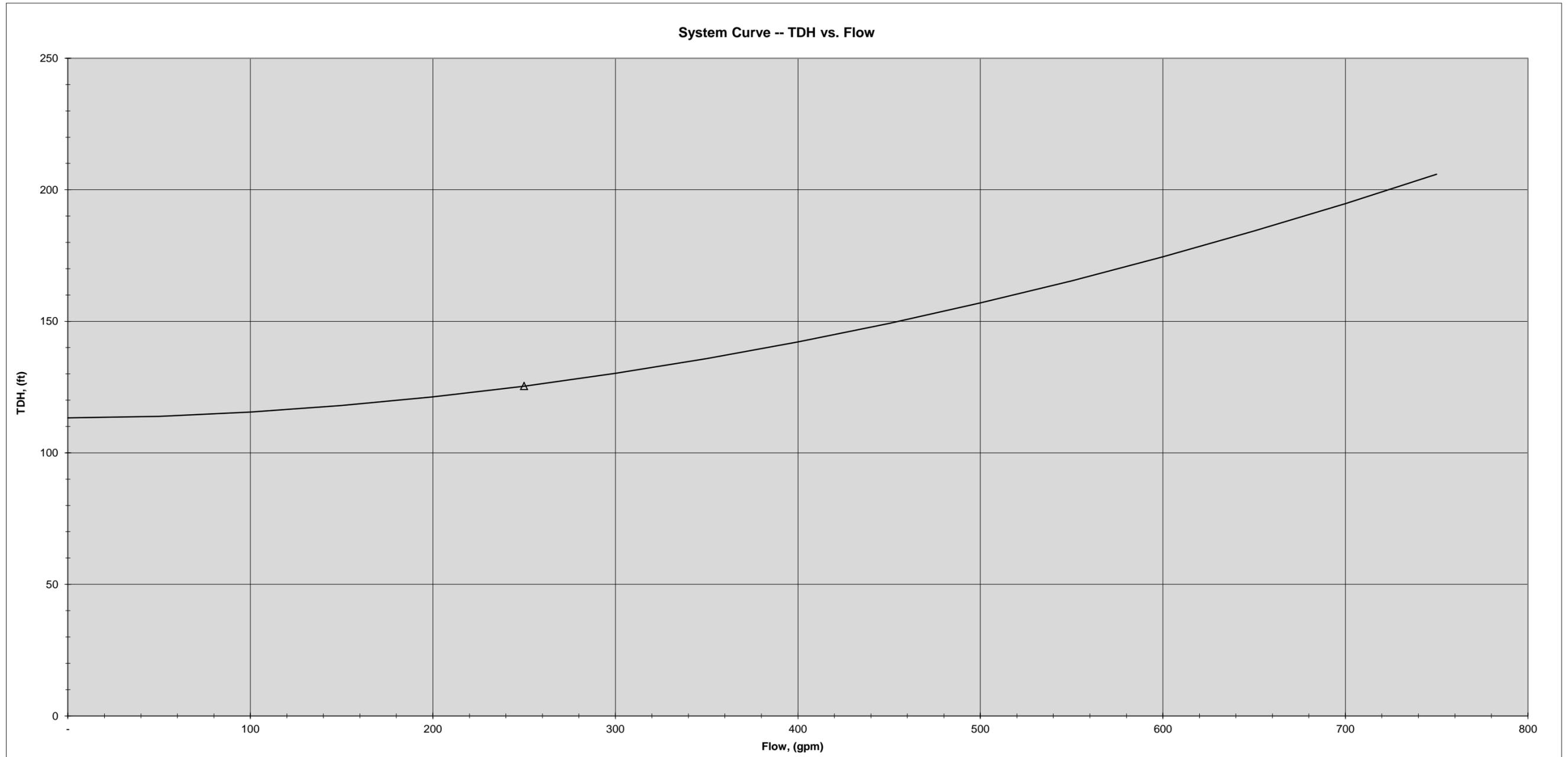
Curve Starting Point: 0
 Flow Increment: 50

Capacity	Static Head	Friction Head	Velocity Head	TDH
-	113.25	-	-	113.25
50	113.25	0.61	0.00	113.86
100	113.25	2.20	0.02	115.47
150	113.25	4.66	0.04	117.95
200	113.25	7.93	0.08	121.26
250	113.25	11.99	0.12	125.36
300	113.25	16.79	0.18	130.22
350	113.25	22.34	0.24	135.83
400	113.25	28.59	0.32	142.16
450	113.25	35.56	0.40	149.21
500	113.25	43.21	0.50	156.96
550	113.25	51.54	0.60	165.39
600	113.25	60.54	0.72	174.51
650	113.25	70.20	0.84	184.30
700	113.25	80.52	0.98	194.75
750	113.25	91.48	1.12	205.85
Design Point	Flow	250	TDH	125.36

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Quail Hollow Pump Station - Design with The Pointe
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 250 gpm	Circular	Diameter:	6 feet
TDH: 125 feet			
Static Head: 113 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 6.39	
ADF: 54,118 gpd	without I/I		
PDF: 345,814 gpd	without I/I		
PDF: 355,814 gpd	with I/I		

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Pump Station Design

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
Pump	Flow: 210 gpm	Circular	Wewell Diameter: 6 feet
	TDH: 110 feet		
	Static Head: 94 feet		
	F.M. Size: 6 inch	Rectangular	Length: 0 feet Width: 0 feet
Flow	ADF: 42,750 gpd	without I/I	PF = 6.73
	PDF: 287,708 gpd	without I/I	
	PDF: 299,526 gpd	with I/I	

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General

Residential Flow

Total Number of Lots	225	
Total Number of Bedrooms Per Lot	-	(Avg = 3)
Total Number of Persons Per Lot	-	(Avg = 3.2)
Flow Per Bedroom	-	(Title 5 = 110 gpd)
Flow Per Person	-	(70 gpd per person)
Flow Per Lot - Based Upon Total Number of Bedrooms	-	
Flow Per Lot - Based Upon Total Number of Persons	-	
Total Flow Per Lot To Be Used	190	

Commercial/Industrial Flow

Total Number of Lots	-	
Flow Per Lot	-	(Avg /100 sf: Ret. = 8.5, Off./Ser. = 4.0, Mfg. = 3.5)

Infiltration Calculation

Infiltration Rate	400	gpd/idm	(Min = 100, Avg = 300, Max = 500)
System Information			

Size (inches)	Length (feet)
8	15,000
8	4,500
-	-
-	-
-	-

Total Infiltration	11,818	gpd
	8.2	gpm

School Flows	Number of Students	Flow Per Student (gpd)	Flow (gpd)
Elementary School			
W/O caf, gym & showers	-	5	-
W caf, no gym & showers	-	8	-
W caf, gym & showers	-	10	-
Secondary/Middle School			
W/O caf, gym & showers	-	10	-
W caf, no gym & showers	-	15	-
W caf, gym & showers	-	20	-
Boarding/College	-	65	-
Total			-

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 210 gpm	Circular	Diameter:	6 feet
TDH: 110 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 6.73	
ADF: 42,750 gpd	without I/I		
PDF: 287,708 gpd	without I/I		
PDF: 299,526 gpd	with I/I		

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Flow Calculation

Total Number of Bedrooms	-	
Total Number of Persons	-	
Total Average Daily Residential Flow	42,750	gpd
	29.7	gpm
Total Average Commercial/Industrial Flow	-	gpd
	-	gpm
Total Average School Flow	-	gpd
	-	gpm
Total Average Flow	42,750	gpd
Total Average Flow with Infiltration	54,568	gpd
	37.9	gpm
Peaking Factor		
Using ASCE Manual No. 37	6.26	
Total Peak Daily Flow	267,710	gpd
	186	gpm
Using TR-16 (WPCF MOP9)	6.73	
Total Peak Daily Flow	287,545	gpd
	200	gpm
Peaking Factor To Be Used	6.73	
Total Peak Daily Flow	287,708	gpd
	200	gpm
Infiltration Flow	8.2	gpm
Total Peak Daily Flow With Infiltration	208	gpm
Total Peak Daily Flow To Be Used	210	gpm
Pump Run Time (10 min detention time)	2.20	min
Pump Run Time (30 min detention time)	6.61	min
Number of Pump Starts per Hour	3.46	

(Maximum 4 to 5 runs per pump per hour)

Remarks:

ADF to PS based on 70 gpd per person and 2.62 persons per property = 183.4 gpd, therefore use 190 gpd.

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 210 gpm	Circular	Diameter:	6 feet
TDH: 110 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 6.73	
ADF: 42,750 gpd	without I/I		
PDF: 287,708 gpd	without I/I		
PDF: 299,526 gpd	with I/I		

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Force Main Sizing

Size	6.00	inches	(Pipe Sizes: 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48)
Velocity	2.38	fps	(Minimum = 3.0 fps Maximum = 5.0 fps)
Surface Roughness	140		(D.I. = 130, PVC = 140)
Head Lost Per 100 l.f.	0.36	feet	
Force Main Length	4,500	feet	
Force Main Detention Time	174.42	min	
	2.91	hrs.	

Remarks:
 FM diameter and length based on existing record information from the Town of Shrewsbury, MA.

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Stoney Hill Pump Station - Design
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>			
Flow:	210 gpm	Circular	<u>Wetwell</u>
TDH:	110 feet		Diameter:
Static Head:	94 feet		6 feet
F.M. Size:	6 inch	Rectangular	Length:
			0 feet
			Width:
			0 feet
<u>Flow</u>			
ADF:	42,750 gpd	without I/I	PF = 6.73
PDF:	287,708 gpd	without I/I	
PDF:	299,526 gpd	with I/I	

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Total Dynamic Head

Force Main High Point Elevation	548.00	feet
Pump Off Elevation	454.00	feet
Static Head	94.00	feet
Pipe Friction Head	16.28	feet
Fitting Friction Head	-	feet
Total Friction Head	16.28	feet
Velocity Head	0.09	feet
Total Dynamic Head	110.37	feet

Remarks:
Elevation based on existing record information from the Town of Shrewsbury, MA.

Wetwell Sizing

Circular Wetwell

Wetwell Diameter	6.00	feet	(6', 8', 10', or 12'. If over 12' use a rectangular wetwell.)
Wetwell Capacity per foot	211.49	gallons	
Effective Volume at 10 minutes of ADF	378.95	gallons	
Effective Volume at 30 minutes of ADF	1,136.84	gallons	
Effective Depth at 10 minutes of ADF	1.79	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	5.38	feet	

Rectangular Wetwell

Wetwell Length	-	feet	
Wetwell Width	-	feet	
Wetwell Capacity per foot	-	gallons	
Effective Volume at 10 minutes of ADF	-	gallons	
Effective Volume at 30 minutes of ADF	-	gallons	
Effective Depth at 10 minutes of ADF	-	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	-	feet	

Effective Depth to be Used: 4.00 feet (Based on 30 minutes of ADF)

Remarks:
Wetwell diameter based on existing record information from the Town of Shrewsbury, MA.

Wetwell Settings

Distance Between Settings	8.00	inches	(Min = 3", Max = 12")
Influent Invert Elevation	460.00	feet	
Force Main Invert Elevation Leaving Station	463.00	feet	
Influent Diameter	8.00	inches	
High Water Alarm Elevation	459.33	feet	
Pump No. 2 ON Elevation	458.67	feet	
Pump No. 1 ON Elevation	458.00	feet	
Pumps OFF Elevation	454.00	feet	
Low Water Alarm Elevation	453.33	feet	
Grade Elevation at Pump Station	468.00	feet	
Submersible Station Depth	17.67	feet	
Suction Lift Station Depth	18.17	feet	
Depth to Groundwater at Pump Station	-	feet	

Remarks:
Elevations and influent diameter based on existing record information from the Town of Shrewsbury, MA.

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 210 gpm	Circular	Diameter:	6 feet
TDH: 110 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 6.73	
ADF: 42,750 gpd	without I/I		
PDF: 287,708 gpd	without I/I		
PDF: 299,526 gpd	with I/I		

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Pump Sizing

Pump Efficiency: 0.00% percent (Pump dependent - refer to pump manufacturer)
 Estimated Hydraulic Horsepower: 5.85 (Pump dependent - refer to pump manufacturer)
 Estimated Brake Horsepower: - (Pump dependent - refer to pump manufacturer)

Remarks:

System Curve

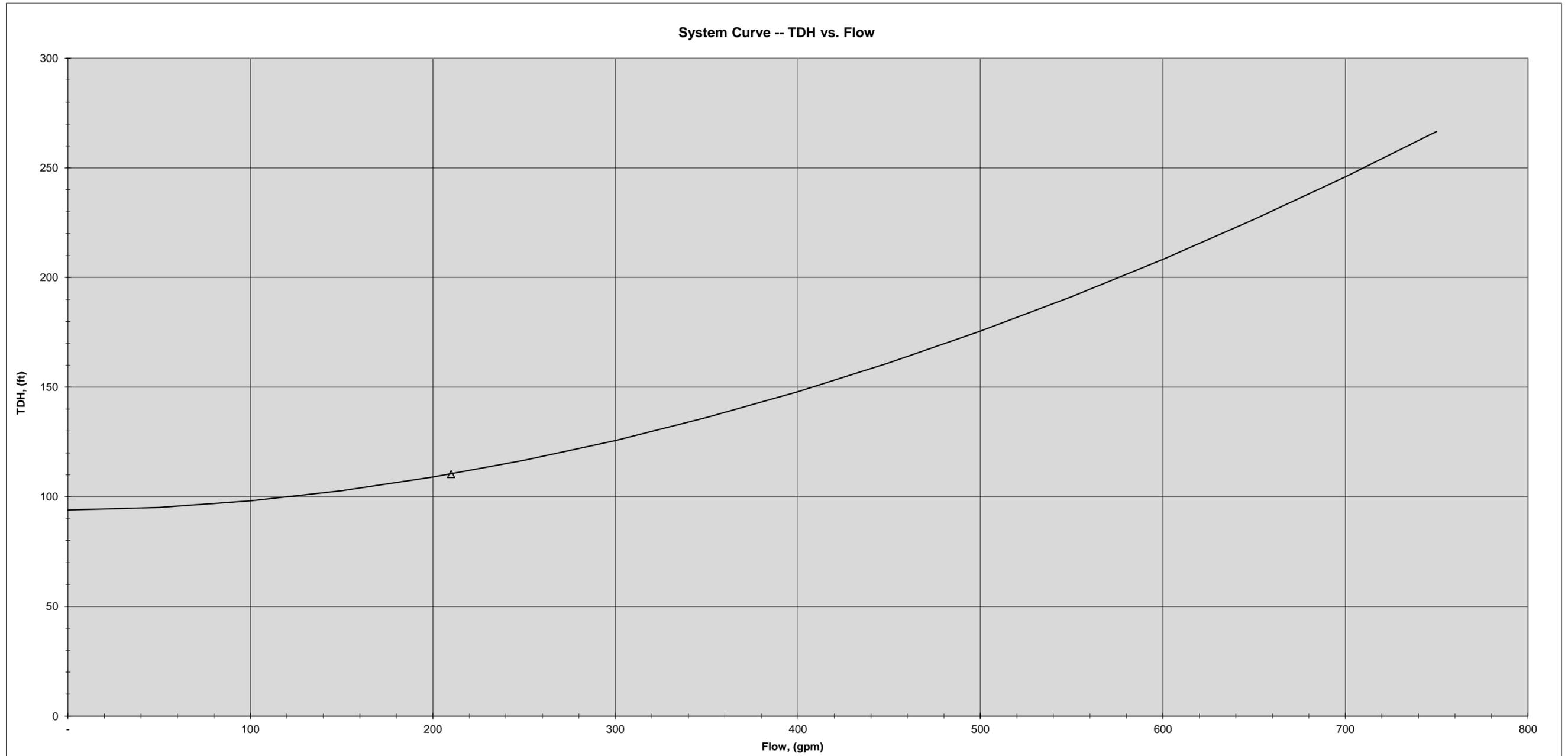
Curve Starting Point: 0
 Flow Increment: 50

Capacity	Static Head	Friction Head	Velocity Head	TDH
-	94.00	-	-	94.00
50	94.00	1.14	0.00	95.15
100	94.00	4.13	0.02	98.15
150	94.00	8.73	0.04	102.78
200	94.00	14.87	0.08	108.95
250	94.00	22.47	0.12	116.60
300	94.00	31.49	0.18	125.67
350	94.00	41.88	0.24	136.12
400	94.00	53.61	0.32	147.93
450	94.00	66.67	0.40	161.07
500	94.00	81.01	0.50	175.51
550	94.00	96.64	0.60	191.24
600	94.00	113.51	0.72	208.23
650	94.00	131.63	0.84	226.48
700	94.00	150.97	0.98	245.95
750	94.00	171.53	1.12	266.65
Design Point	Flow	210	TDH	110.37

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 210 gpm	Circular	Diameter:	6 feet
TDH: 110 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 42,750 gpd	without I/I		PF = 6.73
PDF: 287,708 gpd	without I/I		
PDF: 299,526 gpd	with I/I		

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Pump Station Design

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Stoney Hill Pump Station - Design
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 330 gpm	Circular	Diameter:	6 feet
TDH: 132 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 77,718 gpd	without I/I	PF =	5.91
PDF: 459,313 gpd	without I/I		
PDF: 472,344 gpd	with I/I		

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General

Residential Flow

Total Number of Lots	225		
Total Number of Bedrooms Per Lot	-		(Avg = 3)
Total Number of Persons Per Lot	-		(Avg = 3.2)
Flow Per Bedroom	-	gpd	(Title 5 = 110 gpd)
Flow Per Person	-	gpd	(70 gpd per person)
Flow Per Lot - Based Upon Total Number of Bedrooms	-		
Flow Per Lot - Based Upon Total Number of Persons	-		
Total Flow Per Lot To Be Used	190		

Commercial/Industrial Flow

Total Number of Lots	1		(Avg /100 sf: Ret. = 8.5, Off./Ser. = 4.0, Mfg. = 3.5)
Flow Per Lot	34,968	gpd	

Infiltration Calculation

Infiltration Rate	400	gpd/idm	(Min = 100, Avg = 300, Max = 500)
System Information			

Size (inches)	Length (feet)
8	15,000
8	4,500
8	2,000
-	-
-	-
-	-

Total Infiltration	13,030	gpd
	9.0	gpm

School Flows	Number of Students	Flow Per Student (gpd)	Flow (gpd)
<u>Elementary School</u>			
W/O caf, gym & showers	-	5	-
W caf, no gym & showers	-	8	-
W caf, gym & showers	-	10	-
<u>Secondary/Middle School</u>			
W/O caf, gym & showers	-	10	-
W caf, no gym & showers	-	15	-
W caf, gym & showers	-	20	-
Boarding/College	-	65	-
Total			-

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 330 gpm	Circular	Diameter:	6 feet
TDH: 132 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 5.91	
ADF: 77,718 gpd	without I/I		
PDF: 459,313 gpd	without I/I		
PDF: 472,344 gpd	with I/I		

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Flow Calculation

Total Number of Bedrooms	-	
Total Number of Persons	-	
Total Average Daily Residential Flow	42,750	gpd
	29.7	gpm
Total Average Commercial/Industrial Flow	34,968	gpd
	24.3	gpm
Total Average School Flow	-	gpd
	-	gpm
Total Average Flow	77,718	gpd
Total Average Flow with Infiltration	90,748	gpd
	63.0	gpm
Peaking Factor		
Using ASCE Manual No. 37	5.35	
Total Peak Daily Flow	415,443	gpd
	289	gpm
Using TR-16 (WPCF MOP9)	5.91	
Total Peak Daily Flow	459,542	gpd
	319	gpm
Peaking Factor To Be Used	5.91	
Total Peak Daily Flow	459,313	gpd
	319	gpm
Infiltration Flow	9.0	gpm
Total Peak Daily Flow With Infiltration	328	gpm
Total Peak Daily Flow To Be Used	330	gpm
Pump Run Time (10 min detention time)	2.36	min
Pump Run Time (30 min detention time)	7.08	min
Number of Pump Starts per Hour	3.43	

(Maximum 4 to 5 runs per pump per hour)

Remarks:

ADF to PS based on 70 gpd per person and 2.62 persons per property = 183.4 gpd, therefore use 190 gpd.

plus

Wastewater flow from The Pointe at 248 units at 141 gallons per unit.

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 330 gpm	Circular	Diameter:	6 feet
TDH: 132 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 77,718 gpd	without I/I	PF =	5.91
PDF: 459,313 gpd	without I/I		
PDF: 472,344 gpd	with I/I		

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Force Main Sizing

Size	6.00	inches
Velocity	3.74	fps
Surface Roughness	140	
Head Lost Per 100 l.f.	0.83	feet
Force Main Length	4,500	feet
Force Main Detention Time	104.88	min
	1.75	hrs.

(Pipe Sizes: 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48)
 (Minimum = 3.0 fps Maximum = 5.0 fps)
 (D.I. = 130, PVC = 140)

Remarks:
 FM diameter and length based on existing record information from the Town of Shrewsbury, MA.

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Stoney Hill Pump Station - Design
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>			
Flow:	330 gpm	Circular	<u>Wetwell</u>
TDH:	132 feet		Diameter:
Static Head:	94 feet		6 feet
F.M. Size:	6 inch	Rectangular	Length:
			0 feet
			Width:
			0 feet
<u>Flow</u>			
ADF:	77,718 gpd	without I/I	PF = 5.91
PDF:	459,313 gpd	without I/I	
PDF:	472,344 gpd	with I/I	

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Total Dynamic Head

Force Main High Point Elevation	548.00	feet
Pump Off Elevation	454.00	feet
Static Head	94.00	feet
Pipe Friction Head	37.56	feet
Fitting Friction Head	-	feet
Total Friction Head	37.56	feet
Velocity Head	0.22	feet
Total Dynamic Head	131.78	feet

Remarks:
Elevation based on existing record information from the Town of Shrewsbury, MA.

Wetwell Sizing

Circular Wetwell

Wetwell Diameter	6.00	feet	(6', 8', 10', or 12'. If over 12' use a rectangular wetwell.)
Wetwell Capacity per foot	211.49	gallons	
Effective Volume at 10 minutes of ADF	630.20	gallons	
Effective Volume at 30 minutes of ADF	1,890.59	gallons	
Effective Depth at 10 minutes of ADF	2.98	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	8.94	feet	

Rectangular Wetwell

Wetwell Length	-	feet	
Wetwell Width	-	feet	
Wetwell Capacity per foot	-	gallons	
Effective Volume at 10 minutes of ADF	-	gallons	
Effective Volume at 30 minutes of ADF	-	gallons	
Effective Depth at 10 minutes of ADF	-	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	-	feet	

Effective Depth to be Used: 4.00 feet (Based on 30 minutes of ADF)

Remarks:
Wetwell diameter based on existing record information from the Town of Shrewsbury, MA.

Wetwell Settings

Distance Between Settings	8.00	inches	(Min = 3", Max = 12")
Influent Invert Elevation	460.00	feet	
Force Main Invert Elevation Leaving Station	463.00	feet	
Influent Diameter	8.00	inches	
High Water Alarm Elevation	459.33	feet	
Pump No. 2 ON Elevation	458.67	feet	
Pump No. 1 ON Elevation	458.00	feet	
Pumps OFF Elevation	454.00	feet	
Low Water Alarm Elevation	453.33	feet	
Grade Elevation at Pump Station	468.00	feet	
Submersible Station Depth	17.67	feet	
Suction Lift Station Depth	18.17	feet	
Depth to Groundwater at Pump Station	-	feet	

Remarks:
Elevations and influent diameter based on existing record information from the Town of Shrewsbury, MA.

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 330 gpm	Circular	Diameter:	6 feet
TDH: 132 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 77,718 gpd	without I/I	PF =	5.91
PDF: 459,313 gpd	without I/I		
PDF: 472,344 gpd	with I/I		

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Pump Sizing

Pump Efficiency: 0.00% percent (Pump dependent - refer to pump manufacturer)
 Estimated Hydraulic Horsepower: 10.98 (Pump dependent - refer to pump manufacturer)
 Estimated Brake Horsepower: - (Pump dependent - refer to pump manufacturer)

Remarks:

System Curve

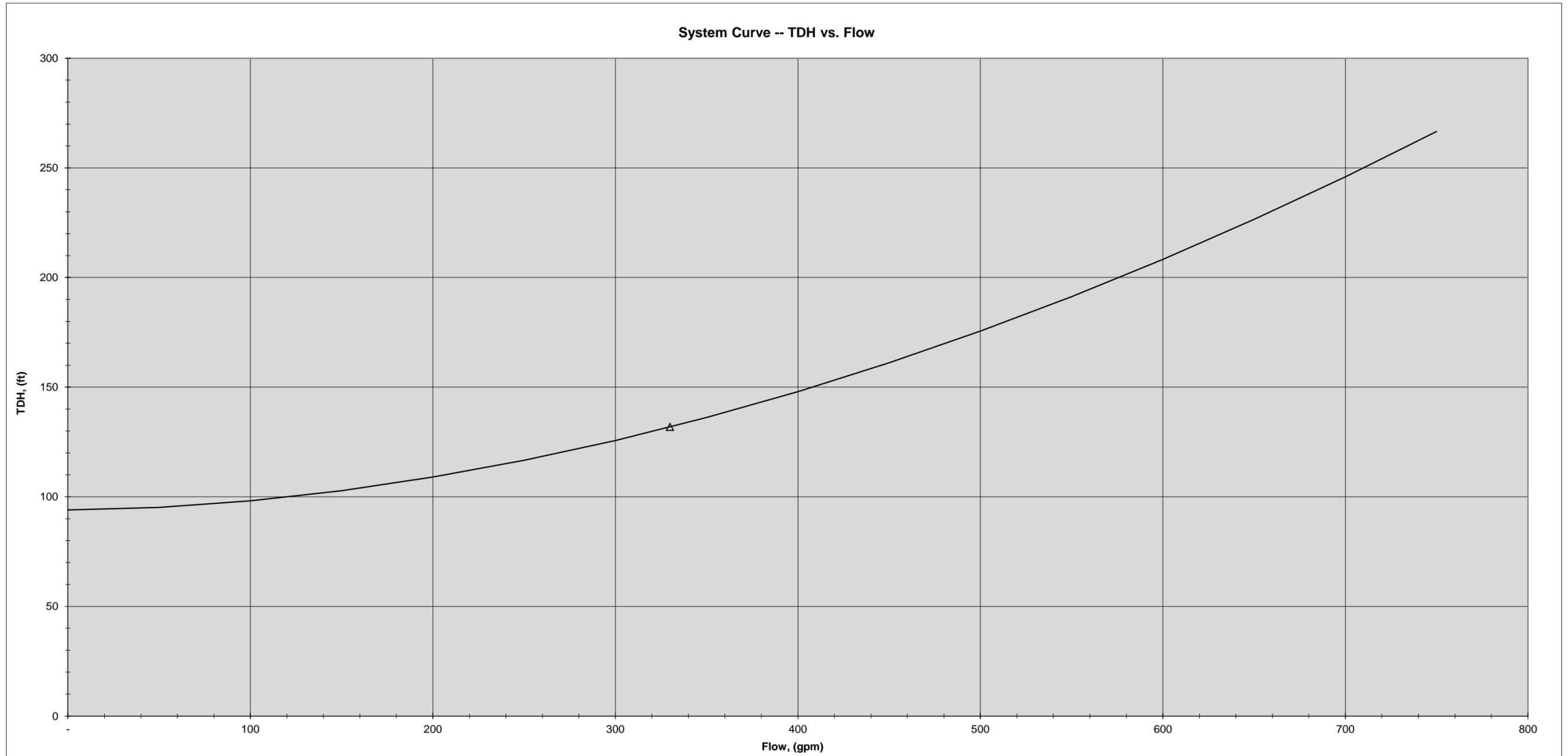
Curve Starting Point: 0
 Flow Increment: 50

Capacity	Static Head	Friction Head	Velocity Head	TDH
-	94.00	-	-	94.00
50	94.00	1.14	0.00	95.15
100	94.00	4.13	0.02	98.15
150	94.00	8.73	0.04	102.78
200	94.00	14.87	0.08	108.95
250	94.00	22.47	0.12	116.60
300	94.00	31.49	0.18	125.67
350	94.00	41.88	0.24	136.12
400	94.00	53.61	0.32	147.93
450	94.00	66.67	0.40	161.07
500	94.00	81.01	0.50	175.51
550	94.00	96.64	0.60	191.24
600	94.00	113.51	0.72	208.23
650	94.00	131.63	0.84	226.48
700	94.00	150.97	0.98	245.95
750	94.00	171.53	1.12	266.65
Design Point	Flow	330	TDH	131.78

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Stoney Hill Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 330 gpm	Circular	Diameter:	6 feet
TDH: 132 feet			
Static Head: 94 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 77,718 gpd	without I/I	PF =	5.91
PDF: 459,313 gpd	without I/I		
PDF: 472,344 gpd	with I/I		

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Start	End	(feet)	Slope (s)	Size (in)	Material	n	Capacity Correction	Design Capacity (gpd) PDF	Estimated Flows (gpd) ADF	I/I (gpd)	PF	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	33,250	9,091	7.10	236,075	245,166	903,461
2E-95	2E-94	-	0.0620	8	Polyvinyl Chloride	0.010	0.80	2,022,366	33,250	9,091	7.10	236,075	245,166	1,777,201
2E-94	2E-93	-	0.0620	8	Polyvinyl Chloride	0.010	0.80	2,022,366	33,250	9,091	7.10	236,075	245,166	1,777,201
2E-93	2E-92	-	0.0530	8	Polyvinyl Chloride	0.010	0.80	1,869,829	33,250	9,091	7.10	236,075	245,166	1,624,663
2E-92	2E-91	-	0.0290	8	Polyvinyl Chloride	0.010	0.80	1,383,130	33,250	9,091	7.10	236,075	245,166	1,137,964
2E-91	2E-90	-	0.0240	8	Polyvinyl Chloride	0.010	0.80	1,258,258	33,250	9,091	7.10	236,075	245,166	1,013,092
2E-90	2E-89	-	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	33,250	9,091	7.10	236,075	245,166	329,148
2E-89	2E-87	-	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	33,250	9,091	7.10	236,075	245,166	329,148
2E-87	2E-256	-	0.0100	8	Polyvinyl Chloride	0.010	0.80	812,202	33,250	9,091	7.10	236,075	245,166	567,036
2E-256	2E-255	-	0.0150	8	Polyvinyl Chloride	0.010	0.80	994,740	33,250	9,091	7.10	236,075	245,166	749,574
2E-255	2E-254	-	0.0100	8	Polyvinyl Chloride	0.010	0.80	812,202	33,250	9,091	7.10	236,075	245,166	567,036
2E-254	2E-253	-	0.0510	8	Polyvinyl Chloride	0.010	0.80	1,834,210	33,250	9,091	7.10	236,075	245,166	1,589,044
2E-253	2E-252	-	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	33,250	9,091	7.10	236,075	245,166	329,148
2E-252	2E-80A	-	0.0120	8	Polyvinyl Chloride	0.010	0.80	889,723	33,250	9,091	7.10	236,075	245,166	644,557
2E-80A	Quail Hollow PS	-	0.0110	8	Polyvinyl Chloride	0.010	0.80	851,845	33,250	9,091	7.10	236,075	245,166	606,679
2E-127	2E-126	-	0.0257	8	Polyvinyl Chloride	0.010	0.80	1,302,059	42,750	11,818	6.73	287,708	299,526	1,002,533
2E-126	2E-125	-	0.0153	8	Polyvinyl Chloride	0.010	0.80	1,004,638	42,750	11,818	6.73	287,708	299,526	705,113
2E-125	2E-124	-	0.0295	8	Polyvinyl Chloride	0.010	0.80	1,395,003	42,750	11,818	6.73	287,708	299,526	1,095,477
2E-124	2E-123	-	0.0291	8	Polyvinyl Chloride	0.010	0.80	1,385,513	42,750	11,818	6.73	287,708	299,526	1,085,987
2E-123	2E-122	-	0.0199	8	Polyvinyl Chloride	0.010	0.80	1,145,752	42,750	11,818	6.73	287,708	299,526	846,226
2E-122	Stoney Hill PS	-	0.0199	8	Polyvinyl Chloride	0.010	0.80	1,145,752	42,750	11,818	6.73	287,708	299,526	846,226
2E-16A	2E-16	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-16	2E-15	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-15	2E-14	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-14	2E-13	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-13	2E-12	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-12	2E-11	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-11	2E-10	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	52,616	13,030	5.80	305,173	318,203	195,478
2E-10	2E-9	-	0.0049	8	Polyvinyl Chloride	0.010	0.80	568,541	52,616	13,030	5.80	305,173	318,203	250,338
2E-9	2E-8	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	70,707	16,061	5.57	393,838	409,899	103,783
2E-8	2E-7	-	0.0049	8	Polyvinyl Chloride	0.010	0.80	568,541	70,707	16,061	5.57	393,838	409,899	158,643
2E-7	2E-6	-	0.0702	8	Polyvinyl Chloride	0.010	0.80	2,151,952	70,707	16,061	5.57	393,838	409,899	1,742,053
2E-6	2E-5	-	0.0298	8	Polyvinyl Chloride	0.010	0.80	1,402,078	70,707	16,061	5.57	393,838	409,899	992,179
2E-5	2E-4	-	0.0450	8	Polyvinyl Chloride	0.010	0.80	1,722,940	73,234	17,394	5.55	406,449	423,843	1,299,098
2E-4	2E-3	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	73,234	17,394	5.55	406,449	423,843	665,841
2E-3	2E-2	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	86,734	22,333	5.43	470,966	493,299	596,384
2E-2	2E-1	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	86,734	22,333	5.43	470,966	493,299	596,384
2E-1	Cherry Street PS	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	86,734	22,333	5.43	470,966	493,299	596,384

Start	End	(feet)	Slope (s)	Size (in)	Material	n	Capacity Correction	Design Capacity (gpd) PDF	Estimated Flows (gpd) ADF	I/I (gpd)	PF	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	54,118	9,773	6.39	345,814	355,587	793,040
2E-95	2E-94	-	0.0620	8	Polyvinyl Chloride	0.010	0.80	2,022,366	54,118	9,773	6.39	345,814	355,587	1,666,780
2E-94	2E-93	-	0.0620	8	Polyvinyl Chloride	0.010	0.80	2,022,366	54,118	9,773	6.39	345,814	355,587	1,666,780
2E-93	2E-92	-	0.0530	8	Polyvinyl Chloride	0.010	0.80	1,869,829	54,118	9,773	6.39	345,814	355,587	1,514,242
2E-92	2E-91	-	0.0290	8	Polyvinyl Chloride	0.010	0.80	1,383,130	54,118	9,773	6.39	345,814	355,587	1,027,543
2E-91	2E-90	-	0.0240	8	Polyvinyl Chloride	0.010	0.80	1,258,258	54,118	9,773	6.39	345,814	355,587	902,671
2E-90	2E-89	-	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	54,118	9,773	6.39	345,814	355,587	218,727
2E-89	2E-87	-	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	54,118	9,773	6.39	345,814	355,587	218,727
2E-87	2E-256	-	0.0100	8	Polyvinyl Chloride	0.010	0.80	812,202	54,118	9,773	6.39	345,814	355,587	456,615
2E-256	2E-255	-	0.0150	8	Polyvinyl Chloride	0.010	0.80	994,740	54,118	9,773	6.39	345,814	355,587	639,153
2E-255	2E-254	-	0.0100	8	Polyvinyl Chloride	0.010	0.80	812,202	54,118	9,773	6.39	345,814	355,587	456,615
2E-254	2E-253	-	0.0510	8	Polyvinyl Chloride	0.010	0.80	1,834,210	54,118	9,773	6.39	345,814	355,587	1,478,623
2E-253	2E-252	-	0.0050	8	Polyvinyl Chloride	0.010	0.80	574,313	54,118	9,773	6.39	345,814	355,587	218,727
2E-252	2E-80A	-	0.0120	8	Polyvinyl Chloride	0.010	0.80	889,723	54,118	9,773	6.39	345,814	355,587	534,136
2E-80A	Quail Hollow PS	-	0.0110	8	Polyvinyl Chloride	0.010	0.80	851,845	54,118	9,773	6.39	345,814	355,587	496,258
2E-127	2E-126	-	0.0257	8	Polyvinyl Chloride	0.010	0.80	1,302,059	77,718	12,727	5.91	459,313	472,041	830,018
2E-126	2E-125	-	0.0153	8	Polyvinyl Chloride	0.010	0.80	1,004,638	77,718	12,727	5.91	459,313	472,041	532,598
2E-125	2E-124	-	0.0295	8	Polyvinyl Chloride	0.010	0.80	1,395,003	77,718	12,727	5.91	459,313	472,041	922,962
2E-124	2E-123	-	0.0291	8	Polyvinyl Chloride	0.010	0.80	1,385,513	77,718	12,727	5.91	459,313	472,041	913,472
2E-123	2E-122	-	0.0199	8	Polyvinyl Chloride	0.010	0.80	1,145,752	77,718	12,727	5.91	459,313	472,041	673,711
2E-122	Stoney Hill PS	-	0.0199	8	Polyvinyl Chloride	0.010	0.80	1,145,752	77,718	12,727	5.91	459,313	472,041	673,711
2E-16A	2E-16	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-16	2E-15	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-15	2E-14	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-14	2E-13	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-13	2E-12	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-12	2E-11	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-11	2E-10	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	87,584	13,939	5.76	504,484	518,423	(4,742)
2E-10	2E-9	-	0.0049	8	Polyvinyl Chloride	0.010	0.80	568,541	87,584	13,939	5.76	504,484	518,423	50,118
2E-9	2E-8	-	0.0040	8	Polyvinyl Chloride	0.010	0.80	513,682	105,675	16,970	5.55	586,496	603,466	(89,784)
2E-8	2E-7	-	0.0049	8	Polyvinyl Chloride	0.010	0.80	568,541	105,675	16,970	5.55	586,496	603,466	(34,925)
2E-7	2E-6	-	0.0702	8	Polyvinyl Chloride	0.010	0.80	2,151,952	105,675	16,970	5.55	586,496	603,466	1,548,486
2E-6	2E-5	-	0.0298	8	Polyvinyl Chloride	0.010	0.80	1,402,078	105,675	16,970	5.55	586,496	603,466	798,612
2E-5	2E-4	-	0.0450	8	Polyvinyl Chloride	0.010	0.80	1,722,940	108,202	18,303	5.52	597,275	615,578	1,107,362
2E-4	2E-3	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	108,202	18,303	5.52	597,275	615,578	474,105
2E-3	2E-2	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	121,702	23,242	5.41	658,408	681,650	408,033
2E-2	2E-1	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	121,702	23,242	5.41	658,408	681,650	408,033
2E-1	Cherry Street PS	-	0.0180	8	Polyvinyl Chloride	0.010	0.80	1,089,683	121,702	23,242	5.41	658,408	681,650	408,033

Pump Station Design

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Cherry Street Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
Pump		Wewell	
Flow: 385 gpm	Circular	Diameter:	6 feet
TDH: 131 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
Flow			
ADF: 93,356 gpd	without I/I	PF =	5.68
PDF: 530,262 gpd	without I/I		
PDF: 554,292 gpd	with I/I		

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General

Residential Flow

Total Number of Lots	-	
Total Number of Bedrooms Per Lot	-	(Avg = 3)
Total Number of Persons Per Lot	-	(Avg = 3.2)
Flow Per Bedroom	-	(Title 5 = 110 gpd)
Flow Per Person	-	(70 gpd per person)
Flow Per Lot - Based Upon Total Number of Bedrooms	-	
Flow Per Lot - Based Upon Total Number of Persons	-	
Total Flow Per Lot To Be Used	-	

Commercial/Industrial Flow

Total Number of Lots	1		(Avg /100 sf: Ret. = 8.5, Off./Ser. = 4.0, Mfg. = 3.5)
Flow Per Lot	93,356	gpd	

Infiltration Calculation

Infiltration Rate	400	gpd/idm	(Min = 100, Avg = 300, Max = 500)
System Information			

Size (inches)	Length (feet)
8	15,000
8	4,500
-	-
-	-
8	20,150

Total Infiltration	24,030	gpd
	16.7	gpm

School Flows	Number of Students	Flow Per Student (gpd)	Flow (gpd)
Elementary School			
W/O caf, gym & showers	-	5	-
W caf, no gym & showers	-	8	-
W caf, gym & showers	-	10	-
Secondary/Middle School			
W/O caf, gym & showers	-	10	-
W caf, no gym & showers	-	15	-
W caf, gym & showers	-	20	-
Boarding/College	-	65	-
Total			-

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Cherry Street Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 385 gpm	Circular	Diameter:	6 feet
TDH: 131 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 93,356 gpd	without I/I	PF =	5.68
PDF: 530,262 gpd	without I/I		
PDF: 554,292 gpd	with I/I		

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Flow Calculation

Total Number of Bedrooms	-	
Total Number of Persons	-	
Total Average Daily Residential Flow	-	gpd
	-	gpm
Total Average Commercial/Industrial Flow	93,356	gpd
	64.8	gpm
Total Average School Flow	-	gpd
	-	gpm
Total Average Flow	93,356	gpd
Total Average Flow with Infiltration	117,386	gpd
	81.5	gpm
Peaking Factor		
Using ASCE Manual No. 37	5.09	
Total Peak Daily Flow	475,388	gpd
	330	gpm
Using TR-16 (WPCF MOP9)	5.68	
Total Peak Daily Flow	530,615	gpd
	368	gpm
Peaking Factor To Be Used	5.68	
Total Peak Daily Flow	530,262	gpd
	368	gpm
Infiltration Flow	16.7	gpm
Total Peak Daily Flow With Infiltration	385	gpm
Total Peak Daily Flow To Be Used	385	gpm
Pump Run Time (10 min detention time)	2.69	min
Pump Run Time (30 min detention time)	8.06	min
Number of Pump Starts per Hour	3.36	

(Maximum 4 to 5 runs per pump per hour)

Remarks:

ADF from Stoney Hill PS based on 70 gpd per person and 2.62 persons per property = 183.4 gpd, therefore use 190 gpd = 42,750 gpd and I/I at 11,818 gpd (19,500 lf of 8-inch GS at 400 gpd/idm).

plus

ADF = Industrial PS at 9,866 gpd; 55 buildings on Cherry Street and Farmington PS at 17,758 gpd; 19 buildings on Cherry Street north of 2E-9 at 2,527 gpd; Adams Farms at 13,500 gpd; and Former Hewlett Packard Building at 8,333 gpd = 50,606 gpd.

I/I = PS at Industrial PS at 1,212 gpd; 55 buildings on Cherry Street and Farmington PS at 3,333 gpd; 19 buildings on Cherry Street north of 2E-9 at 1,364 gpd; Adams Farms at 4,924 gpd; and Former Hewlett Packard Building at 1,378 gpd = 12,211 at 500 gpd/idm or about 20,150 lf of 8-inch GS at 400 gpd/idm.

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 Project Name: Cherry Street Pump Station - Design
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 385 gpm	Circular	Diameter:	6 feet
TDH: 131 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 93,356 gpd	without I/I	PF =	5.68
PDF: 530,262 gpd	without I/I		
PDF: 554,292 gpd	with I/I		

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Force Main Sizing

Size	6.00	inches
Velocity	4.37	fps
Surface Roughness	140	
Head Lost Per 100 l.f.	1.11	feet
Force Main Length	4,500	feet
Force Main Detention Time	81.08	min
	1.35	hrs.

(Pipe Sizes: 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48)
 (Minimum = 3.0 fps Maximum = 5.0 fps)
 (D.I. = 130, PVC = 140)

Remarks:
 FM diameter and length based on existing record information from the Town of Shrewsbury, MA.

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Cherry Street Pump Station - Design
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>			
Flow:	385 gpm	Circular	<u>Wetwell</u>
TDH:	131 feet		Diameter:
Static Head:	81 feet		6 feet
F.M. Size:	6 inch	Rectangular	Length:
			0 feet
			Width:
			0 feet
<u>Flow</u>			
ADF:	93,356 gpd	without I/I	PF = 5.68
PDF:	530,262 gpd	without I/I	
PDF:	554,292 gpd	with I/I	

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Total Dynamic Head

Force Main High Point Elevation	548.00	feet
Pump Off Elevation	467.00	feet
Static Head	81.00	feet
Pipe Friction Head	49.95	feet
Fitting Friction Head	-	feet
Total Friction Head	49.95	feet
Velocity Head	0.30	feet
Total Dynamic Head	131.25	feet

Remarks:
Elevation based on existing record information from the Town of Shrewsbury, MA.

Wetwell Sizing

Circular Wetwell

Wetwell Diameter	6.00	feet	(6', 8', 10', or 12'. If over 12' use a rectangular wetwell.)
Wetwell Capacity per foot	211.49	gallons	
Effective Volume at 10 minutes of ADF	815.18	gallons	
Effective Volume at 30 minutes of ADF	2,445.55	gallons	
Effective Depth at 10 minutes of ADF	3.85	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	11.56	feet	

Rectangular Wetwell

Wetwell Length	-	feet	
Wetwell Width	-	feet	
Wetwell Capacity per foot	-	gallons	
Effective Volume at 10 minutes of ADF	-	gallons	
Effective Volume at 30 minutes of ADF	-	gallons	
Effective Depth at 10 minutes of ADF	-	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	-	feet	

Effective Depth to be Used: 4.00 feet (Based on 30 minutes of ADF)

Remarks:
Wetwell diameter based on existing record information from the Town of Shrewsbury, MA.

Wetwell Settings

Distance Between Settings	8.00	inches	(Min = 3", Max = 12")
Influent Invert Elevation	473.00	feet	
Force Main Invert Elevation Leaving Station	476.00	feet	
Influent Diameter	8.00	inches	
High Water Alarm Elevation	472.33	feet	
Pump No. 2 ON Elevation	471.67	feet	
Pump No. 1 ON Elevation	471.00	feet	
Pumps OFF Elevation	467.00	feet	
Low Water Alarm Elevation	466.33	feet	
Grade Elevation at Pump Station	481.00	feet	
Submersible Station Depth	17.67	feet	
Suction Lift Station Depth	18.17	feet	
Depth to Groundwater at Pump Station	-	feet	

Remarks:
Elevations and influent diameter based on existing record information from the Town of Shrewsbury, MA.

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 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 385 gpm	Circular	Diameter:	6 feet
TDH: 131 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 93,356 gpd	without I/I	PF =	5.68
PDF: 530,262 gpd	without I/I		
PDF: 554,292 gpd	with I/I		

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Pump Sizing

Pump Efficiency: 0.00% percent (Pump dependent - refer to pump manufacturer)
 Estimated Hydraulic Horsepower: 12.76 (Pump dependent - refer to pump manufacturer)
 Estimated Brake Horsepower: - (Pump dependent - refer to pump manufacturer)

Remarks:

System Curve

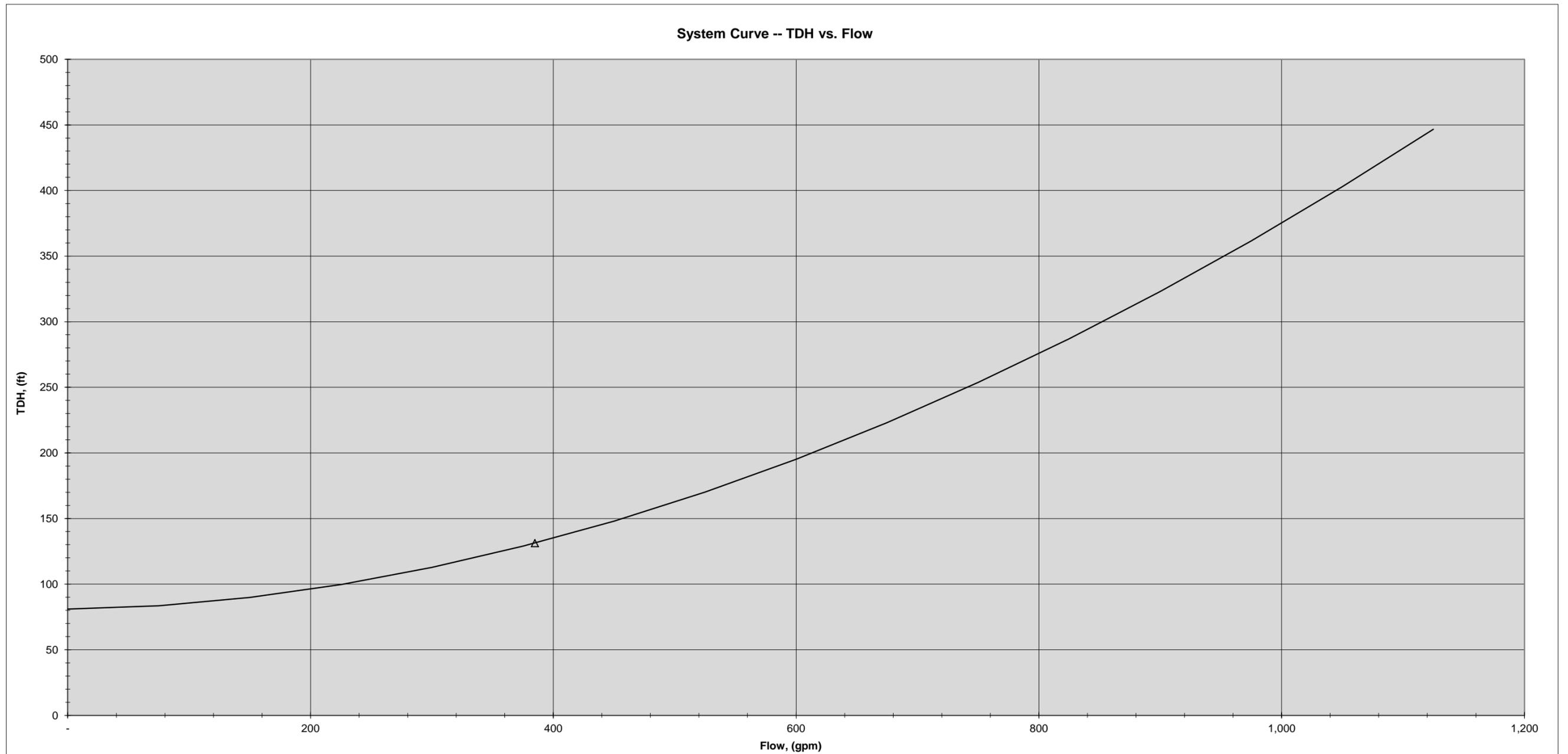
Curve Starting Point: 0
 Flow Increment: 75

Capacity	Static Head	Friction Head	Velocity Head	TDH
-	81.00	-	-	81.00
75	81.00	2.42	0.01	83.43
150	81.00	8.73	0.04	89.78
225	81.00	18.49	0.10	99.59
300	81.00	31.49	0.18	112.67
375	81.00	47.58	0.28	128.86
450	81.00	66.67	0.40	148.07
525	81.00	88.67	0.55	170.22
600	81.00	113.51	0.72	195.23
675	81.00	141.15	0.91	223.06
750	81.00	171.53	1.12	253.65
825	81.00	204.60	1.36	286.96
900	81.00	240.34	1.62	322.95
975	81.00	278.69	1.90	361.59
1,050	81.00	319.65	2.20	402.85
1,125	81.00	363.16	2.53	446.69
Design Point	Flow	385	TDH	131.25

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<u>Pump</u>		<u>Wewell</u>	
Flow: 385 gpm	Circular	Diameter:	6 feet
TDH: 131 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 5.68	
ADF: 93,356 gpd	without I/I		
PDF: 530,262 gpd	without I/I		
PDF: 554,292 gpd	with I/I		

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Pump Station Design

Client: Roderick A. St. Pierre dba The Pointe at Hills Farm
 Project Name: Cherry Street Pump Station - Design with The Pointe
 Contract No.:
 Date Created: 05/10/16
 Date Updated: 06/24/16
 Project No.: 60341898
 Prepared By: TEP

SUMMARY			
Pump		Wewell	
Flow: 495 gpm	Circular	Diameter:	6 feet
TDH: 161 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
Flow			
ADF: 128,324 gpd	without I/I	PF =	5.36
PDF: 687,817 gpd	without I/I		
PDF: 713,059 gpd	with I/I		

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General

Residential Flow

Total Number of Lots	248	
Total Number of Bedrooms Per Lot	-	(Avg = 3)
Total Number of Persons Per Lot	-	(Avg = 3.2)
Flow Per Bedroom	-	(Title 5 = 110 gpd)
Flow Per Person	-	(70 gpd per person)
Flow Per Lot - Based Upon Total Number of Bedrooms	-	
Flow Per Lot - Based Upon Total Number of Persons	-	
Total Flow Per Lot To Be Used	141	

Commercial/Industrial Flow

Total Number of Lots	1	
Flow Per Lot	93,356	gpd (Avg /100 sf: Ret. = 8.5, Off./Ser. = 4.0, Mfg. = 3.5)

Infiltration Calculation

Infiltration Rate	400	gpd/idm (Min = 100, Avg = 300, Max = 500)
System Information		

Size (inches)	Length (feet)
8	15,000
8	4,500
8	2,000
-	-
-	-
8	20,150

Total Infiltration	25,242	gpd
	17.5	gpm

School Flows	Number of Students	Flow Per Student (gpd)	Flow (gpd)
Elementary School			
W/O caf, gym & showers	-	5	-
W caf, no gym & showers	-	8	-
W caf, gym & showers	-	10	-
Secondary/Middle School			
W/O caf, gym & showers	-	10	-
W caf, no gym & showers	-	15	-
W caf, gym & showers	-	20	-
Boarding/College	-	65	-
Total			-

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SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 495 gpm	Circular	Diameter:	6 feet
TDH: 161 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 128,324 gpd	without I/I	PF =	5.36
PDF: 687,817 gpd	without I/I		
PDF: 713,059 gpd	with I/I		

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Flow Calculation

Total Number of Bedrooms	-	
Total Number of Persons	-	
Total Average Daily Residential Flow	34,968	gpd
	24.3	gpm
Total Average Commercial/Industrial Flow	93,356	gpd
	64.8	gpm
Total Average School Flow	-	gpd
	-	gpm
Total Average Flow	128,324	gpd
Total Average Flow with Infiltration	153,566	gpd
	106.6	gpm
Peaking Factor		
Using ASCE Manual No. 37	4.73	
Total Peak Daily Flow	606,995	gpd
	422	gpm
Using TR-16 (WPCF MOP9)	5.36	
Total Peak Daily Flow	688,083	gpd
	478	gpm
Peaking Factor To Be Used	5.36	
Total Peak Daily Flow	687,817	gpd
	478	gpm
Infiltration Flow	17.5	gpm
Total Peak Daily Flow With Infiltration	495	gpm
Total Peak Daily Flow To Be Used	495	gpm
Pump Run Time (10 min detention time)	2.75	min
Pump Run Time (30 min detention time)	8.24	min
Number of Pump Starts per Hour	3.35	

(Maximum 4 to 5 runs per pump per hour)

Remarks:

ADF from Stoney Hill PS based on 70 gpd per person and 2.62 persons per property = 183.4 gpd, therefore use 190 gpd = 42,750 gpd and I/I at 11,818 gpd (19,500 lf of 8-inch GS at 400 gpd/idm).

plus

ADF = Industrial PS at 9,866 gpd; 55 buildings on Cherry Street and Farmington PS at 17,758 gpd; 19 buildings on Cherry Street north of 2E-9 at 2,527 gpd; Adams Farms at 13,500 gpd; and Former Hewlett Packard Building at 8,333 gpd = 50,606 gpd.

I/I = PS at Industrial PS at 1,212 gpd; 55 buildings on Cherry Street and Farmington PS at 3,333 gpd; 19 buildings on Cherry Street north of 2E-9 at 1,364 gpd; Adams Farms at 4,924 gpd; and Former Hewlett Packard Building at 1,378 gpd = 12,211 at 500 gpd/idm or about 20,150 lf of 8-inch GS at 400 gpd/idm.

plus

ADF from The Pointe at 248 units at 141 gallons per unit and I/I at 1,212 gpd (2,000 lf of 8-inch GS) .

Client

Project Name

Contract No.

Date Created

Date Updated

Project No.

Prepared By

<u>SUMMARY</u>			
<u>Pump</u>		<u>Wewell</u>	
Flow: 495 gpm	Circular	Diameter:	6 feet
TDH: 161 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 5.36	
ADF: 128,324 gpd	without I/I		
PDF: 687,817 gpd	without I/I		
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Force Main Sizing

Size	<input type="text" value="6.00"/>	inches
Velocity	<input type="text" value="5.62"/>	fps
Surface Roughness	<input type="text" value="140"/>	
Head Lost Per 100 l.f.	<input type="text" value="1.77"/>	feet
Force Main Length	<input type="text" value="4,500"/>	feet
Force Main Detention Time	<input type="text" value="61.98"/>	min
	<input type="text" value="1.03"/>	hrs.

(Pipe Sizes: 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48)
 (Minimum = 3.0 fps Maximum = 5.0 fps)
 (D.I. = 130, PVC = 140)

Remarks:
 FM diameter and length based on existing record information from the Town of Shrewsbury, MA.

Client	Roderick A. St. Pierre dba The Pointe at Hills Farm
Project Name	Cherry Street Pump Station - Design with The Pointe
Contract No.	
Date Created	05/10/16
Date Updated	06/24/16
Project No.	60341898
Prepared By	TEP

SUMMARY			
<u>Pump</u>		<u>Wetwell</u>	
Flow: 495 gpm	Circular	Diameter:	6 feet
TDH: 161 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>			
ADF: 128,324 gpd	without I/I	PF =	5.36
PDF: 687,817 gpd	without I/I		
PDF: 713,059 gpd	with I/I		

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Total Dynamic Head

Force Main High Point Elevation	548.00	feet
Pump Off Elevation	467.00	feet
Static Head	81.00	feet
Pipe Friction Head	79.52	feet
Fitting Friction Head	-	feet
Total Friction Head	79.52	feet
Velocity Head	0.49	feet
Total Dynamic Head	161.01	feet

Remarks:
Elevation based on existing record information from the Town of Shrewsbury, MA.

Wetwell Sizing

Circular Wetwell

Wetwell Diameter	6.00	feet	(6', 8', 10', or 12'. If over 12' use a rectangular wetwell.)
Wetwell Capacity per foot	211.49	gallons	
Effective Volume at 10 minutes of ADF	1,066.43	gallons	
Effective Volume at 30 minutes of ADF	3,199.30	gallons	
Effective Depth at 10 minutes of ADF	5.04	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	15.13	feet	

Rectangular Wetwell

Wetwell Length	-	feet	
Wetwell Width	-	feet	
Wetwell Capacity per foot	-	gallons	
Effective Volume at 10 minutes of ADF	-	gallons	
Effective Volume at 30 minutes of ADF	-	gallons	
Effective Depth at 10 minutes of ADF	-	feet	(Min = 1', Max = 3')
Effective Depth at 30 minutes of ADF	-	feet	

Effective Depth to be Used: 4.00 feet (Based on 30 minutes of ADF)

Remarks:
Wetwell diameter based on existing record information from the Town of Shrewsbury, MA.

Wetwell Settings

Distance Between Settings	8.00	inches	(Min = 3", Max = 12")
Influent Invert Elevation	473.00	feet	
Force Main Invert Elevation Leaving Station	476.00	feet	
Influent Diameter	8.00	inches	
High Water Alarm Elevation	472.33	feet	
Pump No. 2 ON Elevation	471.67	feet	
Pump No. 1 ON Elevation	471.00	feet	
Pumps OFF Elevation	467.00	feet	
Low Water Alarm Elevation	466.33	feet	
Grade Elevation at Pump Station	481.00	feet	
Submersible Station Depth	17.67	feet	
Suction Lift Station Depth	18.17	feet	
Depth to Groundwater at Pump Station	-	feet	

Remarks:
Elevations and influent diameter based on existing record information from the Town of Shrewsbury, MA.

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 Prepared By: TEP

SUMMARY			
<u>Pump</u>		<u>Wewell</u>	
Flow: 495 gpm	Circular	Diameter:	6 feet
TDH: 161 feet			
Static Head: 81 feet			
F.M. Size: 6 inch	Rectangular	Length:	0 feet
		Width:	0 feet
<u>Flow</u>		PF = 5.36	
ADF: 128,324 gpd	without I/I		
PDF: 687,817 gpd	without I/I		
PDF: 713,059 gpd	with I/I		

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Pump Sizing

Pump Efficiency: 0.00% percent (Pump dependent - refer to pump manufacturer)
 Estimated Hydraulic Horsepower: 20.13 (Pump dependent - refer to pump manufacturer)
 Estimated Brake Horsepower: - (Pump dependent - refer to pump manufacturer)

Remarks:

System Curve

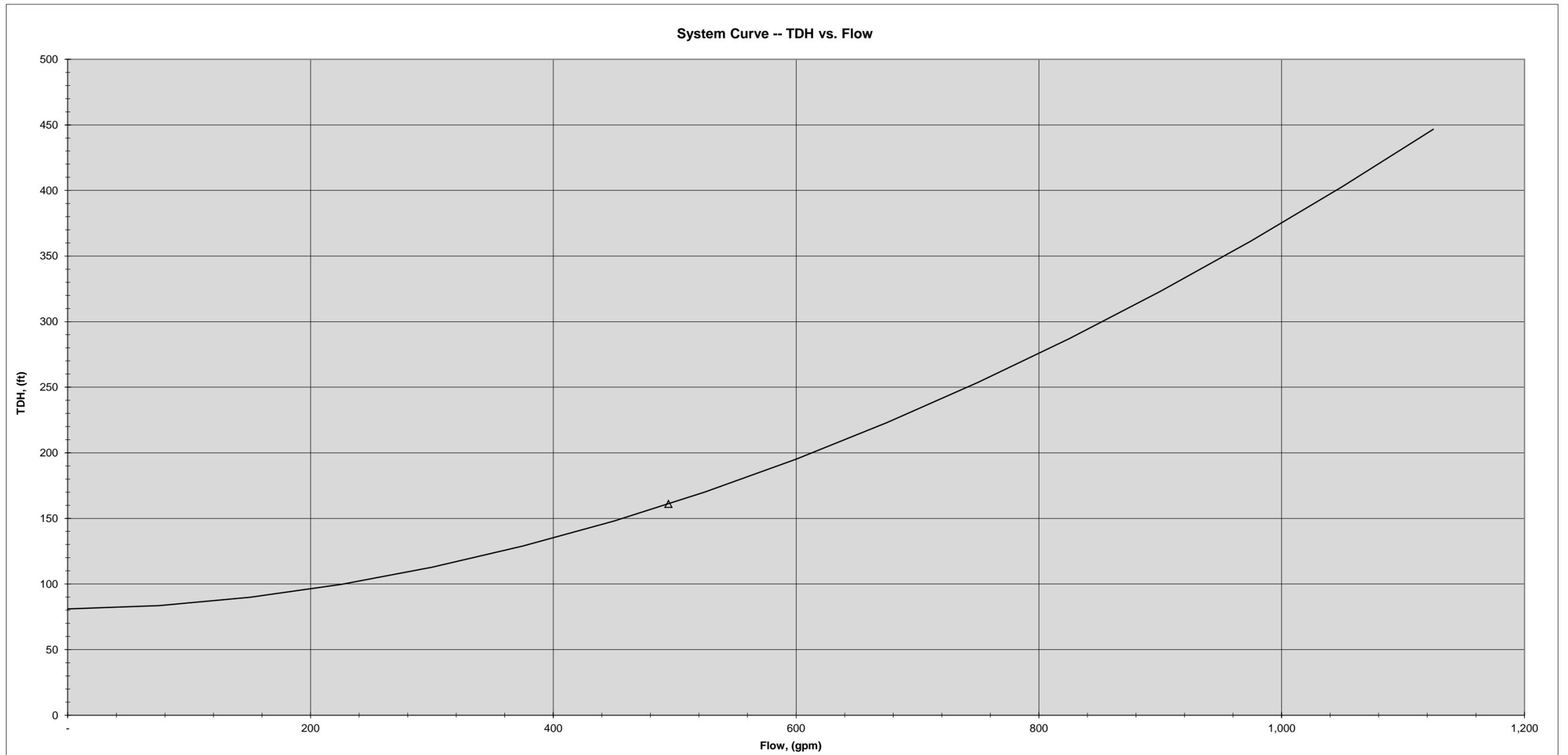
Curve Starting Point: 0
 Flow Increment: 75

Capacity	Static Head	Friction Head	Velocity Head	TDH
-	81.00	-	-	81.00
75	81.00	2.42	0.01	83.43
150	81.00	8.73	0.04	89.78
225	81.00	18.49	0.10	99.59
300	81.00	31.49	0.18	112.67
375	81.00	47.58	0.28	128.86
450	81.00	66.67	0.40	148.07
525	81.00	88.67	0.55	170.22
600	81.00	113.51	0.72	195.23
675	81.00	141.15	0.91	223.06
750	81.00	171.53	1.12	253.65
825	81.00	204.60	1.36	286.96
900	81.00	240.34	1.62	322.95
975	81.00	278.69	1.90	361.59
1,050	81.00	319.65	2.20	402.85
1,125	81.00	363.16	2.53	446.69
Design Point	Flow	495	TDH	161.01

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		Width:	0 feet
<u>Flow</u>		PF = 5.36	
ADF: 128,324 gpd	without I/I		
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Start	End	Slope (s)	Size (in)	Material	n	Capacity Correction	Design Capacity (gpd) PDF	Estimated Flows (gpd) ADF	I/I (gpd)	PF	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	98,356	25,097	5.62	552,761	577,858	953,819
2B-24	2B-23	0.08785	10	Polyvinyl Chloride	0.010	0.80	4,364,677	98,356	25,097	5.62	552,761	577,858	3,786,819
2B-23	2B-22	0.00052	10	Cast Iron, Coated	0.013	0.80	258,315	144,041	28,361	5.26	757,656	786,017	(527,702)
2B-22	2B-22A	0.0137	10	Polyvinyl Chloride	0.010	0.80	1,723,658	144,041	28,361	5.26	757,656	786,017	937,641
2B-22A	2B-21	0.0051	10	Polyvinyl Chloride	0.010	0.80	1,051,661	144,041	28,361	5.26	757,656	786,017	265,644
2B-21	2B-20	0.0050	12	Polyvinyl Chloride	0.010	0.80	1,693,268	152,444	28,846	5.20	792,709	821,555	871,713
2B-20	2B-19	0.0060	12	Polyvinyl Chloride	0.010	0.80	1,850,989	152,444	28,846	5.20	792,709	821,555	1,029,435
2B-19	2B-18	0.0050	12	Polyvinyl Chloride	0.010	0.80	1,693,268	152,444	28,846	5.20	792,709	821,555	871,713
2B-18	2B-17	0.0100	12	Polyvinyl Chloride	0.010	0.80	2,394,643	152,444	28,846	5.20	792,709	821,555	1,573,088
2B-17	2B-16	0.0042	10	Asbestos Cement	0.011	0.80	867,606	152,444	28,846	5.20	792,709	821,555	46,051
2B-16	2B-16A	0.0047	10	Asbestos Cement	0.011	0.80	917,798	152,444	28,846	5.20	792,709	821,555	96,243
2B-16A	2B-15	0.0040	10	Asbestos Cement	0.011	0.80	846,697	152,444	28,846	5.20	792,709	821,555	25,142
2B-15	2B-14	0.0069	10	Asbestos Cement	0.011	0.80	1,112,046	152,444	28,846	5.20	792,709	821,555	290,491
2B-14	2B-13	0.0057	10	Asbestos Cement	0.011	0.80	1,010,731	152,444	28,846	5.20	792,709	821,555	189,176
2B-13	2B-12	0.0057	10	Asbestos Cement	0.011	0.80	1,010,731	152,444	28,846	5.20	792,709	821,555	189,176
2B-12	2B-11	0.0050	10	Asbestos Cement	0.011	0.80	946,636	155,767	29,373	5.18	806,873	836,246	110,390
2B-11	2B-9	0.0060	8	Asbestos Cement	0.011	0.80	571,935	155,767	29,373	5.18	806,873	836,246	(264,311)
2B-9	2B-8	0.00574	10	Asbestos Cement	0.011	0.80	1,014,271	200,085	36,378	4.96	992,422	1,028,799	(14,528)
2B-8	2B-7	0.00517	10	Asbestos Cement	0.011	0.80	962,594	200,085	36,378	4.96	992,422	1,028,799	(66,205)
2B-7	2B-7B	0.04241	8	Polyvinyl Chloride	0.010	0.80	1,672,623	200,085	36,378	4.96	992,422	1,028,799	643,824
2B-7B	2B-6	0.03004	8	Polyvinyl Chloride	0.010	0.80	1,407,712	200,085	36,378	4.96	992,422	1,028,799	378,913
2B-6	2B-5	0.05424	8	Polyvinyl Chloride	0.010	0.80	1,891,576	200,085	36,378	4.96	992,422	1,028,799	862,777
2B-5	4A-45	0.0080	14	Polyvinyl Chloride	0.010	0.80	3,230,803	290,812	50,756	4.65	1,352,276	1,403,032	1,827,771

*Items in bold were field verified

Start	End	Slope (s)	Size (in)	Material	n	Capacity Correction	Design Capacity (gpd) PDF	Estimated Flows (gpd) ADF	I/I (gpd)	PF	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	133,324	26,309	5.33	710,617	736,926	794,751
2B-24	2B-23	0.08785	10	Polyvinyl Chloride	0.010	0.80	4,364,677	133,324	26,309	5.33	710,617	736,926	3,627,751
2B-23	2B-22	0.00052	10	Cast Iron, Coated	0.013	0.80	258,315	179,009	29,573	5.06	905,786	935,359	(677,044)
2B-22	2B-22A	0.0137	10	Polyvinyl Chloride	0.010	0.80	1,723,658	179,009	29,573	5.06	905,786	935,359	788,299
2B-22A	2B-21	0.0051	10	Polyvinyl Chloride	0.010	0.80	1,051,661	179,009	29,573	5.06	905,786	935,359	116,302
2B-21	2B-20	0.0050	12	Polyvinyl Chloride	0.010	0.80	1,693,268	187,412	30,058	5.02	940,808	970,866	722,402
2B-20	2B-19	0.0060	12	Polyvinyl Chloride	0.010	0.80	1,850,989	187,412	30,058	5.02	940,808	970,866	880,123
2B-19	2B-18	0.0050	12	Polyvinyl Chloride	0.010	0.80	1,693,268	187,412	30,058	5.02	940,808	970,866	722,402
2B-18	2B-17	0.0100	12	Polyvinyl Chloride	0.010	0.80	2,394,643	187,412	30,058	5.02	940,808	970,866	1,423,776
2B-17	2B-16	0.0042	10	Asbestos Cement	0.011	0.80	867,606	187,412	30,058	5.02	940,808	970,866	(103,260)
2B-16	2B-16A	0.0047	10	Asbestos Cement	0.011	0.80	917,798	187,412	30,058	5.02	940,808	970,866	(53,069)
2B-16A	2B-15	0.0040	10	Asbestos Cement	0.011	0.80	846,697	187,412	30,058	5.02	940,808	970,866	(124,169)
2B-15	2B-14	0.0069	10	Asbestos Cement	0.011	0.80	1,112,046	187,412	30,058	5.02	940,808	970,866	141,179
2B-14	2B-13	0.0057	10	Asbestos Cement	0.011	0.80	1,010,731	187,412	30,058	5.02	940,808	970,866	39,864
2B-13	2B-12	0.0057	10	Asbestos Cement	0.011	0.80	1,010,731	187,412	30,058	5.02	940,808	970,866	39,864
2B-12	2B-11	0.0050	10	Asbestos Cement	0.011	0.80	946,636	190,735	30,585	5.00	953,675	984,260	(37,624)
2B-11	2B-9	0.0060	8	Asbestos Cement	0.011	0.80	571,935	190,735	30,585	5.00	953,675	984,260	(412,325)
2B-9	2B-8	0.00574	10	Asbestos Cement	0.011	0.80	1,014,271	235,053	37,590	4.83	1,135,306	1,172,896	(158,625)
2B-8	2B-7	0.00517	10	Asbestos Cement	0.011	0.80	962,594	235,053	37,590	4.83	1,135,306	1,172,896	(210,301)
2B-7	2B-7B	0.04241	8	Polyvinyl Chloride	0.010	0.80	1,672,623	235,053	37,590	4.83	1,135,306	1,172,896	499,728
2B-7B	2B-6	0.03004	8	Polyvinyl Chloride	0.010	0.80	1,407,712	235,053	37,590	4.83	1,135,306	1,172,896	234,817
2B-6	2B-5	0.05424	8	Polyvinyl Chloride	0.010	0.80	1,891,576	235,053	37,590	4.83	1,135,306	1,172,896	718,681
2B-5	4A-45	0.0080	14	Polyvinyl Chloride	0.010	0.80	3,230,803	325,780	51,968	4.56	1,485,557	1,537,525	1,693,278

*Items in bold were field verified