SEWER SYSTEM
INFILTRATION AND INFLOW ANALYSIS

Town of Bourne, MA

August 2021

ENVIRONMENTAL PARTNERS

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LIST OF ABBREVIATIONS

EP	Environmental Partners
DEP	Massachusetts Department of Environmental Protection
GIS	Geographical Information System
gpd	Gallons per Day
gpm	Gallons per Minute
I/I	Infiltration and Inflow
idm	Inch-Diameter * Mile
in	Inch
in/hr	Inch per Hour
LF	Linear Feet
MassDEP	Massachusetts Department of Environmental Protection
MGD	Million Gallons per Day
mi	Mile
PS	Pump Station
RII	Rain Induced Infiltration

EXECUTIVE SUMMARY

The Town of Bourne sanitary sewer collection system transports an average wastewater flow of 0.11 MGD[1] through over 8 miles of sewer pipe, more than 90 manholes, and 2 pump stations. Wastewater from the collection system discharges from the Town at the Red Brook Pump Station via 6-inch forcemain and at the Main Street Pump Station via 6-inch forcemain to the Town of Wareham Collection System and WWTF. As required by MassDEP, the Town has performed this I/I Analysis to track and remove extraneous water from the sanitary sewer system. **Figure ES-1** displays the sanitary sewer collection system (gravity and low pressure), and delineates the four (4) sewershed subareas used for this evaluation.

INFILTRATION RESULTS

The Town conducted a wastewater flow metering program between March and April 2021 to identify infiltration and inflow in the system. Environmental Partners isolated the nighttime flows during dry weather in high groundwater season to quantify infiltration in each subarea. Approximately 2,250 linear feet of gravity sewer located in Subarea C experiences excessive infiltration, or more than 4,000 gpd/idm.

INFLOW RESULTS

During the metering period, EP compared wet weather events to dry weather events to identify inflow. EP developed trendlines to model the inflow experienced in a series of wet weather events, then interpolated the data based on a 5-year design storm to quantify the peak hour inflow that would be anticipated in each subarea. The top 40% of inflow occurred in Subarea D.

CONCLUSIONS

EP has ranked the subareas based on a combined need for further investigations specifically CCTV inspection from both the infiltration and inflow analysis:

1. B &C
2. D

[1] Based on data collected during the flow monitoring period between March and April 2021.

RECOMMENDATIONS

EP recommends that Bourne conduct CCTV and MH inspections of the gravity sewers in Subareas B and C in Year 1, and investigate remaining Subarea D in Year 2.

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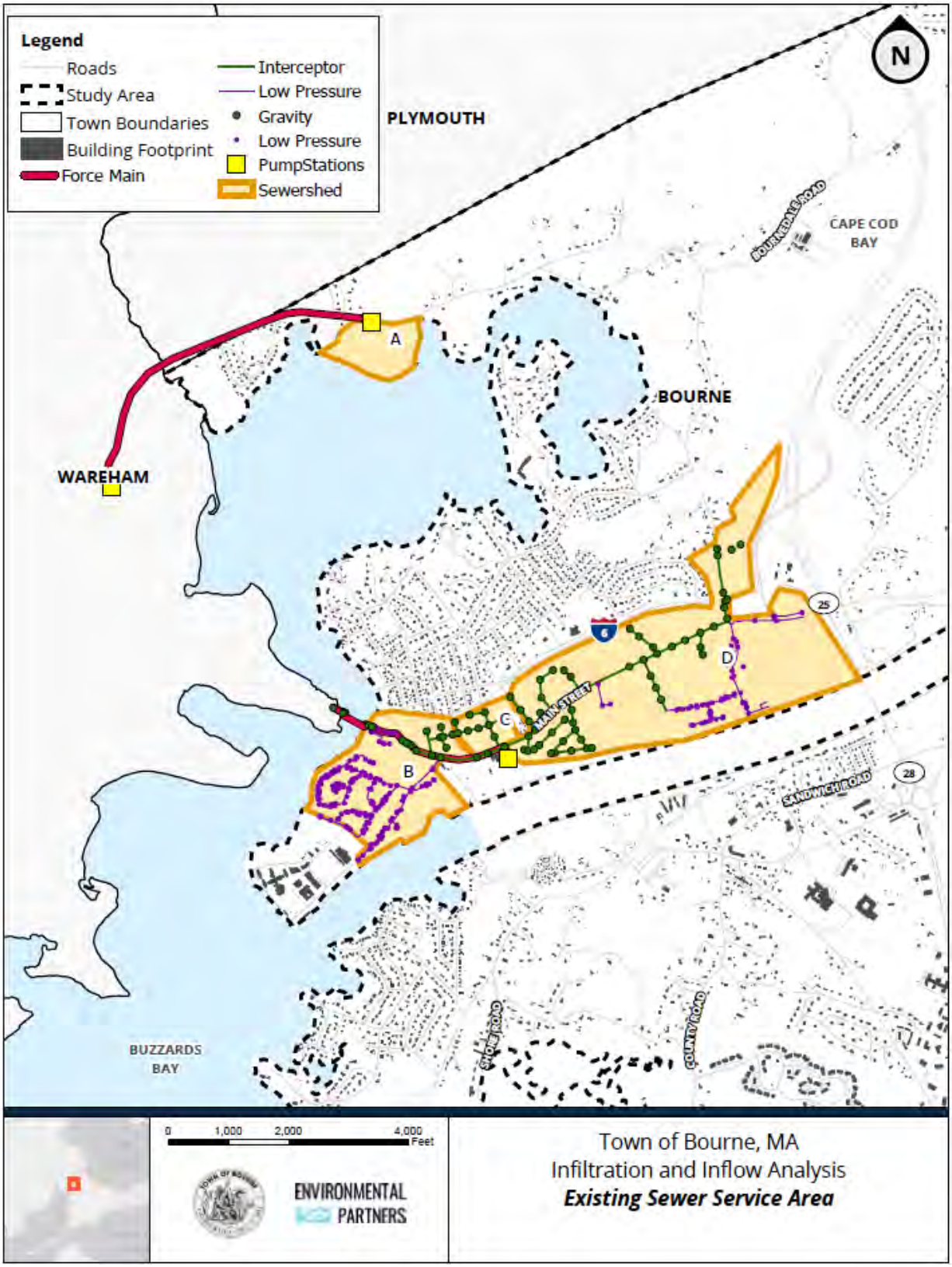
Figure ES-1


Legend
Roads
Study Area
Town Boundaries
Building Footprint
Force Main
Interceptor
Low Pressure
Gravity
Low Pressure
PumpStations
Sewershed
N
PLYMOUTH
CAPE COD BAY
BOURNE
WAREHAM
A
B
C
D
MAIN STREET
SANDWICH ROAD
BUZZARDS BAY
0 1,000 2,000 4,000 Feet
ENVIRONMENTAL PARTNERS
Town of Bourne, MA
Infiltration and Inflow Analysis
Existing Sewer Service Area

Back of Figure ES-1

SECTION 1 INTRODUCTION

The Town of Bourne (Town) is located in Barnstable County, abutting Plymouth to the north, Sandwich to the east, Wareham to the west, and Falmouth to the south. The Town spans approximately 40.7 square miles and, according to Town Annual Reports, houses more than 20,000 year-round residents and up to 40,000 residents during summer months.

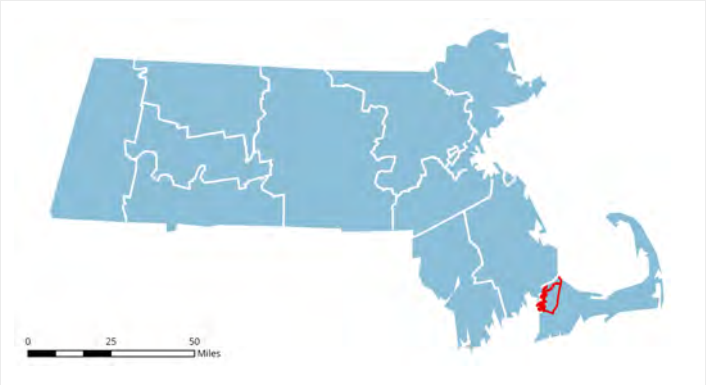


Figure 1-1: Town of Bourne Location Map

Bourne's location in the Commonwealth is in **Figure 1-1**.

SECTION 1.1 PURPOSE AND SCOPE OF STUDY

On January 19, 2021, the Town of Bourne (Town) retained Environmental Partners (EP) to perform a Phase I Infiltration and Inflow (I/I) Analysis on the sanitary sewer collection system owned by the Town, compliant with the Massachusetts Guidelines. Data was collected during flow monitoring conducted in Spring 2021 by EST Associates, Inc. (EST), as designed and procured by EP. This is part of the Town's on-going efforts to identify and remove extraneous water from their sanitary sewer system.

The Town of Bourne sewer system connects Downtown Buzzards Bay, Downtown Bourne, Taylor Point, and Hideaway Village. The existing sewer system serves approximately 604 residential and commercial properties. According to record drawings, the Town sewer system was designed and constructed in the early 1990s.

The existing sanitary sewer collection system consists of approximately 3.5 miles (over 17,000 linear feet (LF)) of gravity sewer, approximately 9,500 LF of force main, over 90 manholes, and 2 municipally owned and operated wastewater pumping stations. The Town's sanitary sewer system collects an average wastewater flow of 0.11 million gallons per day (MGD). Wastewater from the collection system discharges from the Town at the Hideaway Village Pump Station and the Main Street Pump Station both via a 6–inch force main to the Town of Wareham Collection System and treatment plant.

The purpose of this analysis is to identify and quantify the infiltration and inflow (I/I) in the Town's sanitary sewer collection system. This report will provide the Town with an understanding of I/I conditions in the collection system and identify subareas experiencing the most severe I/I issues. Infiltration, the penetration of subsurface water into a pipe, may enter a sewer system at pipe joints, breaks, or manhole defects, which can be a result of infrastructure aging or poor construction. Inflow, the flow of surface water into a pipe, typically occurs during rainfall events and can enter the system

at illegal sewer connections to roof leaders, yard drains, catch basins, or sump pumps; at defective manhole covers and frame seals; or through connections to stormwater infrastructure. Excessive I/I in a sanitary network can increase treatment costs, reduce the useful life of a sanitary network, and, in severe cases, lead to sanitary sewer overflows. Evidence of severe I/I can also indicate an environment for exfiltration during periods of low groundwater levels. Thus, proper evaluation and mitigation of I/I is a valuable capital and environmental investment.

The scope of work for the I/I Analysis includes the following tasks:

1. Categorization of flow within each subsystem into three categories: sanitary flow, infiltration, and inflow, in accordance with MassDEP's Guidelines.
2. Assessment of recurrence interval of storms from metering period.
3. Determination of inflow volume during a 1-year, 6-hour design storm event.
4. Assessment of risk of SSO during a 5-year, 24-hour storm event using the model developed in 2019 as part of Task Order No. 2 – Infiltration/Inflow Analysis 2019.
5. Development of a final report that includes:
    a. An Executive Summary highlighting all tasks performed, a subsection of conclusions, recommendations, and approximate costs.
    b. Description of existing wastewater treatment and collection systems.
    c. Description of problems (overflows, surcharging, etc.) within the system.
    d. Sewer map delineating subsystems, gauging locations, sewer size, surcharge locations, etc.
    e. Narrative description of analysis including flow categorization methodology.
    f. Tabular summary of flow metering results.
    g. Summary of all inspection reports.
    h. Recommendations for Phase 1 SSES work including estimated cost and schedule.

The system has no known sewer system overflows or bypasses. The Town Operations Staff indicates that significant surcharging events related to maintenance issues (i.e. clogs, blockages) are infrequent. There are no areas of the collection system that experience chronic surcharging/SSOs due to hydraulic restrictions or poor condition of the sewer infrastructure. Several low pressure sewer areas exist within the existing sewer system, and metering does not need to be performed in these neighborhoods, as they are considered closed loop systems. For this study, only gravity sewers were metered.

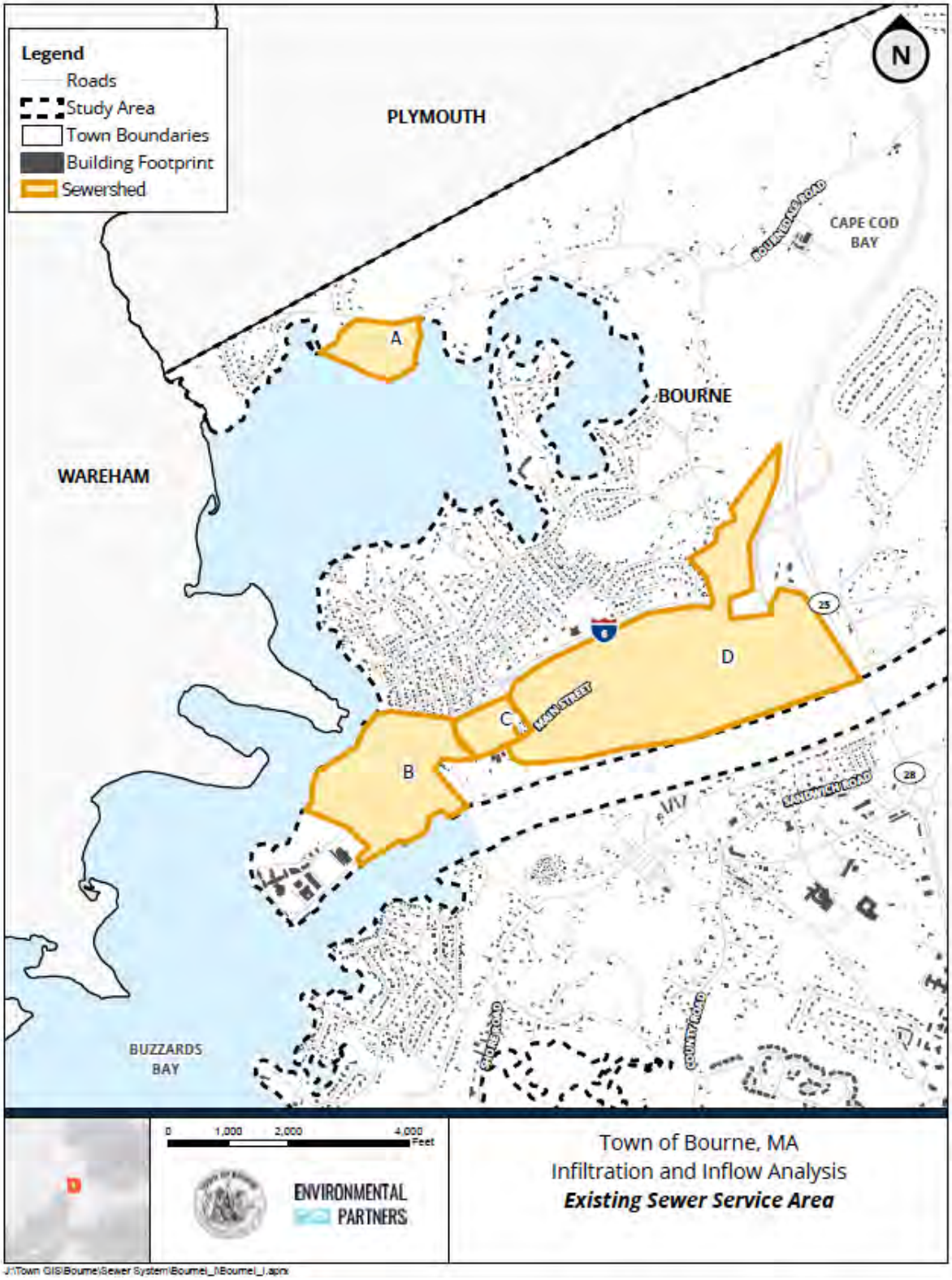
EP divided the sanitary sewer collection system into 4 subareas. Subareas were generally selected using pump station tributary areas, with the exception of Subarea C, which is located between the two metered subareas and the Main Street Pump Station. When possible, manholes selected for flow meter placement show only one inflow and one outflow pipe with wastewater flowing approximately straight through the manhole to maximize flow meter accuracy. **Figure 1-2** shows the selected sewer subarea boundaries within the Town.

Two flow meters operated between March and April 2021. EST installed the groundwater monitors in the lower elevation manhole of the two metering locations. Two (2) rain gauges were installed to

measure rainfall during the flow-monitoring period. Per Massachusetts guidelines, EST placed one groundwater gauge per 20,000 LF of sewer system area.

EP used the data from the flow meters, rain gauges, and groundwater gauges to estimate infiltration and inflow in the sanitary sewer collection system.

Figure 1-2: Town of Bourne Sewer Subareas



SECTION 1.2 GUIDELINES

This report references the Commonwealth of Massachusetts Department of Environmental Protection (MassDEP) *Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Surveys*, (May 2017) (Guidelines) for industry standards and methods for conducting SSES reports.

SECTION 1.3 DEFINITIONS

The following table defines phrases and concepts utilized for this analysis:

1-year, 6-hour Design Storm	1-year, 6-hour Design Storm a storm with total rainfall depth of 1.72 inches, and a peak hourly intensity of 0.87 inches/hour.
5-year, 24-hour Design Storm	5-year, 24-hour Design Storm a storm with total rainfall depth of 4.61 inches, and a peak hourly intensity of 0.73 inches/hour.
Gallons per day per inch diameter * mile (gpd/idm)	Gallons per Day per Inch Diameter * Miles of Sewer (gpd/idm) is the amount of infiltration in a pipe, in gallons per day (gpd), divided by the inch diameter * miles of that pipe reach.
Inch Diameter * Mile	Inch Diameter * Mile of sewer (idm) is the sum of the products of sewer diameter, in inches, multiplied by the lengths of sewers, in miles, of corresponding pipe diameters.
Infiltration	Groundwater entering the sanitary sewer is considered infiltration. Infiltration can enter the system through defective pipes, pipe joints, connections, or manholes. Prior to entering the sewer, the groundwater does not require treatment, but once in enters it mixes with sewage, becomes polluted, and must be handled like wastewater, increasing the cost of treatment and transportation. Infiltration can contribute to system back ups and surcharging during high groundwater season.
Inflow	Water from a storm event that enters the sanitary sewer, either immediately or with some delay, is considered inflow. Inflow often comes through roof leaders, yard drains, defective manhole covers, and cross connections from storm drainage collection systems. Surges in sewer flows due to inflow are caused by rain events, and are not exclusively related to groundwater levels.

Direct Inflow	Direct inflow is the portion of total inflow that originates from direct connections to the sanitary sewer system such as catch basins, roof leaders, manhole covers, etc. Influence by direct inflow is quickly observed after the onset of a storm event, and the effect of direct inflow quickly subsides after the conclusion of the storm event.
Delayed Inflow	Delayed inflow is the portion of total inflow that originates from indirect connections to the sanitary sewer system (e.g. sump pump and foundation drains) which contribute inflow after a significant time delay from the onset of a storm event. The effect of delayed inflow gradually subsides after the conclusion of the storm event.
Rain Induced Infiltration	Rain induced infiltration (RII) is the increased flow that occurs more than 12 hours and less than 24 hours after a rain event has finished. This is a result of the lag time from the beginning of the storm to the point when sump pumps turn on or additional infiltration of rainwater through cracked manholes and pipes occurs. The difference between the average dry weather flow and the average wet weather flow for the time period immediately (12-24 hours) following a storm event is typically considered RII. A portion of RII may be delayed inflow, or any water that enters the system via sump pumps, etc.

SECTION 1.4 RECORD DRAWINGS AND MAPPING

The Town of Bourne provided EP with the collection system data, including lengths, some diameters, and general layout of the pipes and manholes, via GIS (Geographic Information System) files. EP updated portions of the sewer system layers by incorporating record drawing informaiotn where available and inspections performed by EST for this analysis.

SECTION 2 STUDY AREA DESCRIPTION

The following section describes the area analyzed by this study.

SECTION 2.1 DESCRIPTION OF THE STUDY AREA

The Town of Bourne (Town) is located in Barnstable County, abutting Plymouth to the north, Sandwich to the east, Wareham to the west, and Falmouth to the south. The Town spans approximately 40.7 square miles and houses more than 19,000 residents year-round, with population estimates of up to 40,000.

Section 2.1.1 Population

The United States Census Bureau provides lists of population by town, and the Town collects similar information between census years. The last five years of US and Town Reports are presented in Table 2-1.

Table 2-1: Population Data

		US Census Data		Town Report	
	Year	Pop.	Growth Rate	Pop.	Growth Rate
Historical	1990	16,064	15.8%	N/A	
	2000	18,721	16.5%		
	2010	19,754	5.5%	20,495	
	2015	N/A		19,507	-4.8%
	2016			20,185	+3.5%
	2017			20,987	+4.0%
	2018			20,501	-2.3%
	2019	19,762	0.04%	20,392	-0.5%

Based on this analysis, we do not anticipate the population to change significantly over the next twenty years. We predict residential wastewater flow to respond proportionally, outside the effects of infiltration and inflow.

Section 2.1.2 Subarea Descriptions

Subarea A

Subarea A is in the northwestern part of the Town, separated from the other subareas by Buttermilk Bay. Subarea A is a self-contained low-pressure system serving homes in the Hideaway Village community, on the north side of Buttermilk Bay. The Hideaway Village community contains largely two and three season homes. The Hideaway Village Pump Station collects flow and conveys directly to the Town of Wareham Sewer Collection System via the Red Brook Pump Station. Subarea A covers

approximately 26 acres. Subarea A is not connected to the remaining subareas within the sewer system.

Subarea B

Subarea B is located in Taylor's Point, the western most part of Town in Buzzards Bay Sewer Area Subarea C is to the east. Subarea B contains a majority of residential properties with few commercial and public properties. Subarea B discharges into the Main Street Interceptor at Academy Drive. Subarea B covers approximately 92 acres.

Subarea C

Subarea C is in the southwestern part of the Town. Subarea B is to the west and Subarea D is to the east. Subarea C contains residential properties with some public properties. Subarea C receives flow from Subarea B and discharges to the Main Street Pump Station by way of gravity sewer. Subarea C covers approximately 15 acres.

Subarea D

Subarea D is in the southwestern part of the Town. Subarea C is to the west. Subarea D contains equal parts commercial and residential properties with some public properties. Subarea D conveys flows to the Main Street Pump Station via gravity sewer. Subarea D covers approximately 262 acres.

Table 2-2 below shows the list of subareas along with the approximate area in acres.

Table 2-2: Subarea Area in Acres

	Subarea	Area (acres)
1	A	26
2	B	92
3	C	15
4	D	262
TOTAL ESTIMATED SEWERED AREA		**395**

Section 2.1.3 Pumping Station Locations

There are two (2) municipally owned wastewater pumping stations located throughout the Town sanitary sewer collection system.

	Pump Station Name	Subarea
1	Hideaway Village PS	A
2	Main Street PS	C

Figure 2-1 shows a schematic diagram of how the wastewater flows in the system, and **Figure 2-2** shows the existing gravity sewer, pressure force main, and pump stations. The Hideaway Village pump station effluent is conveyed to the Town of Wareham Red Brook pump station by approximately 6,089 ft. of forcemain. The Hideaway Village pump station and forcemain are

maintained by the Town of Bourne Sewer Department. The Main Street pump station effluent is conveyed by 3,412 ft. of forcemain. Both the Main Street pump station and forcemain are maintained by the Town of Bourne Sewer Department.

Figure 2-1: Flow Schematic of Town Subareas

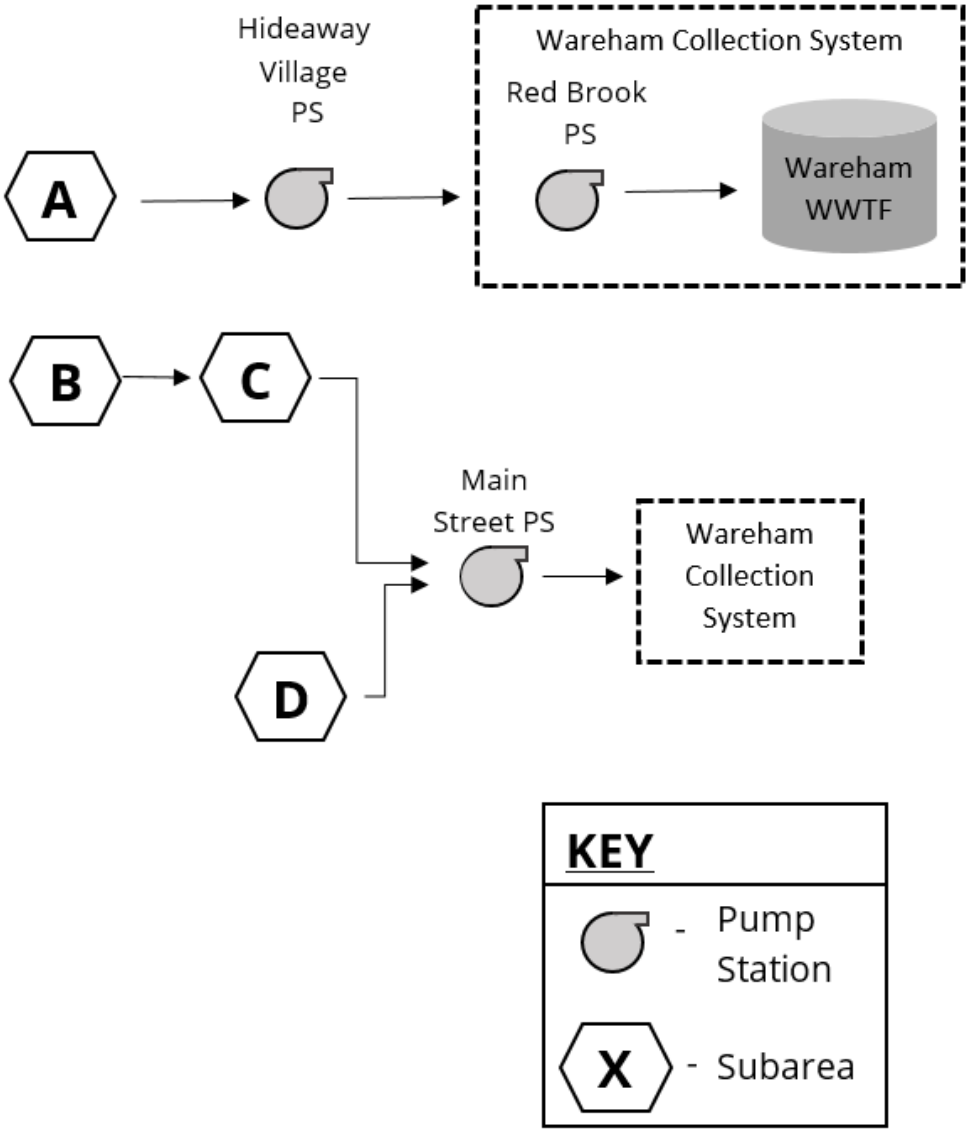
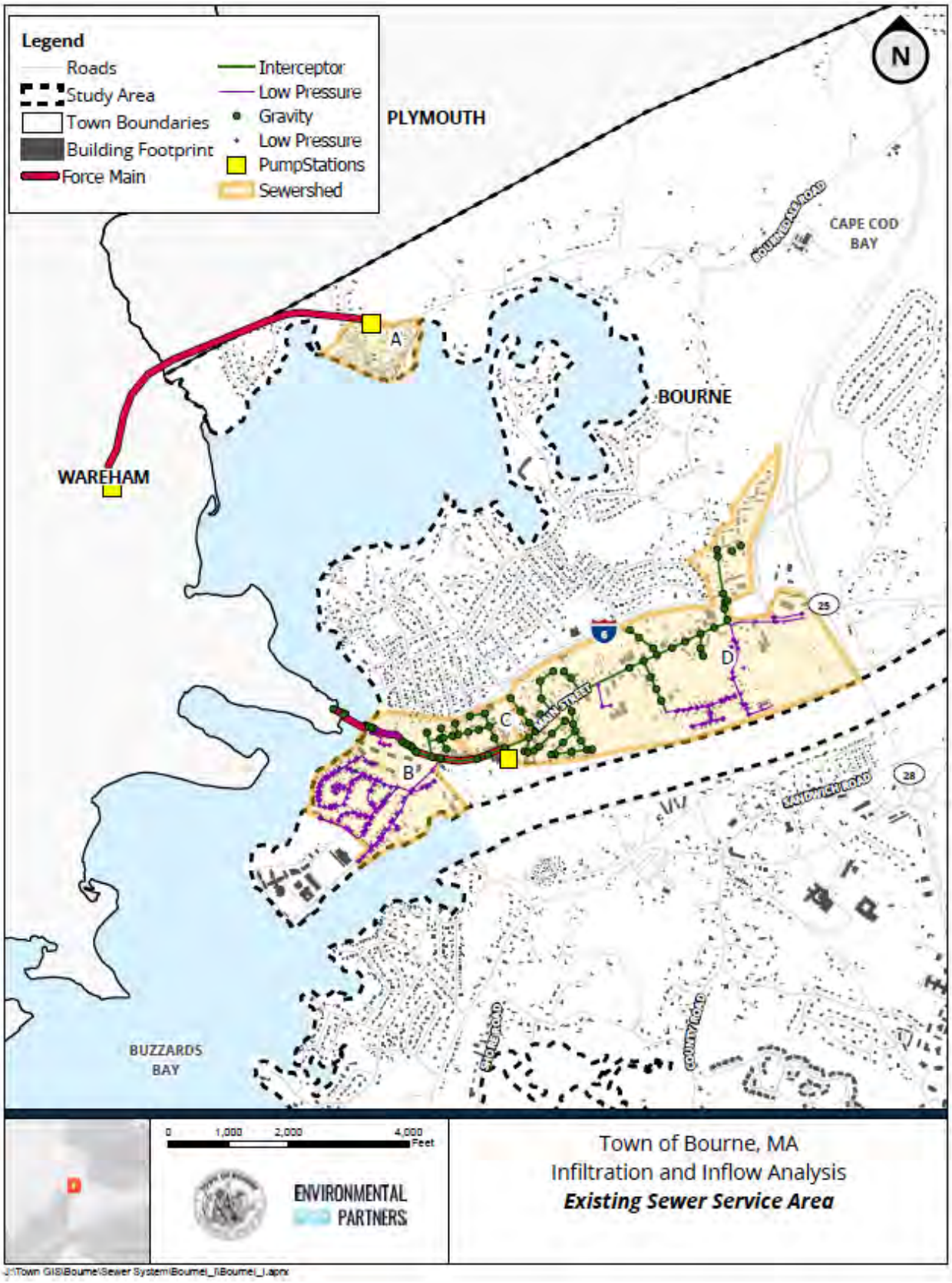


Figure 2-2: Town Sewer System Map



SECTION 2.2 UPDATED EXISTING COLLECTION SYSTEM DATA

Based on the GIS database, the existing public sanitary sewer collection system contains 5 miles of gravity sewer pipe. **Table 2-3** shows the pipe distribution by subarea in miles and **Table 2-4** shows the same information in linear feet. **Table 2-5** shows the length of pipe at each nominal diameter in the system in feet.

Table 2-3: Gravity Sewer Pipe Lengths by Diameter and Subarea in Miles

Subarea	≤8"	10" – 12"	Total Miles
A	0.00	0.00	0.00
B	0.54	0.00	0.54
C	0.39	0.04	0.43
D	1.89	0.52	2.41
Total Miles	2.82	0.56	3.38

Table 2-4: Gravity Sewer Pipe Lengths by Diameter and Subarea in Feet

Subarea	≤8"	10" – 12"	Total Feet [2]
A	0	0	0
B	2,835	0	2,835
C	2,043	204	2,247
D	9,987	2,759	12,746
Total Feet	14,865	2,963	17,828

Table 2-5: Gravity Sewer Pipe Length Summary by Diameter

Diameter	Length (ft)
6"	338
8"	14,527
10"	570
12"	2,393
TOTAL	17,828

The inch diameter mile (idm) of each subarea was calculated based on the total lengths of pipe at each nominal diameter. **Table 2-6** shows the values used to calculate the idm for each subarea.

[2] Length in feet is shown rounded to the nearest ten feet. Geospatial data has not been field verified and may be different from actual existing conditions.

Table 2-6: Gravity Sewer Pipe Inch Diameter Miles

Subarea	Diameter (in)	Length (mi)	idm
A	0		
		A Subtotal	**N/A**
B	8	0.54	4.30
		B Subtotal	**4.30**
C	8	0.39	3.10
	12	0.04	0.46
		C Subtotal	**3.56**
D	6	0.06	0.38
	8	1.83	14.62
	10	0.11	1.08
	12	0.41	4.98
		D Subtotal	**21.06**
		Total	**28.91**

Table 2-7 summarizes the calculated idm for each subarea which will be used for further analysis.

Table 2-7: Gravity Sewer Pipe Inch Diameter Mile Summary

Subarea	idm
A	N/A
B	4.30
C	3.56
D	21.06

SECTION 2.3 TIDAL INFLUENCE

The Town is coastal and the subsurface conditions are subject to tidal influence. During high tide, the groundwater fluctuates (seasonally) and recedes during low tide. Traditional low-pressure systems are designed to transport only sewage, however the Taylor's Point neighborhood contains a boat pump out station, whose effluent discharges into the low pressure system. During high tides, water has been observed entering the intermediate pumping station, indicating that the collection line requires additional dye and smoke testing. Details on the additional investigation is required is summarized in Section 6.2 Recommendations.

Figure 2-3: Example Dockside Pump-out System

Figure 2-4: Suspected Tidal Inflow MH

SECTION 3 FLOW MONITORING ANALYSIS

The following section discusses the monitoring program for the sanitary sewer system.

SECTION 3.1 ANALYSIS SUMMARY

EP worked with the Town to divide the sanitary sewer collection system into four (4) subareas, as described in the previous sections. Subareas were selected to contain approximately 20,000 linear feet of gravity sewer pipe and were based on topography, flow, and layout of existing pump stations. EP selected the 2 upstream subareas to meter, and collected pump station flow data from the pump stations that were at the terminal points of subareas. The pump station flow data was collected during the metering period from:

1. Hideaway Pump Station
2. Main Street Pump Station

On March 3, 2021, field crews from EST installed two flow meters, which operated for approximately 7 weeks between March and April 2021. They installed two groundwater gauges across the sewersheds. **Tables 3-1** and **3-2** lists the flow meter and groundwater gauge locations.

EST installed two (2) rain gauges to measure rainfall during the flow-monitoring period. EST installed rain gauges at the following locations:

- One (1) Main St. Pump Station, 130 Main Street providing spatial coverage for the western area of the sewer system.
- One (1) at the rear of 320 Main Street, providing spatial coverage for the eastern area of the sewer system.

EP used the data from the pump stations, flow meters, rain gauges, and groundwater gauges to estimate infiltration and inflow in the sanitary sewer collection system. The data received from EST is included in **Appendix C**, inclusive of site photographs where they installed each meter and gauge. **Figure 3-1** below provides an example of flow data collected at each meter location, with the depth, velocity, and the flow calculated based on the measured items and the geometry of the gravity sewer.

Table 3-1: Flow Meter Locations

Meter Number	Subarea	Manhole ID	Meter ID	Location
1	B	SMH-169	MH-1	90 Main Street, Buzzards Bay
2	D	SMH-174	MH-2	140 Main Street, Buzzards Bay

Table 3-2: Groundwater Gauge Locations

GW Gauge Number	Subarea	Manhole ID	GW Gauge ID	Location
1	B	SMH-169	Meter-1	90 Main Street, Buzzards Bay

Figure 3-1: Typical Flow Meter Data (from Subarea B)

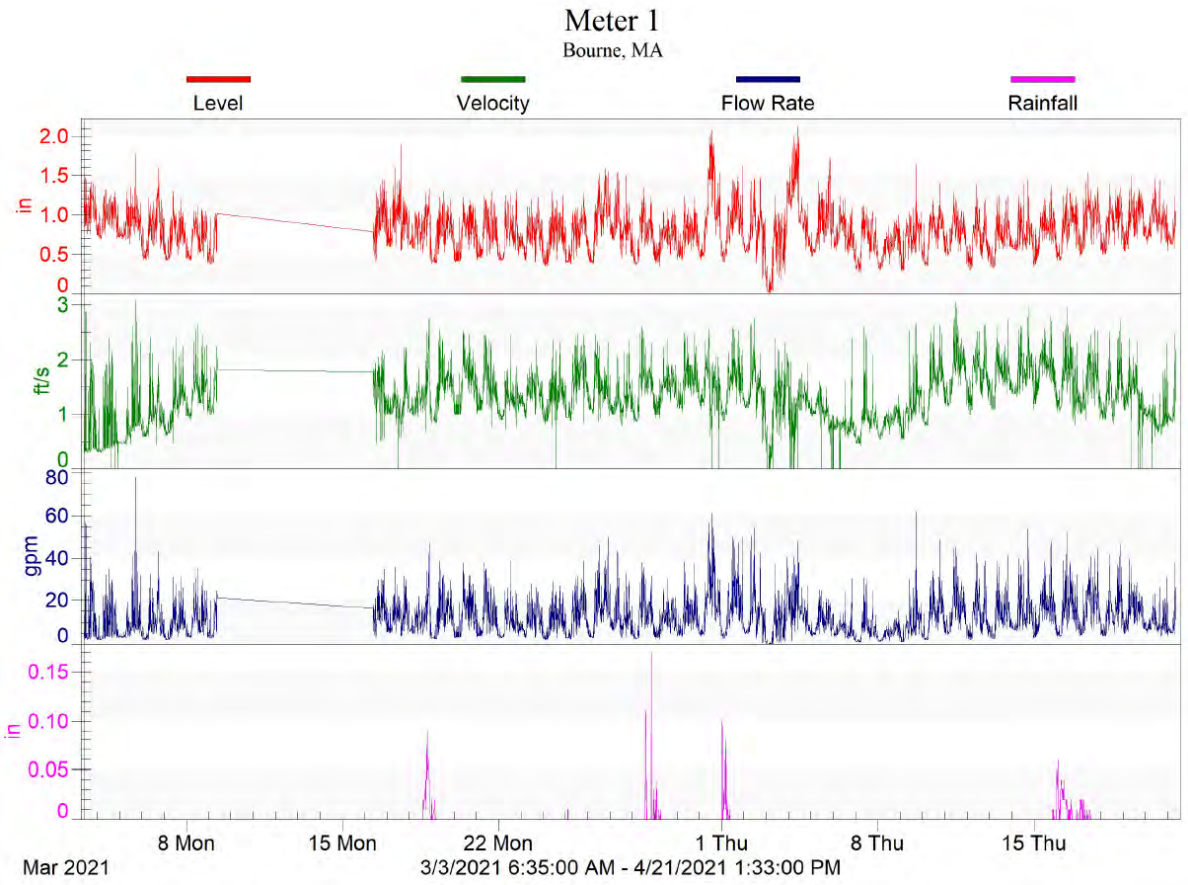


Figure 3-2: Flow Meter Locations

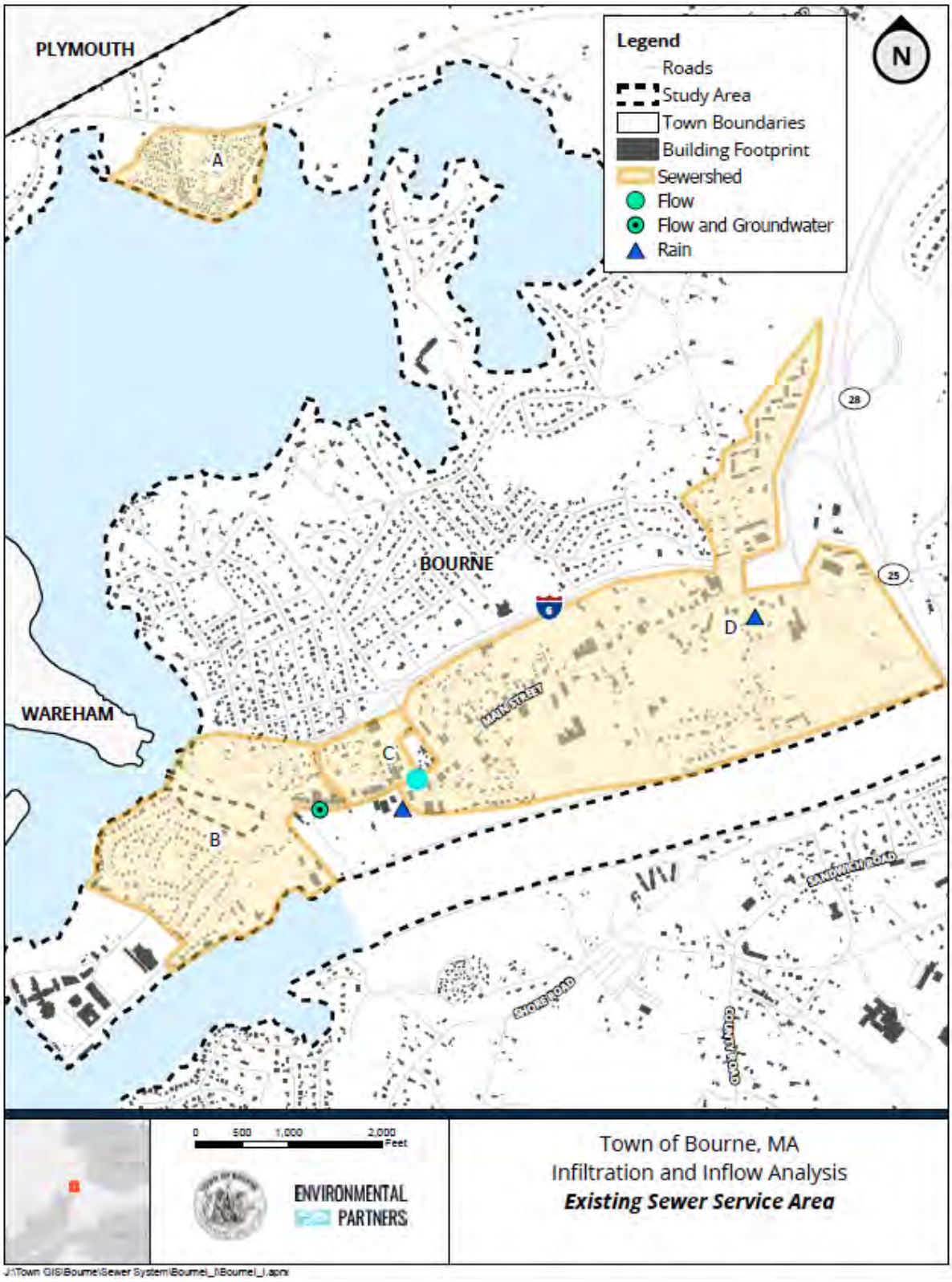


Figure 3-3 displays a composite of the flow data collected during the metering period along with a hyetograph of the rain events. The trend line shows that the overall average flows in the system during the metering period were roughly 0.12 MGD, with the lowest average flows metered mid-March after several weeks of dry weather.

Figure 3-3: Overall Metered Flow

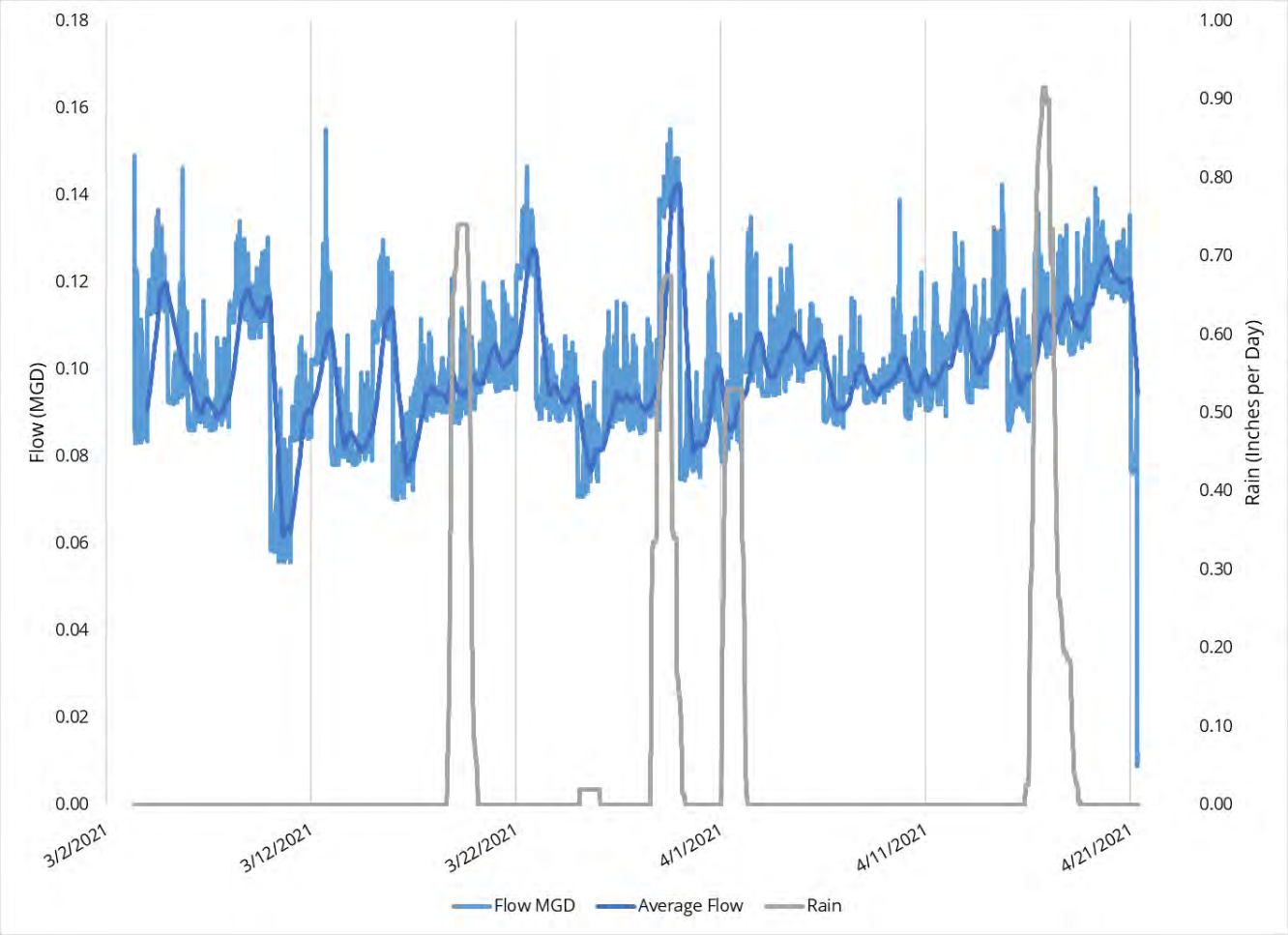
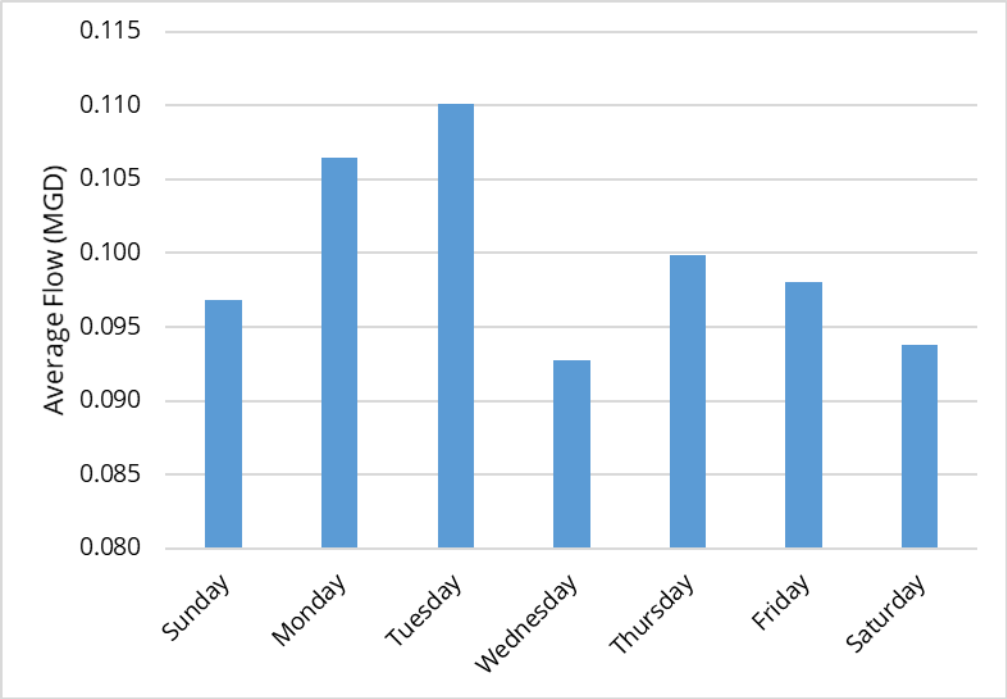


Figure 3-4 shows the average flows during the metering period based on day of the week. Between March and April 2021, the Town's sanitary sewer flowed with greater volumes on Mondays and Tuesdays, with the least volume on Wednesdays.

Figure 3-4: Weekly Flow Pattern



SECTION 3.2 DATA OBSERVATIONS AND CORRECTIONS

EP compared the metered flow data to the collection system network for connectivity to gain a general understanding of sanitary flow potential concerns. In general, raw metered data was used directly for upstream subareas, and the upstream data was subtracted from the raw metered data of downstream subareas. If the system experienced only gravity based flow, each change in upstream flow would directly affect downstream flow, with attenuation proportional to the pipe roughness and the distance traveled. In a system with pump stations, upstream flows accumulate in a wet well prior to the pump engaging, and then flow is dispersed downstream based on the pump hydraulics. When subtracting raw metered upstream data from a downstream subarea that is separated by a pump station, it is reasonable to anticipate ebbs and surges in the calculated downstream data, and negative values can appear in calculated datasets if the data contains surges that compensate for the apparent losses. Although sometimes datasets contain anomalies that are true indicators to the conditions of the system, through logical observation, often the datasets require correction or even omission in the analysis. Revisions and omissions made during this analysis are detailed in this section.

Section 3.2.1 Pump Station Flow Data

The Town tracks the daily total flows from each pump station based on a flow chart recorder located at each station (monitored semi-regularly and changed weekly). To verify order of magnitude measured from the metering program, EP compared the pump station data to the values tracked by the flow meters. EP calculated the average daily flow at each of the evaluated pump stations during the metering period as presented in **Table 3-3** below.

Table 3-3: Pump Station Flow Averages (March – April 2021)

Pump Station Name	Average Gallons per Day	Average Gallons Per Minute
Hideaway Pump Station	8,051	5.6
Main Street Pump Station	91,493	63.1

EP compared the average flow rate from each pump station to the average flow rate per subarea as measured by the flow meters. The data was evaluated for reliability and consistency, and outliers were identified and discussed.

Since Subarea A, the subarea immediately upstream of Hideaway Pump Station (the terminal pump station that carries wastewater out of this area of Town), was not metered by EST, and information about flows in this subarea is limited to the daily flow data collected from the flow chart for the Hideaway Pump Station. Subarea A is privately owned and calculations were not performed for Infiltration and Inflow analysis.

SECTION 4 INFILTRATION DERIVATION

This section details the infiltration analysis performed for the Town sewer system.

SECTION 4.1 INFILTRATION ANALYSIS SUMMARY

Infiltration is groundwater entering the sanitary sewer system through defects in the underground gravity pipes, lateral building connections, manhole structures, and joints. Infiltration varies seasonally increasing as groundwater rises above the collection system infrastructure elevations. Infiltration is determined by finding the average minimum flow rates when water usage is lowest (overnight), during a dry event period, and during high groundwater season (typically in early spring).

Section 4.1.1 Identifying Dry Weather Events

When the rain gauge had been dry for over 72 consecutive hours, EP noted the beginning of a dry weather event in our dataset. Any indication of precipitation effectively "restarted the clock", requiring 72 consecutive hours of consistent dry weather after the precipitation ended until the data period was designated a dry weather event. All infiltration was calculated based on flow in the system during the determined dry weather events.

Table 4-1: Dry Weather Events

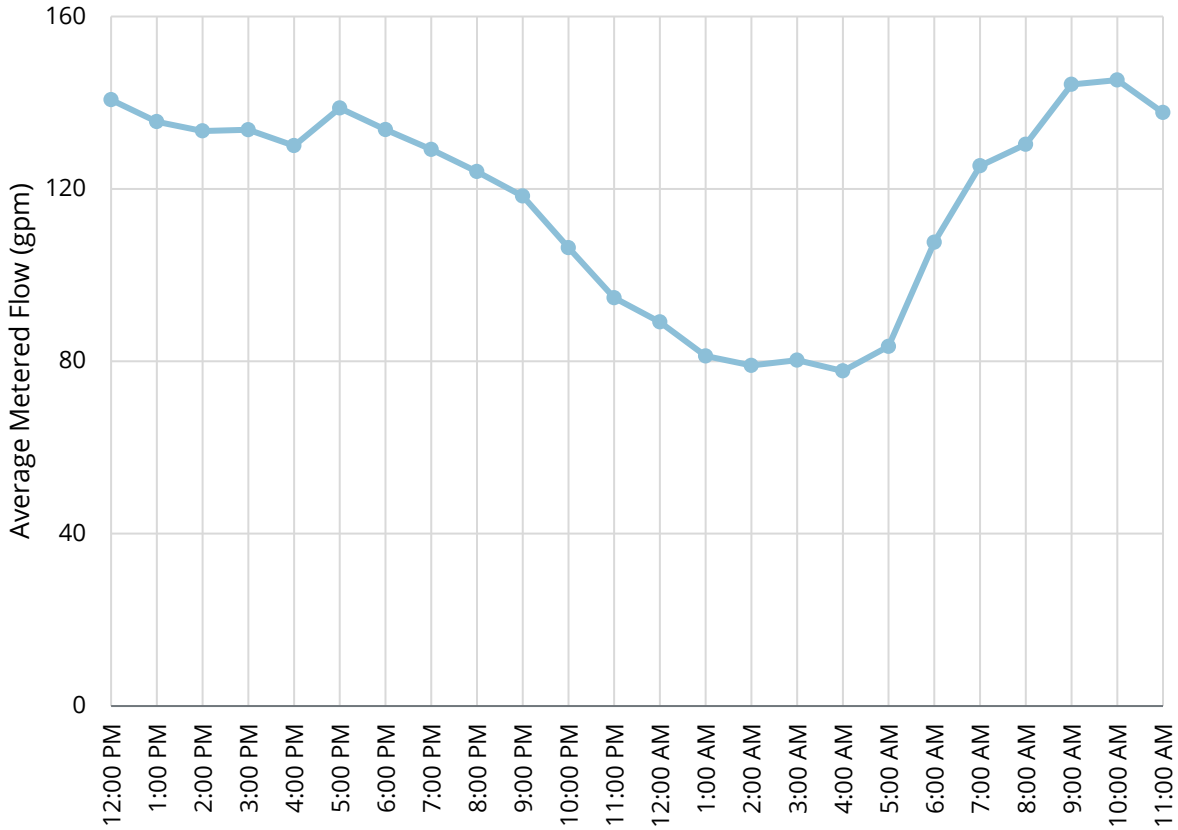
Dry Event	Start of Event	End of Event	Duration (hours)
1	3/3/21 9:00 AM	3/18/21 2:15 PM	365
2	3/19/21 4:00 PM	3/25/21 2:00 AM	130
3	3/25/21 2:25 PM	3/28/21 1:15 PM	71
4	3/29/21 6:30 AM	4/1/21 12:15 AM	66
5	4/1/21 9:00 AM	4/15/21 8:00 PM	347
6	4/17/21 1:00 PM	4/21/21 7:45 AM	91

Section 4.1.2 Identifying Overnight Low Flow

On March 12, 2020, the Governor of Massachusetts issued the first order of provisions and restrictions regarding COVID-19. By March 23, 2020, the Governor's Orders prohibited gatherings of more than 10 people, which inspired many businesses to shift to having employees work remotely (from their homes) when possible. The societal impact of COVID-19 has continued to affect nearly every metric of life, including activities that generate wastewater. Note that flow rates during this year may vary from previous years due to ongoing COVID-19 impacts.

For this analysis, EP calculated the overall average flow per subarea per hour from the dataset. The sum of the average hourly flow per subarea was evaluated to determine the overall daily system flow, by hour, and this was divided by the overall daily-metered total. The period of overnight low flow was determined by the sag in flow rate over a 24-hour span, shown in **Figure 4-1** to occur between midnight and 5:00 AM, during which time sewer activity is at a minimum.

Figure 4-1: Overall Diurnal Flow Trend March through April 2021



Section 4.1.3 Identification of Infiltration

Infiltration flow can be determined during periods of low sewer activity and dry weather flow. Infiltration flow in each subarea determined from the average of each measured flow rate during periods that met that criteria (i.e., periods of both nighttime and dry weather flow). To quantify severity of infiltration, the inch-diameter-mile for each subarea was calculated. An inch-diameter-mile (idm) is a value that represents summation each pipe diameter in the subarea times its length. This value indicates the amount of surface area available for infiltration. Dividing the infiltration flow rate, in this instance given in gallons per day (gpd) by the inch-diameter mile, gives a gpd/idm, a value that can express infiltration on a normalized unit basis. Results of the infiltration analysis are shown in **Table 4-2**.

Table 4-2: Infiltration Results

Subarea	Infiltration (gpd)	idm	gpd/idm
B	16,788	4.30	3,904
C	22,017	3.56	**6,185**
D	60,886	21.06	2,891

SECTION 4.2 INFILTRATION RANKING

Subarea C is experiencing more than 4,000 gpd/idm of infiltration, as highlighted and ranked in **Table 4-2** below. The highest gpd/idm is 6,185, according to data collected.

Table 4-3: Infiltration Ranking

Rank	Subarea	gpd/idm
1	C	**6,185**
2	B	3,904
3	D	2,891

SECTION 5 INFLOW DERIVATION

This section details the inflow analysis performed for the Town sewer system.

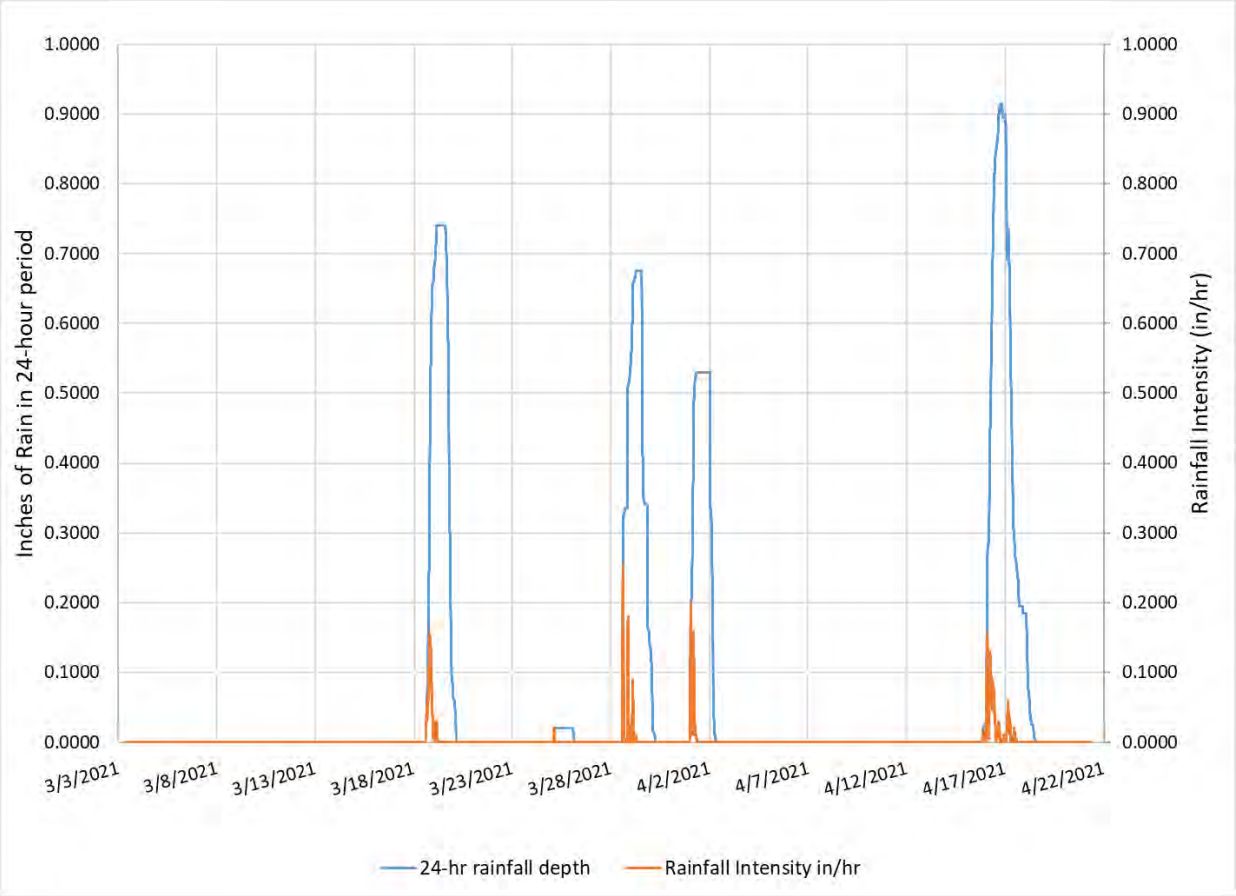
SECTION 5.1 INFLOW ANALYSIS SUMMARY

Inflow is water from a storm event that enters the sanitary sewer from sources such as roof leaders, yard drains, defective manhole covers, and cross connections from stormwater/drainage collection systems. Historically, collection systems were designed and constructed to gather both sanitary sewage and rain water, however that practice is no longer acceptable because the rain water does not need to be treated as wastewater (prior to entering the system) and the costs associated with the surge in system flow contributes significantly to capacity limitations within the collection system. The Bourne sewer system was designed and constructed as a completely separated system; there are no combined sewer overflow structures included in Bourne's system.

Section 5.1.1 Identification of Wet and Dry Weather Events

A composite of the rain gauge data collected during the flow-metering period in **Figure 5-1** are both based on intensity in inches per hour, and in total depth in inches over a rolling 24-hour period.

Figure 5-1: Wet Weather Events



Based on intensity and total rainfall depth over a 24-hour period, EP identified three (3) significant storm events. These two events, including the date of occurrence, peak rainfall intensity, and total rainfall are in **Table 5-1**, along with corresponding dry event. A corresponding dry weather event is one that occurred during similar time of day and day of the week.

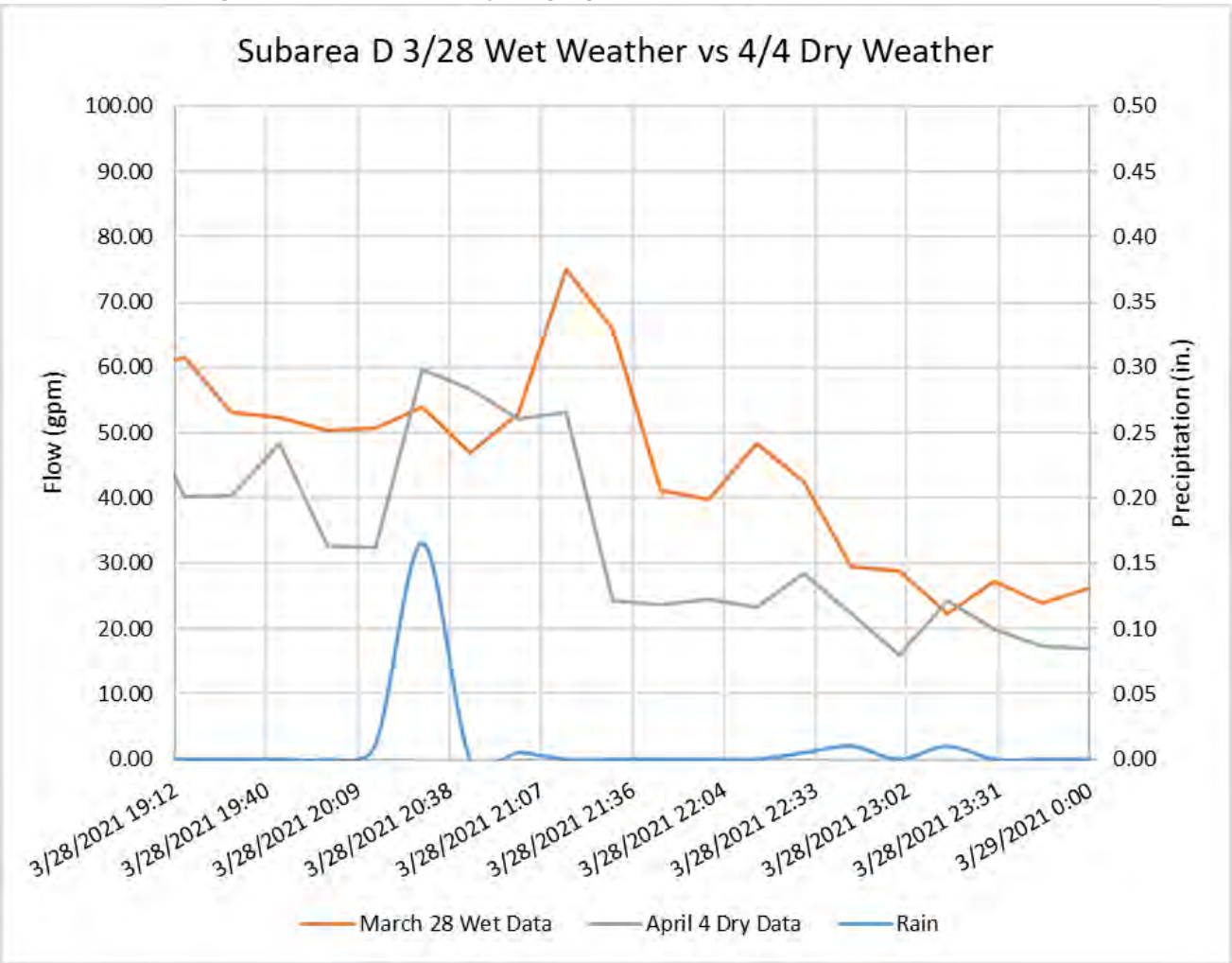
Table 5-1: Inflow Analysis 2021 Wet and Dry Events

Wet Event				Corresponding Dry Event Date	Day of the Week
Event	Peak Intensity (in./hr.)	Rainfall Total (in.)	Date		
1	0.05	1.14	March 18 – 19	March 25 - 26	Thursday - Friday
2	0.04	1.05	March 28 – 29	April 4 - 5	Sunday - Monday
3	0.03	1.60	April 15 - 17	April 8 – 10	Thursday - Saturday

Section 5.1.2 Identification of Inflow

The selection of the corresponding dry event provides a baseline flow to estimate the amount of inflow that occurred during the storm. For example, the hyetograph for Subarea B included in **Figure 5-2** shows the flow rate during the wet weather event on 3/28/2021, the precipitation depth during the wet weather event and the corresponding dry weather flow on 4/4/2021. In this figure, the wet weather flows appear much higher than those of the corresponding dry weather events. This indicates that the discrepancy between these flow rates is a result of inflow into the system from the rain event.

Figure 5-2. Subarea D Hydrograph Events 3/28/2021 vs 4/4/2021



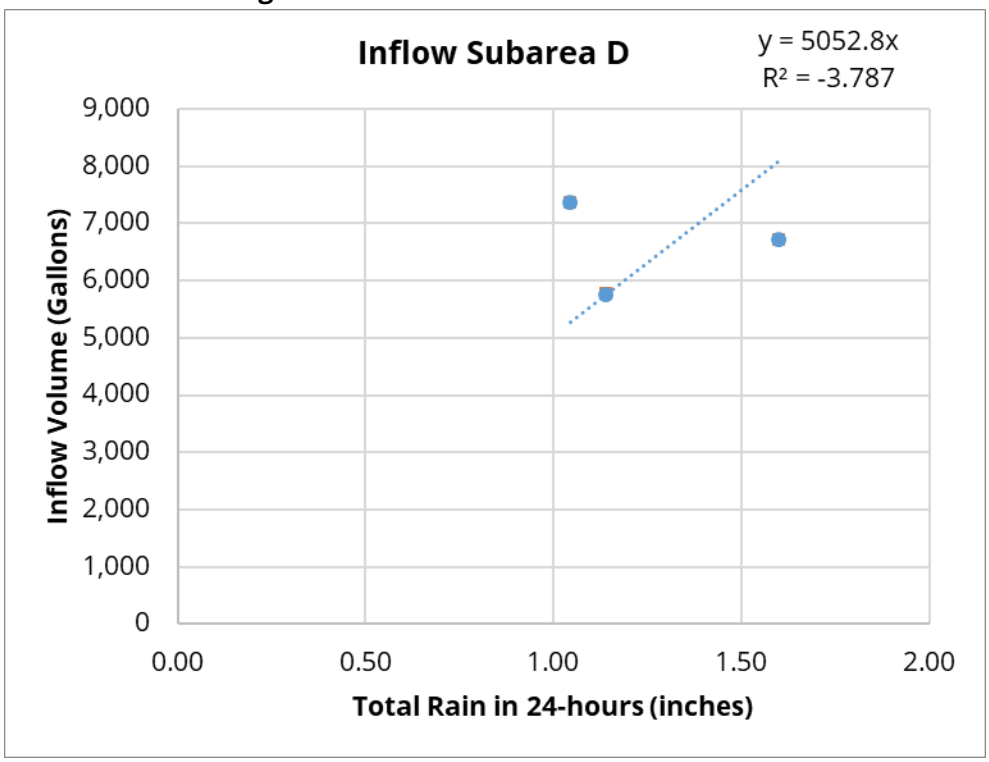
To determine the inflow during each storm, the difference between wet weather and dry weather flow rate was calculated and totaled for each wet weather event in each subarea. Results of this analysis are shown in **Table 5-2**.

Table 5-2: Wet Weather Analysis

Parameter	Event 1	Event 2	Event 3
Intensity (in/hr)	0.05	0.04	0.03
Peak Hour	(19:30)	(21:00)	(4/16, 2:15)
24-hr Total Inches	**1.14**	**1.05**	**1.60**
Rain Day	3/18 - 3/19	3/28 – 3/29	4/15 – 4/17
Dry Day	3/25 – 3/26	4/4 – 4/5	4/8 – 4/10
Subarea	**Inflow (gallons)**		
B	-1,148	3,137	**5,765**
C	**947**	-1,214	**7,368**
D	**14,660**	-3,231	**6,718**

EP developed trend lines for each subarea to show the total rainfall compared to the calculated total inflow. EP set the y-interceptor to zero (0) because when there is no rain there is theoretically no direct inflow. Not all calculated inflow volumes were included for every subarea. Bold values from **Table 5-2** developed the trend lines, and grey values are omitted. **Figure 5-2** shows an example trend line for Subarea B.

Figure 5-3. Subarea D Inflow Trend Line



These trend lines were used to interpolate the expected inflow during a rain event with the depth of the design storm. Results of this analysis are shown in **Table 5-3.**

Per MassDEP Guidelines, the data was adjusted to reflect the expected inflow during both the 5-year, 24-hour Design Storm (total rainfall depth of 4.61 inches, peak hourly intensity of 0.73 inches/hour) and the 1-year, 6-hour Design Storm (total rainfall depth of 1.72 inches, peak hourly intensity of 0.29 inches/hour).

Table 5-3: Inflow Results

Subarea	Design Storm Inflow (gallons)	
	1-yr, 6-hr Storm	5-yr, 24-hr Storm
B	8,037	21,540
C	4,733	12,686
D	8,691	23,294

For further consideration, and because both design storms produce the same ranking of results, EP will consider the inflow from the 1-year 6-hour storm as the inflow of the subarea.

SECTION 5.2 INFLOW RANKING

Expected inflow for each Subarea from the 1-year, 6-hour Design Storm is ranked greatest to least in **Table 5-4**.

Table 5-4: Ranked Inflow Results

Rank	Subarea	Design Storm Inflow (gallons)	% of Total
1	D	8,691	40%
2	B	8,037	37%
3	C	4,733	22%

SECTION 6 I/I SUMMARY

This section compiles the results of the infiltration and inflow analysis into a comprehensively ranked list.

SECTION 6.1 ANALYSIS SUMMARY

To develop a general condition assessment of each subarea based on the I/I Analysis, EP considered the subareas' rank for both infiltration and inflow, as shown in **Table 6-1** below. Because there was limited information available for Subarea A, EP assigned Subarea A as an area in need of further investigation.

Table 6-1: Subareas I/I Rank

Subarea	Inflow Rank	Infiltration Rank	Further Investigation Need[1]
B	**2**	**2**	**4**
C	3	**1**	**4**
D	**1**	3	**4**

1. Further Investigation Need is the summation of the ranks from inflow and infiltration.

The subareas were listed based on their further investigation need, with the lowest value having the greatest need, as shown in **Table 6-2** below.

Table 6-2: Further Investigation Rank

Further Investigation Rank	Subarea	Further Investigation Need Based on I/I Analysis
1	C	Mostly Infiltration Needs
2	D	Mostly Inflow Needs
3	B	Infiltration and Inflow Needs

This I/I based ranking provides a basis for assigning priority to the areas of the sewer system with the greatest need. As the town addresses needs in the priority subareas, the needs will develop further down the list. Therefore, this list can be used as a tool to develop a plan.

SECTION 6.2 RECOMMENDATIONS

EP recommends the Town of Bourne investigate 20% of their sanitary sewer collection system on an annual basis. Highest priority for further investigation should be given to the subareas that experienced the most severe infiltration and inflow rates. Using the ranking developed from the I/I analysis as the basis of priority EP prepared a plan for inspection and rehabilitation of the entire gravity wastewater system over a two year period. **Table 6-3** shows this plan.

Section 6.2.1 Year 1 and Year 2 Projects

Subareas B and C were combined as they are both relatively smaller than Subarea D. The plan will be to CCTV and repair or rehabilitate mains and connections at the same time to address issues immediately and reduce overall cost of the projects.

Table 6-3: Future Collection System Planning

Rank	Subarea	Linear Feet	% of Total	Investigate
1	B & C	5,082	29%	Year 1
2	D	12,746	71%	Year 2
	Total	17,828		

With this approach, the Town can develop an annual investigation budget to comprehensively identify both I/I and structural needs within the system. By focusing first on the priority areas identified in this analysis, the Town will identify their known I/I defects efficiently and within a reasonable budget for a system of this size. Additionally, reduction of I-I flows reduces the amount of flow sent to Wareham, making the inspection and repairs a cost effective way to manage wastewater flows.

Environmental Partners approach will be as follows:

1. **Year 1 – Subareas B & C work and assumptions**
    a. The preparation of specifications and GIS mapping for cleaning, CCTV inspection, identification and repair of damaged sewers, manholes, sewer connections and sewer laterals. Bidding oversight, construction administration and assistance on interpretation of damage and resident project representation for 2 months five days a week for 8 hours per day.
    b. Assumptions have been made for the extent of rehabilitation required based on age, material and initial metering program.
    c. As stated in Section 2.3, some additional investigation is required at the Taylor's Point Marina sewer connection, including dye testing and service line locating for inspection and possible repair. Approximate costs for this investigation is included in the cost estimate for Subarea B.
    d. **Table 6-4** presents the Opinion of Construction Costs and engineering fees. OPCC is based on recently bid similar projects. The costs of the construction could vary greatly due to the high volatile nature of the construction market. Costs are based on Turner Construction Index of 1187.

Table 6-4: Subareas B & C CCTV Inspection & Rehabilitation OPCC

Item No.	Item Description and Unit Price in Words	Units	Estimated Quantity - Subareas B and C	OPCC	
				Unit Price	Extended Amount
1	Mobilization and Demobilization	LS	1	$20,000.00	$20,000.00
2	Light Cleaning (6"-12" Sewer Mains)	LF	2,582	$2.00	$5,164.00
3	Heavy Cleaning (all sizes, as directed)	LF	2,500	$5.00	$12,500.00
4	CCTV Inspection (6"- 12" Sewer Mains)	LF	2,582	$2.00	$5,164.00
5	Mechanical Root Removal (All Sizes, Sewer Mains)	LF	100	$20.00	$2,000.00
6	Chemical Root Treatment (6"-12" Sewer Mains)	LF	100	$3.00	$300.00
7A	CIPP Structural Continuous Liner, 8-inch Sewer Pipe	LF	508	$32.00	$16,300.00
7B	CIPP Structural Continuous Liner, 12-inch Sewer Pipe	LF	102	$36.00	$3,672.00
7C	Remove and Replace, 8"	LF	50	$200.00	$10,000.00
7D	Remove and Replace, 12"	LF	20	$240.00	$4,800.00
8	Cutting Protruding Taps	EA	50	$50.00	$2,500.00
9	Reinstate Service Connections	EA	60	$105.00	$6,300.00
10	Grout Service Connections	EA	60	$260.00	$15,600.00
11	Chemical Grout	GAL	760	$5.00	$3,800.00
12	6" Lateral Lining	EA	1	$7,200.00	$7,200.00
13	Remove and Replace Gravity Sewer Manhole	EA	1	$17,199.00	$17,199.00
14	Remove and Replace Frame and Cover	EA	10	$1,047.50	$10,475.00
15	Remove and Reset Frame and Cover	EA	3	$682.50	$2,047.50
16	Furnish and Install Service Lateral Lining up to One (1) Linear Foot into Existing Service Connection	EA	5	$3,500.00	$17,500.00
17	Furnish and Install Service Lateral Lining Beyond One (1) Linear Foot into Existing Service Connection	LF	120	$50.00	$6,000.00
18	Sewer Manhole Cementitious Lining	EA	25	$170.00	$4,250.00
19	Exterior Manhole Grouting and Interior Crack Sealing to Stop Leaks	EA	2	$750.00	$1,500.00
20	Rebuild Bench and Invert	EA	5	$500.00	$2,500.00
21	Internal Chimney Seal	EA	30	$350.00	$10,500.00
22	Sewer Manhole Epoxy Lining	EA	5	$490.00	$2,450.00
23	Temporary Trench Paving	SY	100	$30.00	$3,000.00
24	Permanent Trench Paving	SY	100	$30.00	$3,000.00
25	Uniformed Police Officers	HOUR	300	$60.00	$18,000.00
26a	Taylor Point Dye-Testing at Pump Station.	Days	1	$1,000.00	$1,000.00
26b	Allowance for Taylor Point sewer repair and electrical upgrades at the submerged pump station	LS	1	$17,240.00	$17,240.00
27	Miscellaneous Work Items	LS	1	$1,000.00	$1,000.00
			TOTAL		**$233,000.00**
			Construction Contingency		**$23,300.00**
			Estimated Engineering Services (design, const. admin, Resident Project Representation, GIS record update)	**$**	**61,200.00**
			Total Project Cost		**$317,500.00**

2. Year 2 – Subarea D work and assumptions

a. The preparation of specifications and GIS mapping for cleaning, CCTV inspection, identification and repair of damaged sewers, manholes, sewer connections and sewer laterals. Bidding oversight, construction administration and assistance on interpretation of damage and resident project representation for 3 months five days a week for 8 hours per day.

b. Assumptions have been made for the extent of rehabilitation required based on age, material and initial metering program.

Table 6-5, located on the next page, presents the Opinion of Construction Costs and engineering fees. OPCC is based on recently bid similar projects. The costs of the construction could vary greatly due to the high volatile nature of the construction market. Costs are based on Turner Construction Index of 1187.

Table 6-5: Subarea D CCTV Inspection & Rehabilitation OPCC

Item No.	Item Description and Unit Price in Words	Units	Estimated Quantity - Subarea D	OPCC	
				Unit Price	Extended Amount (Rounded up)
1	Mobilization and Demobilization	LS	1	$20,000.00	$20,000.00
2	Light Cleaning (6"-12" Sewer Mains)	LF	10,246	$2.00	$20,492.00
3	Heavy Cleaning (all sizes, as directed)	LF	2,500	$5.00	$12,500.00
4	CCTV Inspection (6"- 12" Sewer Mains)	LF	10,246	$2.00	$20,492.00
5	Mechanical Root Removal (All Sizes, Sewer Mains)	LF	100	$20.00	$2,000.00
6	Chemical Root Treatment (6"-12" Sewer Mains)	LF	100	$3.00	$300.00
7A	CIPP Structural Continuous Liner, 6-inch Sewer Pipe	LF	34	$32.00	$1,100.00
7B	CIPP Structural Continuous Liner, 8-inch Sewer Pipe	LF	965	$34.00	$32,900.00
7C	CIPP Structural Continuous Liner, 10-inch Sewer Pipe	LF	57	$36.00	$2,052.00
7D	CIPP Structural Continuous Liner, 12-inch Sewer Pipe	LF	219	$36.00	$7,900.00
8A	Remove and Replace, 6"	LF	34	$200.00	$6,760.00
8B	Remove and Replace, 8"	LF	96	$200.00	$19,298.00
8C	Remove and Replace, 10"	LF	6	$240.00	$1,368.00
8D	Remove and Replace, 12"	LF	22	$240.00	$5,300.00
9	Cutting Protruding Taps	EA	50	$50.00	$2,500.00
10	Reinstate Service Connections	EA	100	$105.00	$10,500.00
11	Grout Service Connections	EA	100	$260.00	$26,000.00
12	Chemical Grout	GAL	760	$5.00	$3,800.00
13	6" Lateral Lining	EA	1	$7,200.00	$7,200.00
14	Remove and Replace Gravity Sewer Manhole	EA	1	$17,199.00	$17,199.00
15	Remove and Replace Frame and Cover	EA	10	$1,047.50	$10,475.00
16	Remove and Reset Frame and Cover	EA	3	$682.50	$2,047.50
17	Furnish and Install Service Lateral Lining up to One (1) Linear Foot into Existing Service Connection	EA	5	$3,500.00	$17,500.00
18	Furnish and Install Service Lateral Lining Beyond One (1) Linear Foot into Existing Service Connection	LF	150	$50.00	$7,500.00
19	Sewer Manhole Cementitious Lining	EA	25	$170.00	$4,250.00
20	Exterior Manhole Grouting and Interior Crack Sealing to Stop Leaks	EA	2	$750.00	$1,500.00
21	Rebuild Bench and Invert	EA	5	$500.00	$2,500.00
22	Internal Chimney Seal	EA	30	$350.00	$10,500.00
23	Sewer Manhole Epoxy Lining	EA	5	$490.00	$2,450.00
24	Temporary Trench Paving	SY	100	$30.00	$3,000.00
25	Permanent Trench Paving	SY	100	$30.00	$3,000.00
26	Uniformed Police Officers	HOUR	300	$60.00	$18,000.00
28	Miscellaneous Work Items	LS	1	$1,000.00	$1,000.00
			TOTAL	**$**	**303,400.00**
			Construction Contingency	**$**	**30,340.00**
			Estimated Engineering Services (design, const. admin, Resident Project Representation, GIS record update)	**$**	**87,900.00**
			Total Project Cost	**$**	**421,600.00**

Section 6.2.2 Additional Investigations for Subsequent Years

The focus of this report is on the gravity sewer system, associated MHs and sewer connections as it relates to potential locations of infiltration and inflow in the existing wastewater system. Hydrogen sulfide has been problematic for the Town over the years. This is not uncommon for a seasonal community are a community with low pressure systems. If sewage sites for a period of time an increase in hydrogen sulfide is created in the sewage. The recommended Year 1 and Year 2 rehabilitation includes epoxy lining for the MHs which receive flow from the low pressure sewer systems. These areas are:

- Main Street West (SMH #191)
- Taylor's Point (SMH #168)
- Everett Road and Perry Ave (SMH #43)
- Old Bridge Road & Main Street East (SMH #99)

It is recommended that additional analysis be conducted on the ductile iron force main from Hideaway Village Pump station and ductile iron force main from the Main St Pump Station. These are the only pipes that transports wastewater from these areas to the Wareham water treatment plant. Since hydrogen sulfide has been problematic for the Town it is important to determine if any of the force mains have been exposed and have the potential for failure. EP recommends the Town conduct a condition assessment on both force mains. This assessment would require bypass pumping of flows, CCTV inspection and taking a sample of the pipe material. The sample will assist in confirming its structural integrity. Additional information would be needed to prepare an opinion of cost for this work.

APPENDIX A
Hydrographs

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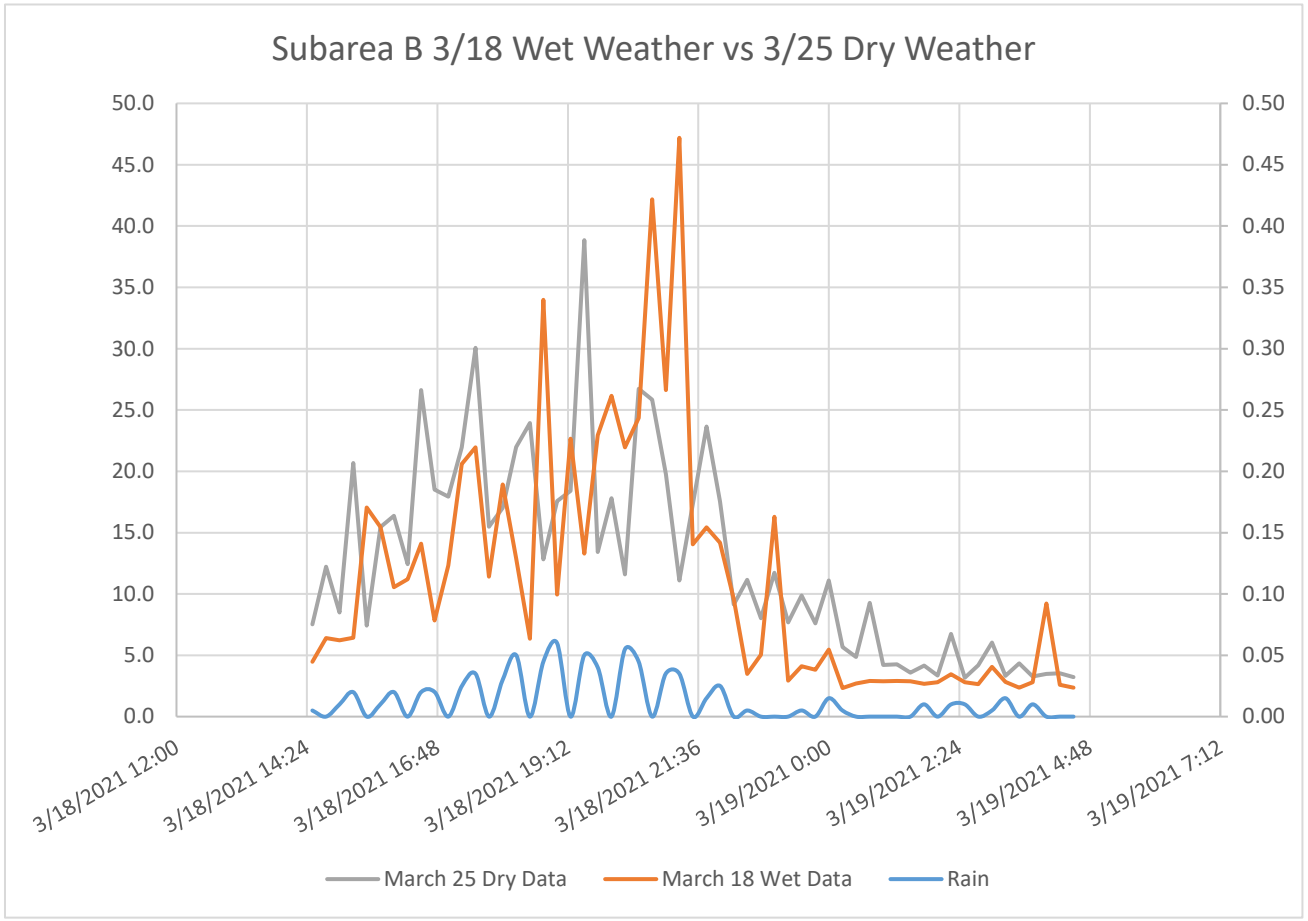
Subarea B 3/18 Wet Weather vs 3/25 Dry Weather
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40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
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0.40
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0.00
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3/18/2021 16:48
3/18/2021 19:12
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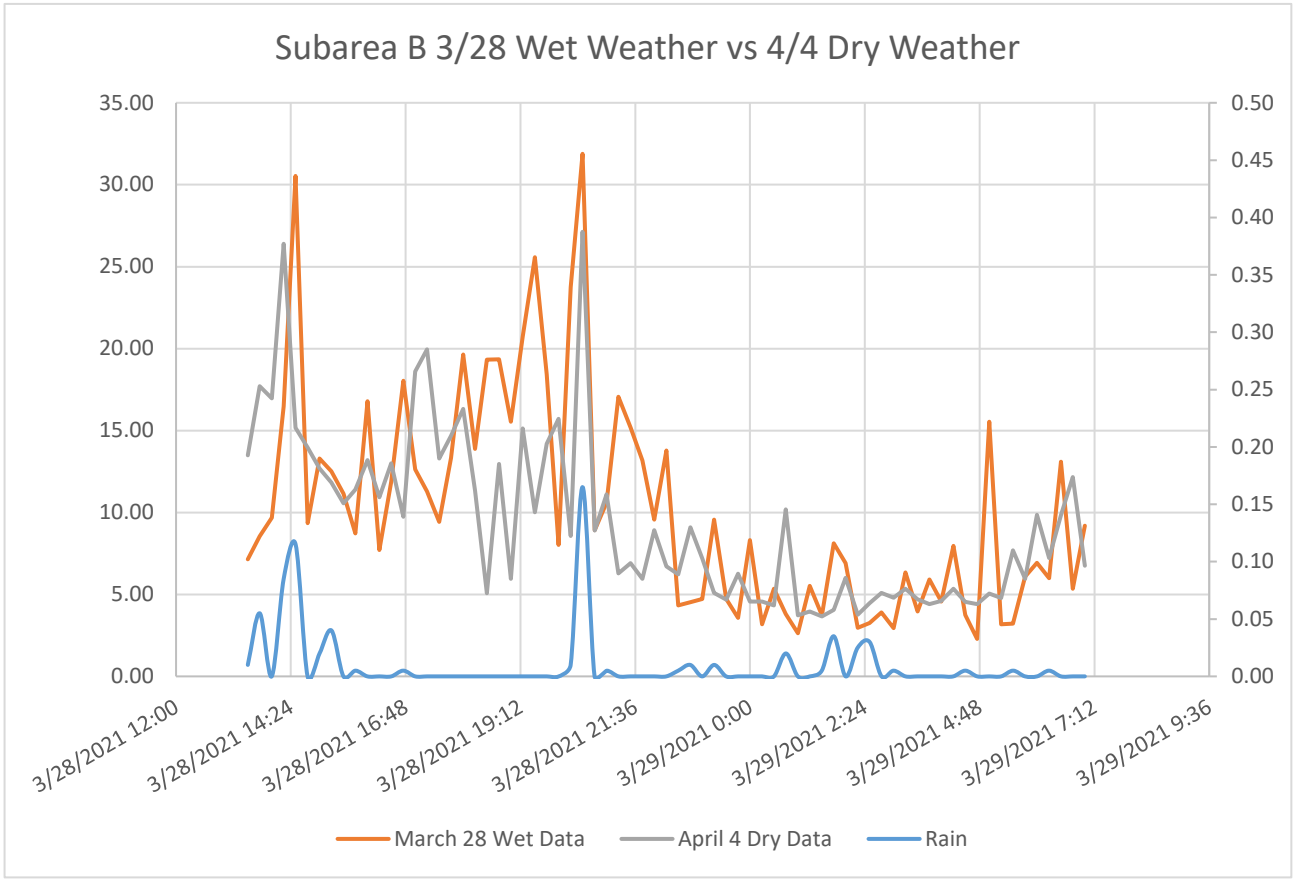
March 25 Dry Data
March 18 Wet Data
Rain


Subarea B 3/28 Wet Weather vs 4/4 Dry Weather
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3/28/2021 12:00
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3/28/2021 16:48
3/28/2021 19:12
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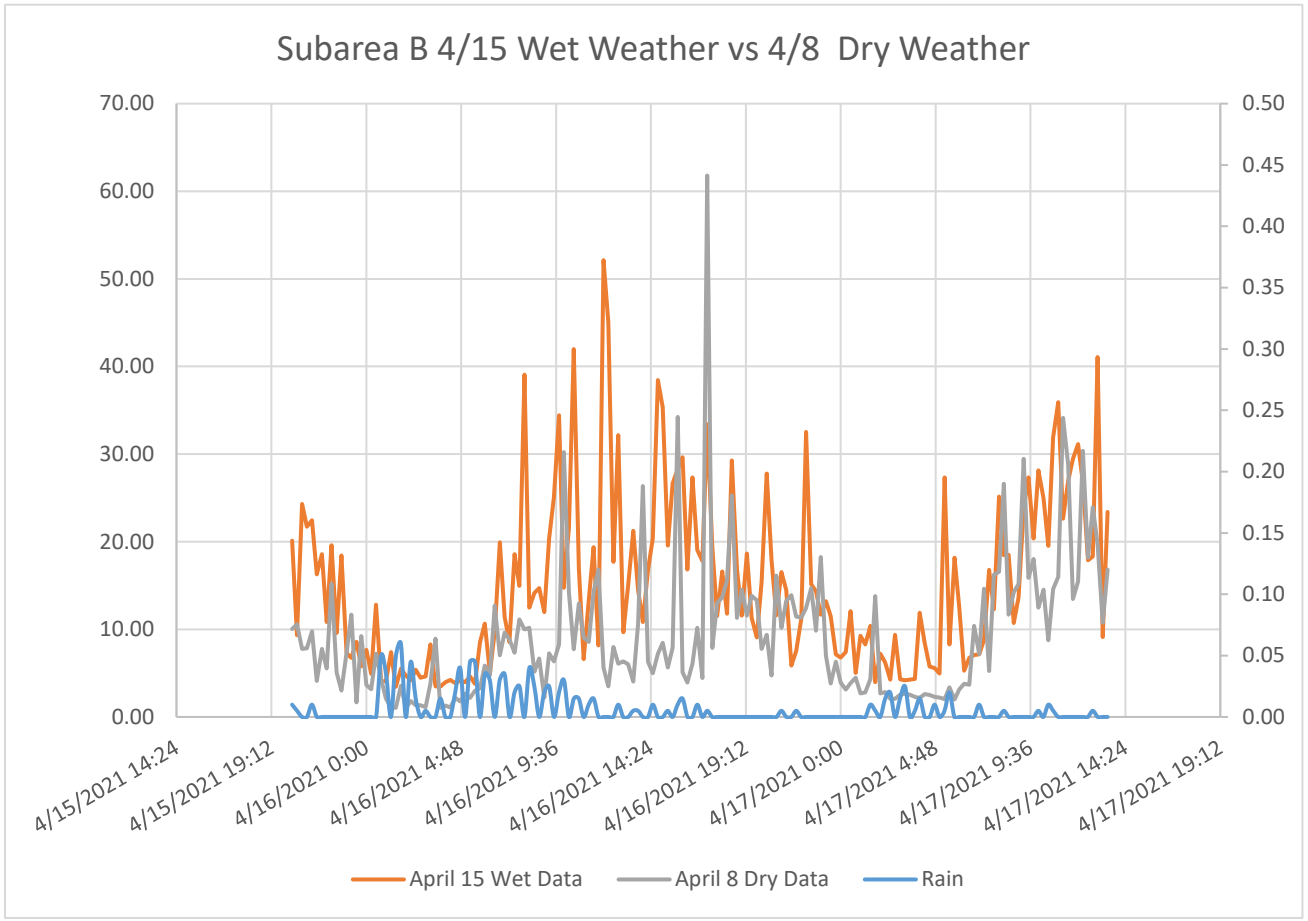
March 28 Wet Data
April 4 Dry Data
Rain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4/15/2021 14:24
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4/16/2021 4:48
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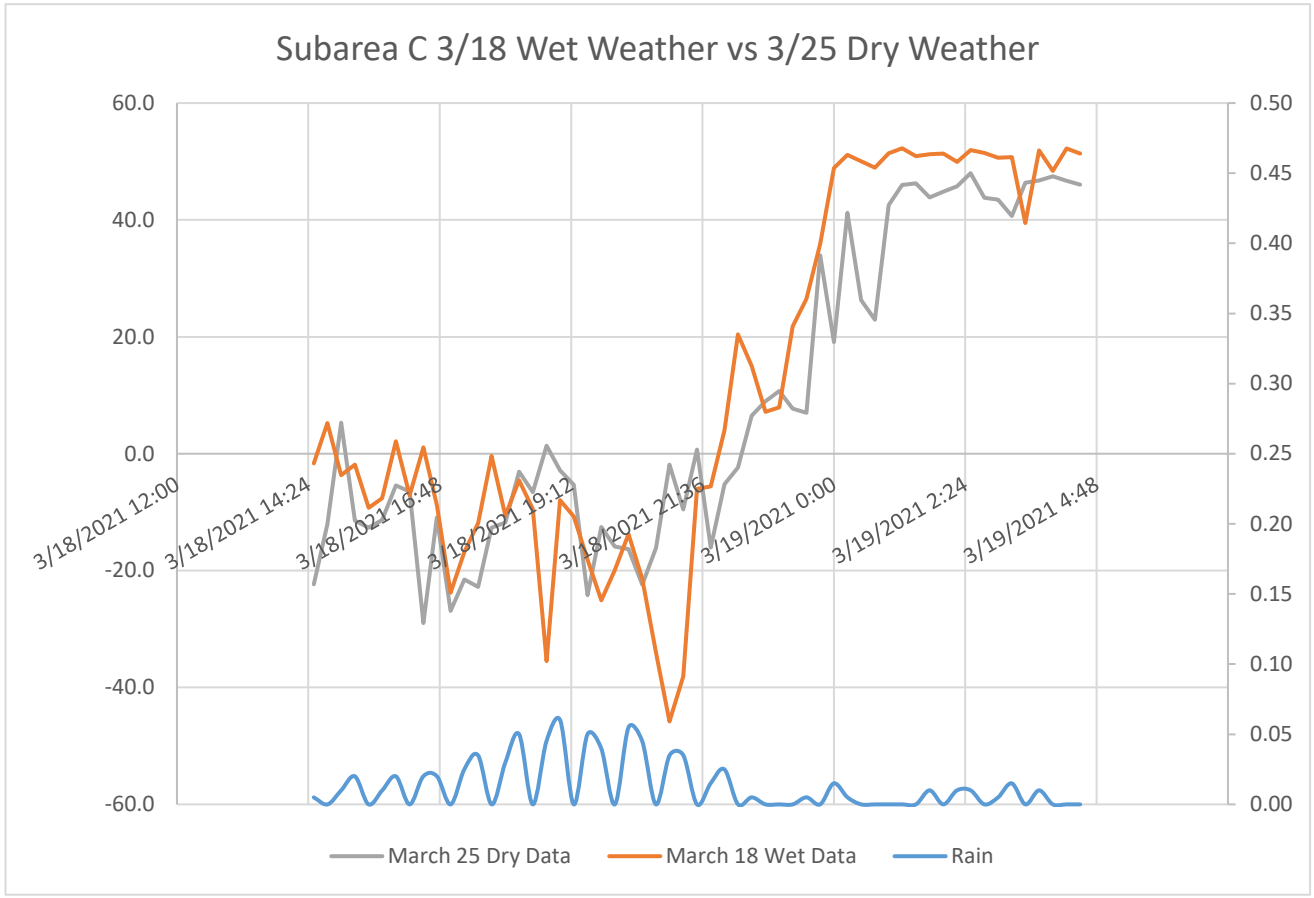
April 15 Wet Data
April 8 Dry Data
Rain


Subarea C 3/18 Wet Weather vs 3/25 Dry Weather
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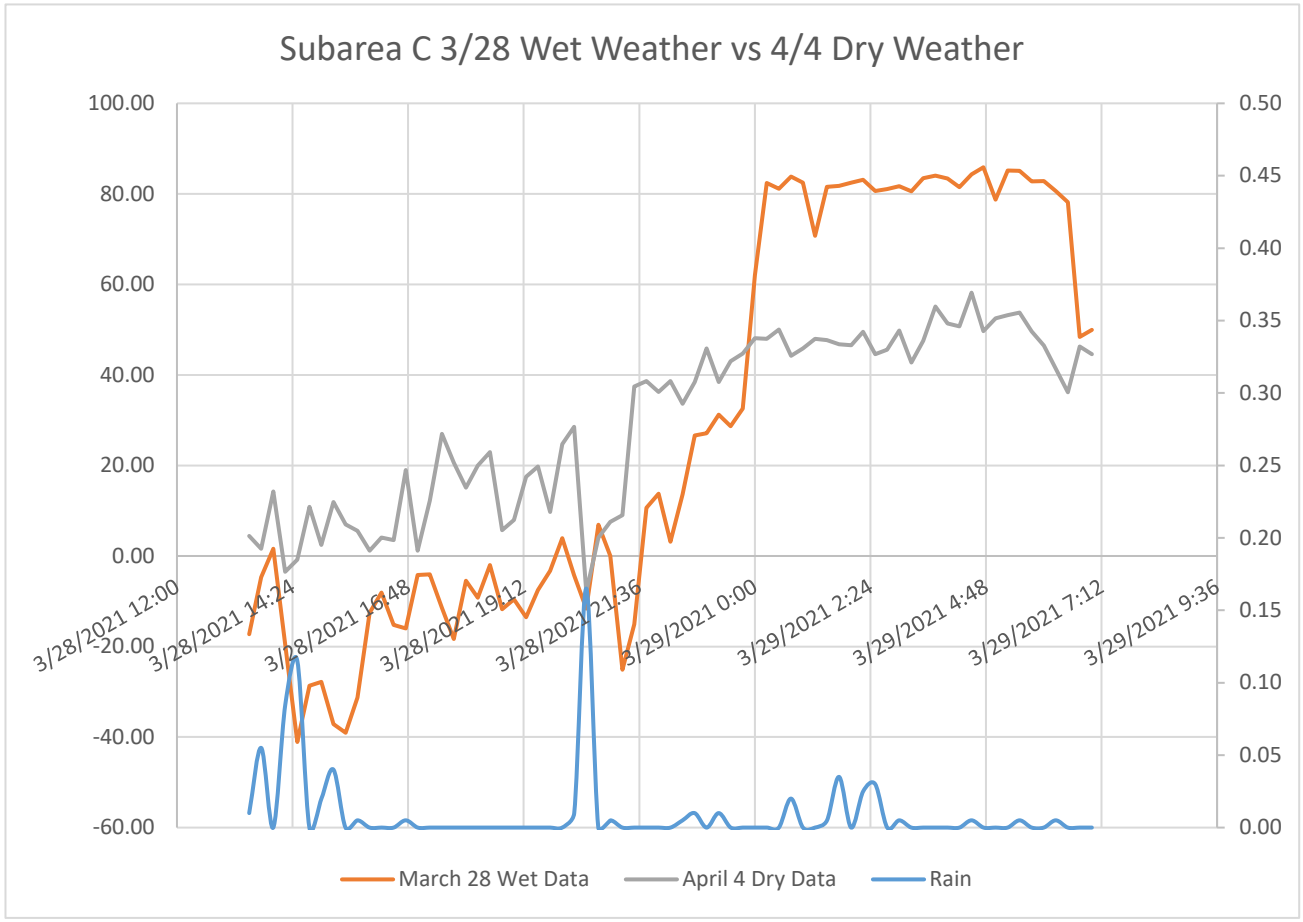
March 18 Wet Data
Rain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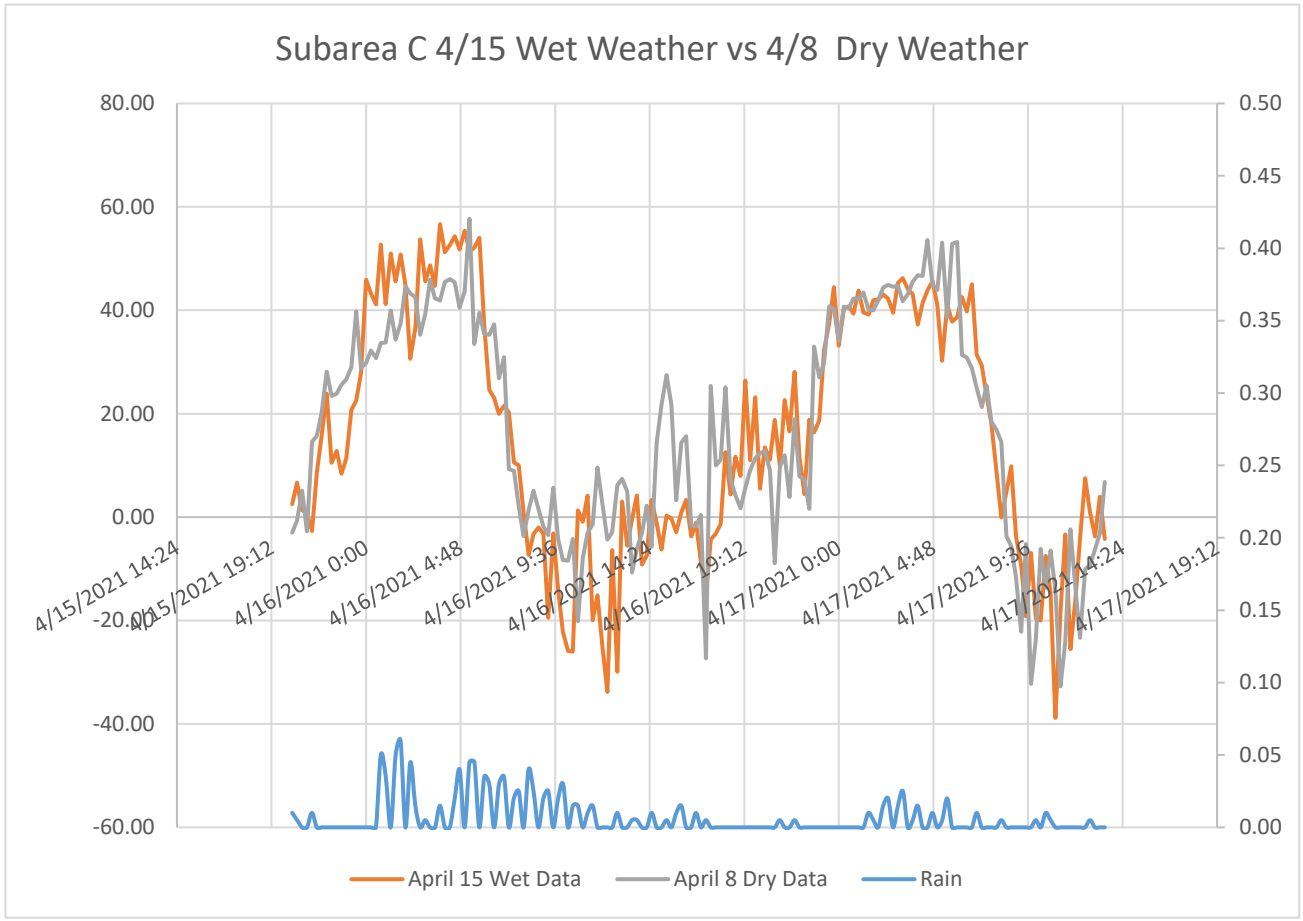
March 28 Wet Data
April 4 Dry Data
Rain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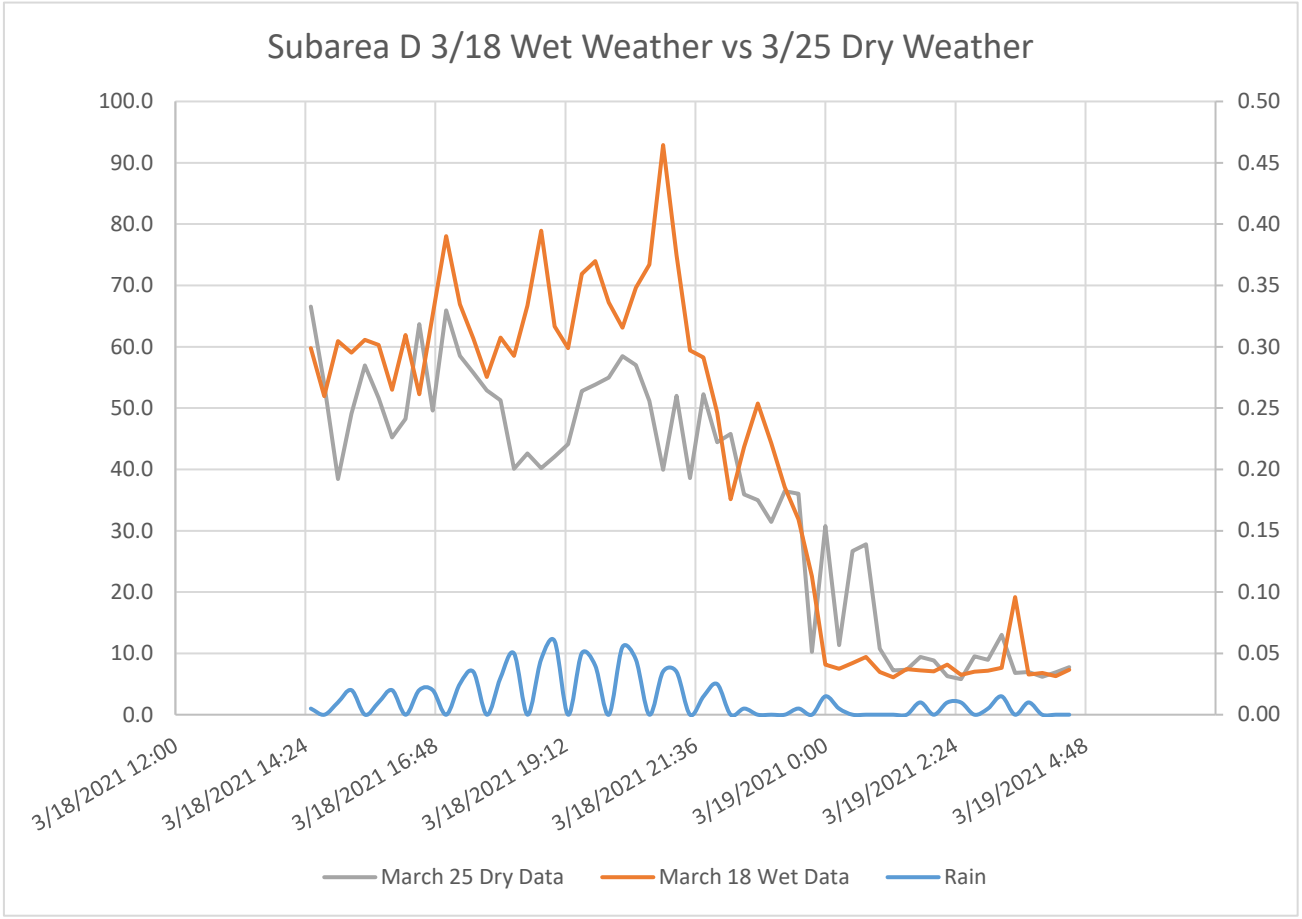
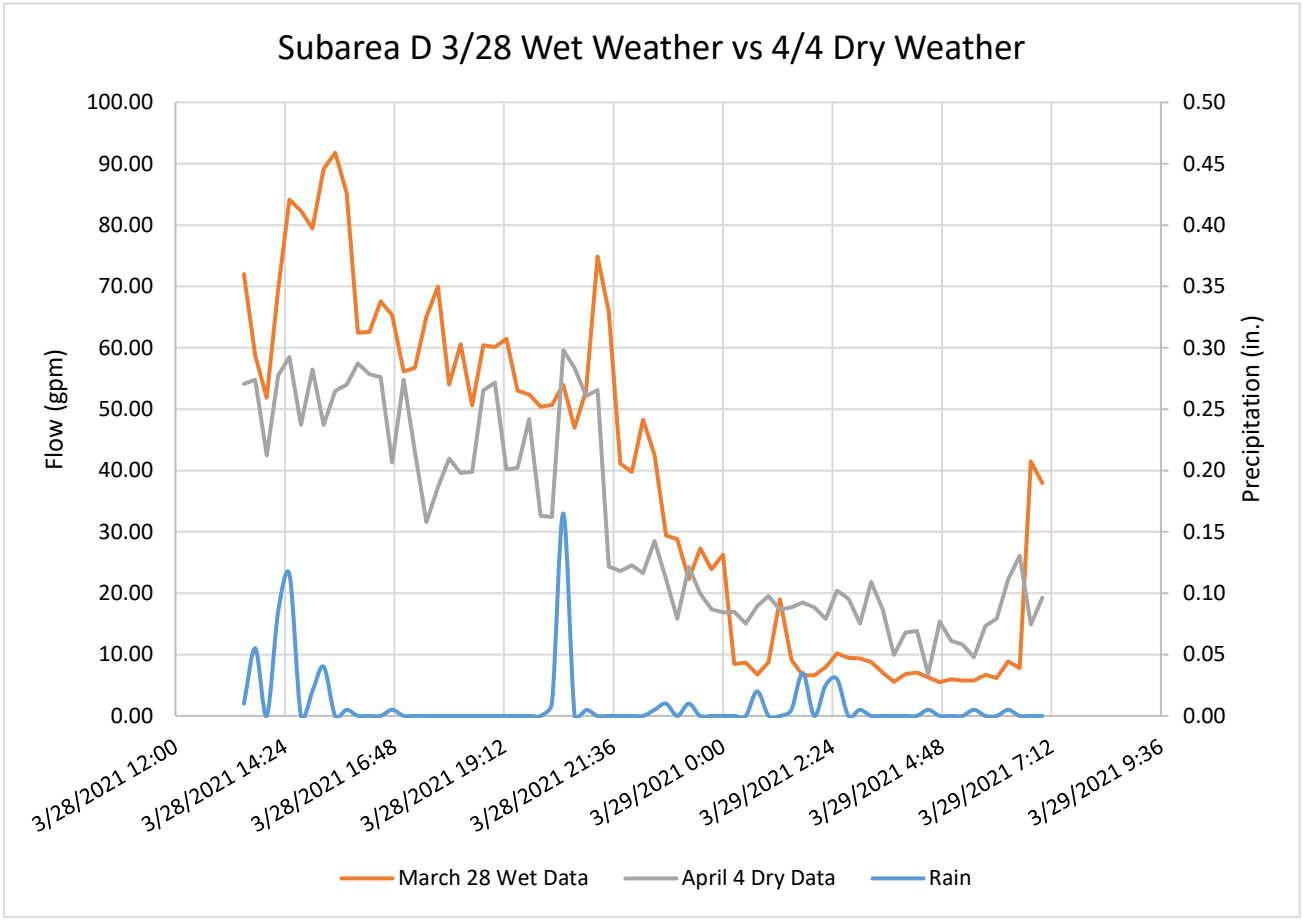
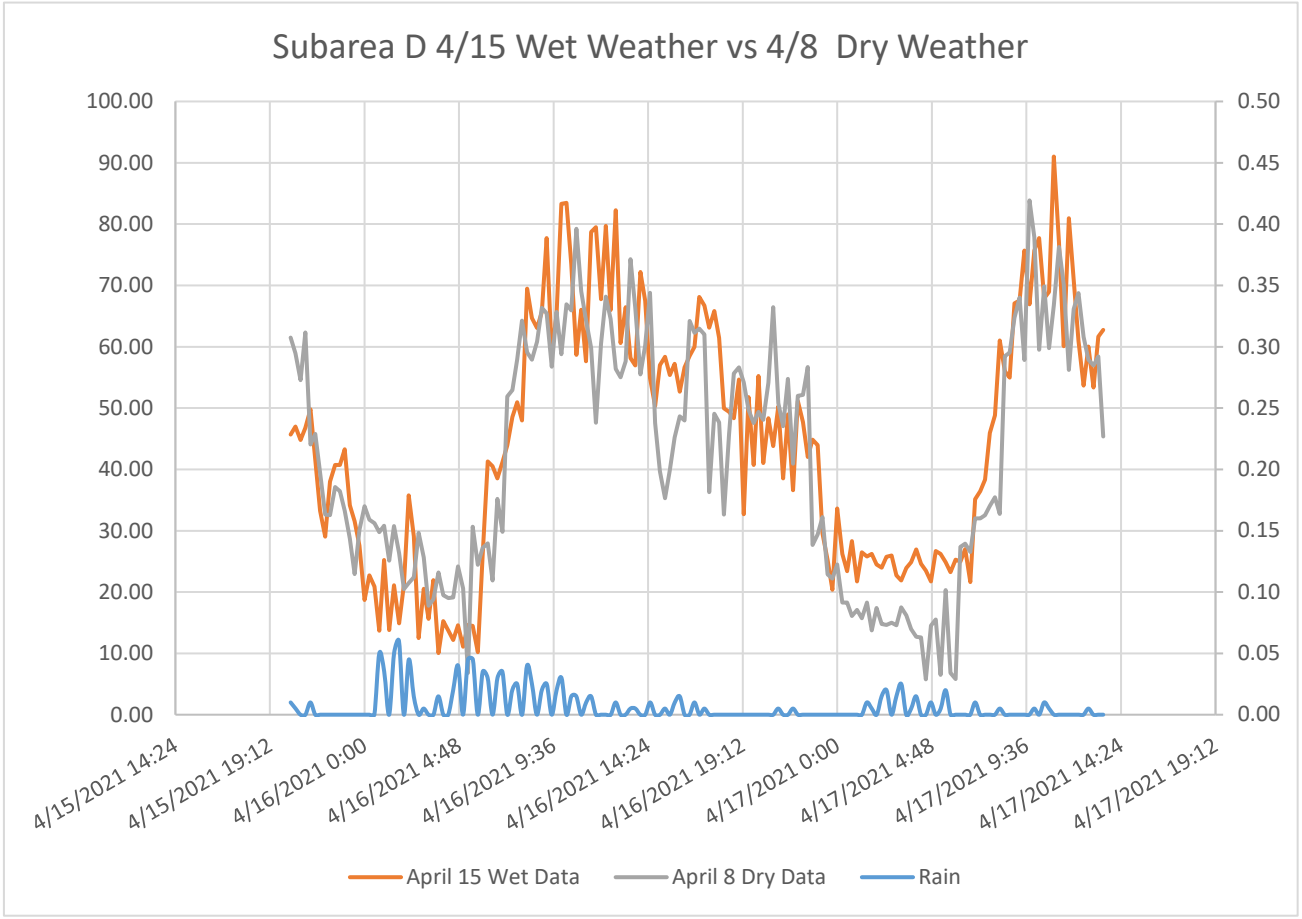
4/17/2021 4:48
4/17/2021 9:36
4/17/2021 14:24
4/17/2021 19:12
April 15 Wet Data
April 8 Dry Data
Rain


Subarea D 3/18 Wet Weather vs 3/25 Dry Weather
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
3/18/2021 12:00
3/18/2021 14:24
3/18/2021 16:48
3/18/2021 19:12
3/18/2021 21:36
3/19/2021 0:00
3/19/2021 2:24
3/19/2021 4:48
March 25 Dry Data
March 18 Wet Data
Rain


Subarea D 3/28 Wet Weather vs 4/4 Dry Weather
Flow (gpm)
Precipitation (in.)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
3/28/2021 12:00
3/28/2021 14:24
3/28/2021 16:48
3/28/2021 19:12
3/28/2021 21:36
3/29/2021 0:00
3/29/2021 2:24
3/29/2021 4:48
3/29/2021 7:12
3/29/2021 9:36
March 28 Wet Data
April 4 Dry Data
Rain


Subarea D 4/15 Wet Weather vs 4/8 Dry Weather
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
4/15/2021 14:24
4/15/2021 19:12
4/16/2021 0:00
4/16/2021 4:48
4/16/2021 9:36
4/16/2021 14:24
4/16/2021 19:12
4/17/2021 0:00
4/17/2021 4:48
4/17/2021 9:36
4/17/2021 14:24
4/17/2021 19:12
April 15 Wet Data
April 8 Dry Data
Rain

APPENDIX B

Inflow Calculation Graphs

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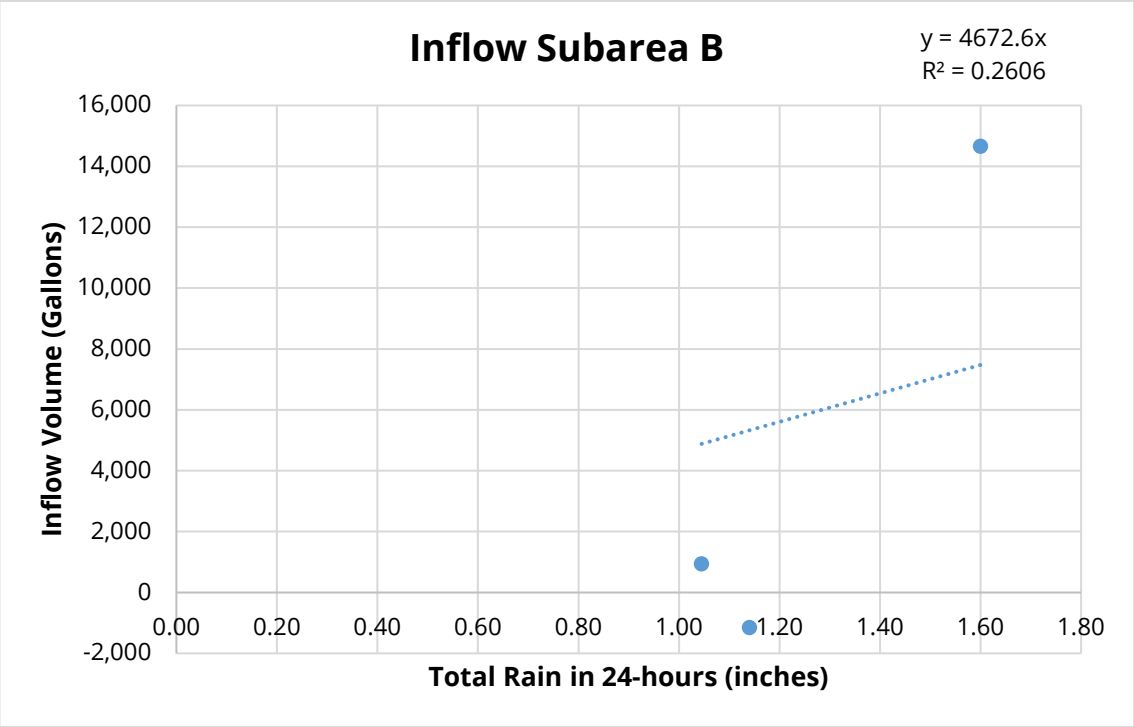
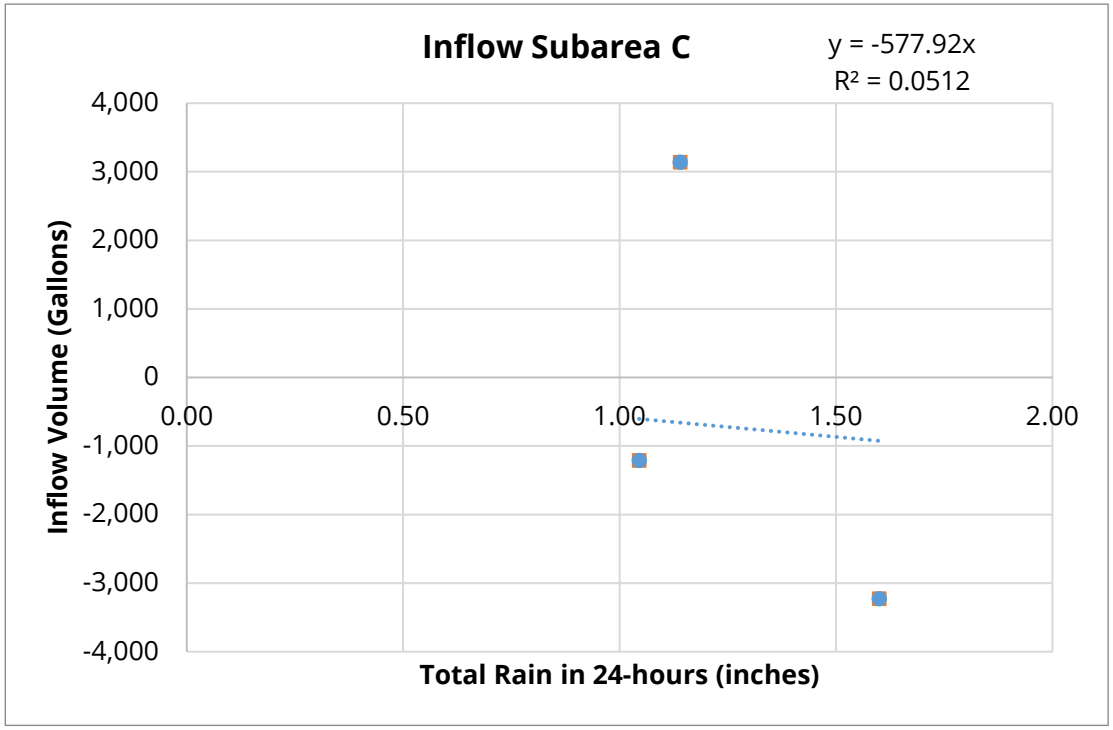
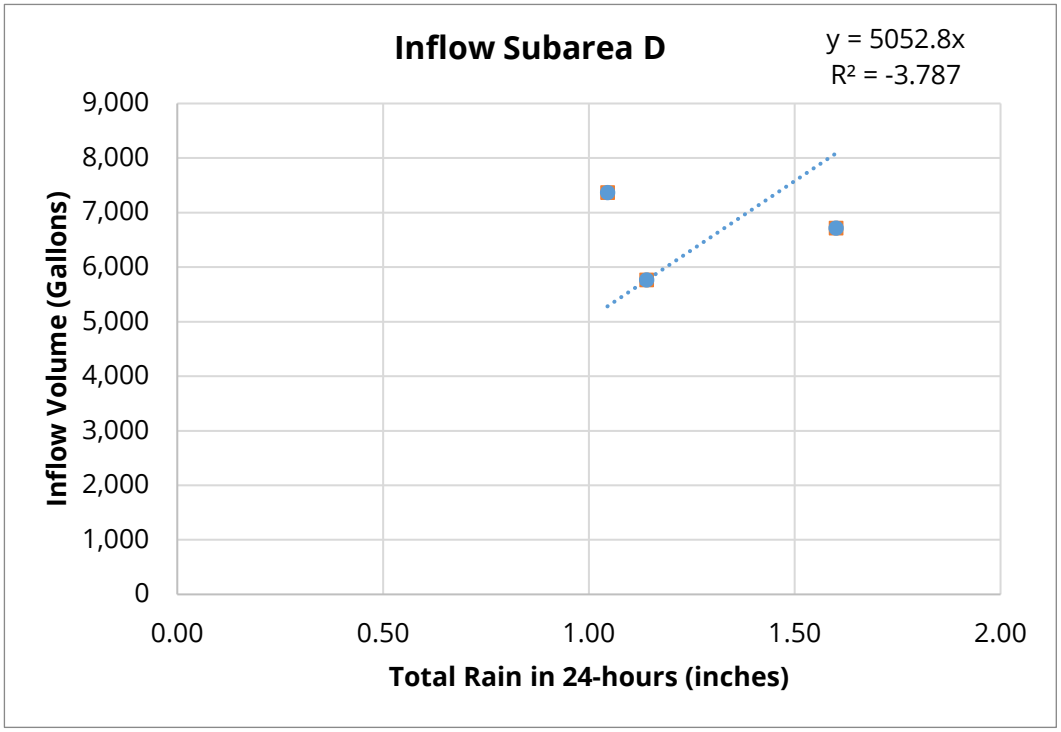

Inflow Subarea B
y = 4672.6x
R² = 0.2606
Inflow Volume (Gallons)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-2,000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
Total Rain in 24-hours (inches)


Inflow Subarea C
y = -577.92x
R² = 0.0512
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
0.00
0.50
1.00
1.50
2.00
Inflow Volume (Gallons)
Total Rain in 24-hours (inches)


Inflow Subarea D
y = 5052.8x
R² = -3.787
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Inflow Volume (Gallons)
0.00
0.50
1.00
1.50
2.00
Total Rain in 24-hours (inches)

APPENDIX C

Flow Metering and Groundwater Monitoring Data
Separately Bound

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EST Associates, Inc.

Flow Monitoring Report

March - April 2021

Prepared For:

Environmental Partners Group

Services Performed In:

Bourne, MA

Prepared by:

EST Associates Inc.
124 Crescent Road, Needham, MA 02494
Tel: (781) 455-0003
ESTAssociates.com

EST
Associates, Inc.

Meter 1 - Bourne, MA

Outside View

Downhole View

Downstream View

Upstream View

124 Crescent Road, Needham, MA 02494
tel: 781-455-0003 fax: 781-455-8336

EST
Associates, Inc.

Environmental Monitoring
Pipeline Services
Operations & Maintenance

SITE INVESTIGATION FORM

Project: EPG - Bourne, MA

Technicians: MK/TA

SITE LOCATION

Location: 90 Main Street, Buzzards Bay, MA

MH# Meter-1

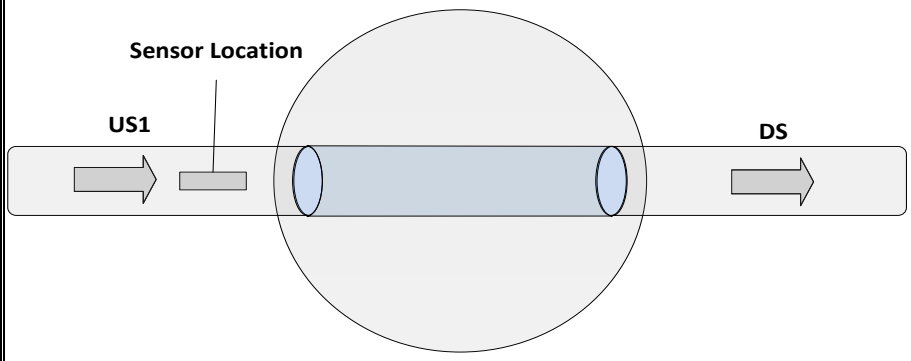
GPS Coordinates: 41.745125, -70.614776

Date: 3/3/2021

Time: 9:45 AM

Sensor Location: US1

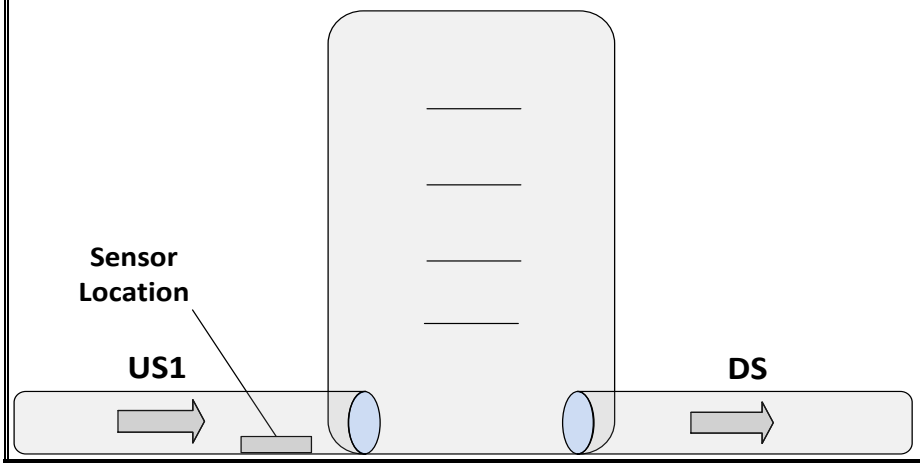
PLAN VIEW



LINE DESCRIPTIONS

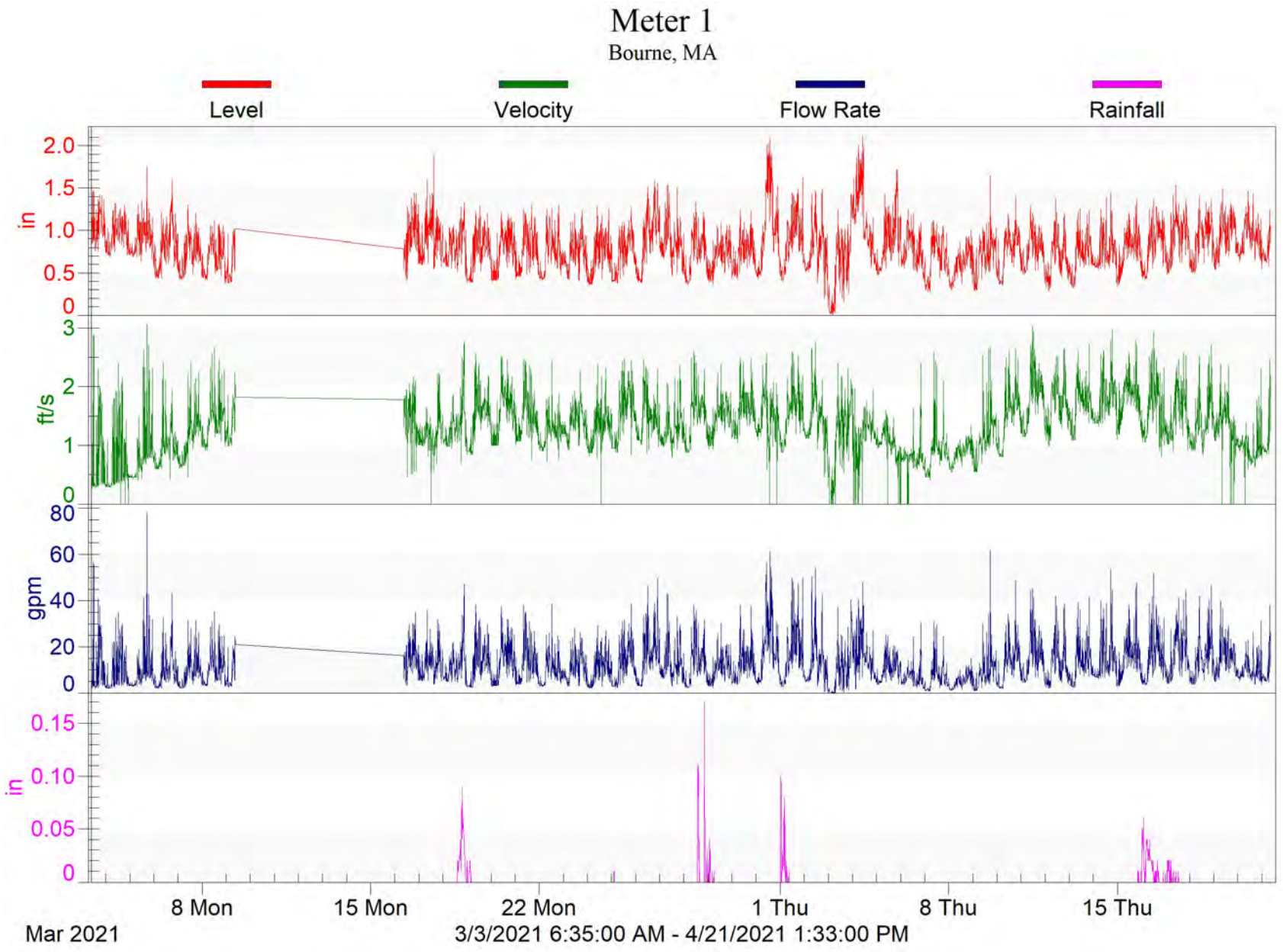
	DS	US1	US2	US3
Size	8"	8"		
Material	PVC	PVC		
Debris	/	/		
Shape	Circle	Circle		
Depth	9'5"	9'4"		

PROFILE VIEW



LINE DESCRIPTIONS (continued)

	US4	US5	US6	US7
Size				
Material				
Debris				
Shape				
Depth				


Meter 1
Bourne, MA
Level
Velocity
Flow Rate
Rainfall
in
2.0
1.5
1.0
0.5
0
ft/s
3
2
1
0
gpm
80
60
40
20
0
in
0.15
0.10
0.05
0
8 Mon
15 Mon
22 Mon
1 Thu
8 Thu
15 Thu
Mar 2021
3/3/2021 6:35:00 AM - 4/21/2021 1:33:00 PM

EST
Associates, Inc.

Environmental Monitoring
Pipeline Services
Operations Maintenance

GROUNDWATER GAUGING INSTALLATION & MAINTENANCE CHART

LOCATION: Academy Drive & Main Street, Bourne, MA

MH NUMBER: Meter-1

GPS COORDINATES: 41.745125, -70.614776

MH DEPTH: 9'5"

DATES MONITORED	COMMENTS	GROUNDWATER ABOVE INVERT
03/03/21	Tie was set to 35" above invert	35"
03/09/21	Groundwater is 3.5" below tie	31.5"
03/16/21	Groundwater is 7" below tie	28"
03/23/21	Groundwater is 7" below tie	28"
03/31/21	Groundwater is 9" below tie	26"
04/06/21	Groundwater is 9" below tie	26"
04/15/21	Groundwater is 6" below tie	29"
04/21/21	Groundwater is 1.5" above tie	36.5"

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-3-21 **INSPECTORS' INITIALS:** MK/BK/SP

TIME: 0945

SITE NAME: Bourne Meter 1
ADDRESS:

METER SERIAL NUMBER: EST 144

SERVICES/ACTIONS PERFORMED:

- ☐ Sensor Cleaning
- ☐ Calibration Check
- ☐ Data Downloaded
- ☑ Other Meter Install

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 12.0
New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** .75 **(in)**	**Actual:** .75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** .311 **(ft/s)**	**Actual:** .3 **(ft/s)**	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-9-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0910

SITE NAME: Bourne Meter 1 **METER SERIAL NUMBER:** EST 144

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other

Data Downloaded?

- ☐ By Modem: [date:]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 12.0

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** (in)	**Actual:** (in)	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.018 (in)	**Actual:** 1.0 (in)	**Recalibrated** ☐
Velocity Readings	**Meter:** 2.404 (ft/s)	**Actual:** 2.4 (ft/s)	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-16-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0839

SITE NAME: Bourne Meter 1 **METER SERIAL NUMBER:** EST 144

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 11.9

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** .782 **(in)**	**Actual:** .75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 1.776 **(ft/s)**	**Actual:** 1.8 **(ft/s)**	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-23-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0805

SITE NAME: Bovine Meter 1 **METER SERIAL NUMBER:** EST 144

ADDRESS: _____

_____

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other _____

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 11.7

New voltage: _____

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** .695 **(in)**	**Actual:** .75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 1.352 **(ft/s)**	**Actual:** 1.4 **(ft/s)**	

Errors recorded: _____

_____

_____

Work to be performed/Additional Comments/Observations: _____

_____

_____

_____

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-31-21 **INSPECTORS' INITIALS:** MK/IA

TIME: 0821

SITE NAME: Bourne Meter 1 **METER SERIAL NUMBER:** EST 144

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 12.2

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** .943 **(in)**	**Actual:** 1.0 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 1.899 **(ft/s)**	**Actual:** 1.9 **(ft/s)**	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 04/06/21 **INSPECTORS' INITIALS:** TA MK

TIME: 0824

SITE NAME: Bourne Meter 1 **METER SERIAL NUMBER:** EST 144

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other

Data Downloaded?

- ☐ By Modem: [date:]
- ☑ To Laptop (Y / N) [SN: #MK]

Replace Batteries? (Y / (N))

Existing voltage: 12.2

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / (N))

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** ✓ **(in)**	**Actual:** ✓ **(in)**	**Recalibrated**	☐
A/V Level Readings	**Meter:** .83 **(in)**	**Actual:** .8 **(in)**	**Recalibrated**	☐
Velocity Readings	**Meter:** .82 **(ft/s)**	**Actual:** .8 **(ft/s)**		

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 4-15-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0836

SITE NAME: Bourne Meter 1
ADDRESS: _____

METER SERIAL NUMBER: EST 144

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other _____

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: #MK]

Replace Batteries? (Y / N)
Existing voltage: 12.1
New voltage: _____

Dessicant Status: Good
Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** _____ **(in)**	**Actual:** _____ **(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** .686 **(in)**	**Actual:** .75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 1.762 **(ft/s)**	**Actual:** 2.0 **(ft/s)**	

Errors recorded: _____

Work to be performed/Additional Comments/Observations: Minor ragging on sensor. Readings increased after it was cleaned

EST
Associates, Inc.

FLOW MONITORING

DATE: 4-21-21 **INSPECTORS' INITIALS:** MK/TG

TIME: 0831

SITE NAME: Bourne Meter 1
ADDRESS: _____

METER SERIAL NUMBER: EST 144

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☑ Other Meter Removal

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: FMK]

Replace Batteries? (Y / N)
Existing voltage: 12.0
New voltage:_____

Dessicant Status: Good
Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** .829 **(in)**	**Actual:** .75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 1.239 **(ft/s)**	**Actual:** 1.2 **(ft/s)**	

Errors recorded: _____

Work to be performed/Additional Comments/Observations: _____

EST
Associates, Inc.

Meter 2 - Bourne, MA

Outside View

Downhole View

Downstream View

US1 View

US2 View

124 Crescent Road, Needham, MA 02494
tel: 781-455-0003 fax: 781-455-8336

EST Associates, Inc.

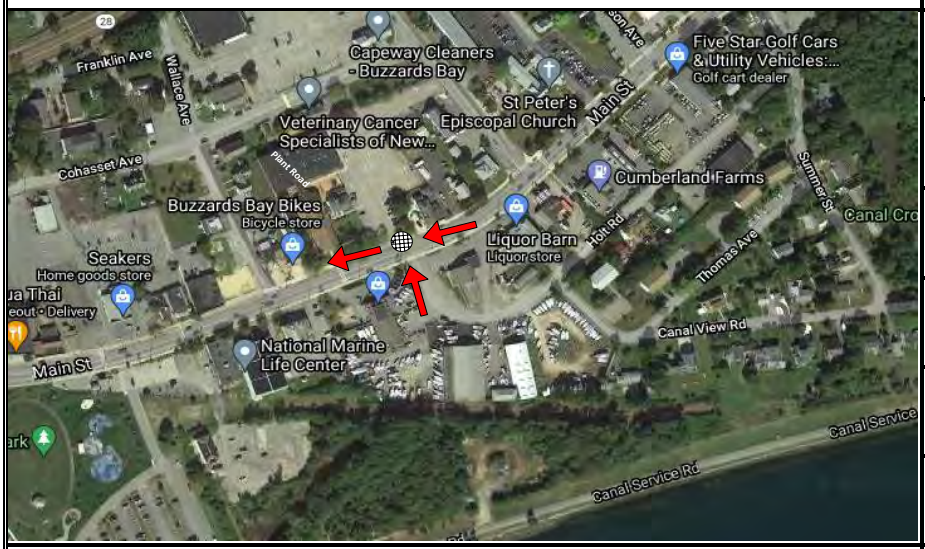
Environmental Monitoring
Pipeline Services
Operations & Maintenance

SITE INVESTIGATION FORM

Project: EPG - Bourne, MA

Technicians: MK/TA

SITE LOCATION



Location: 140 Main Street, Buzzards Bay, MA

MH# Meter-2

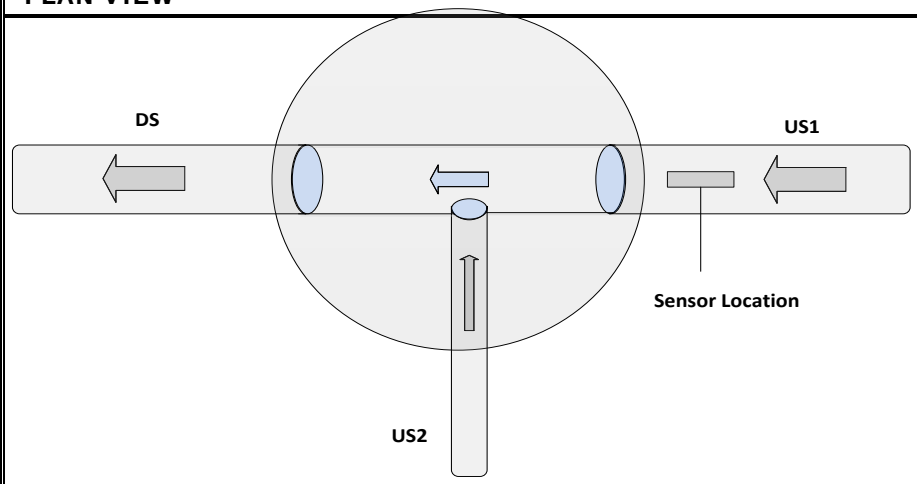
GPS Coordinates: 41.746003, -70.611053

Date: 3/3/2021

Time: 8:57 AM

Sensor Location: US1

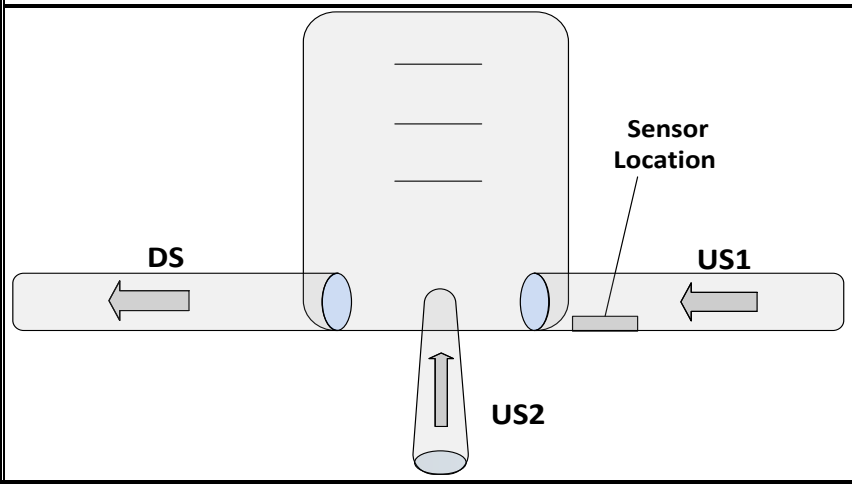
PLAN VIEW



LINE DESCRIPTIONS

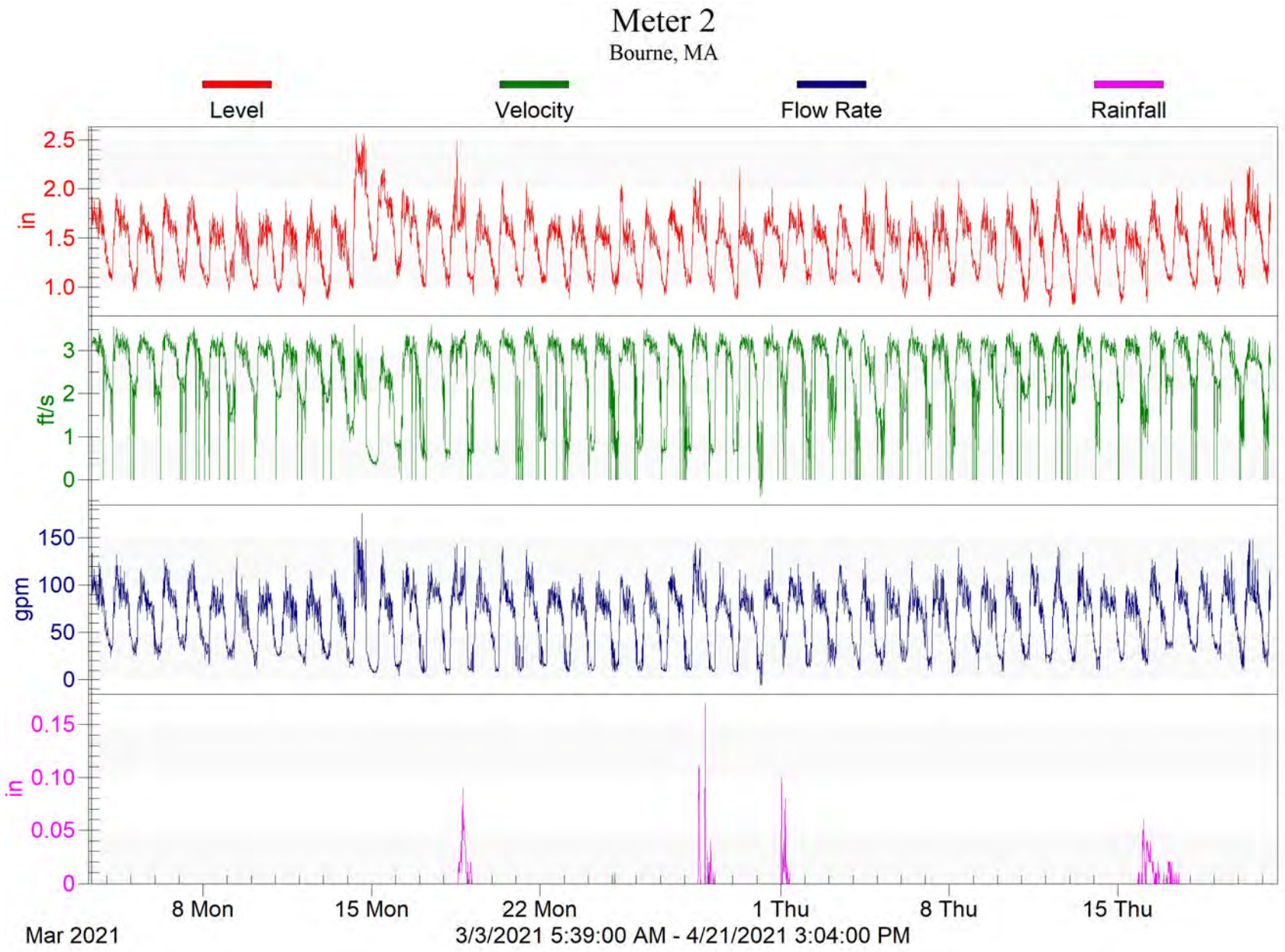
	DS	US1	US2	US3
Size	12"	12"	8"	
Material	PVC	PVC	PVC	
Debris	/	/	/	
Shape	Circle	Circle	Circle	
Depth	15'0"	14'10"	10'9"	

PROFILE VIEW



LINE DESCRIPTIONS (continued)

	US4	US5	US6	US7
Size				
Material				
Debris				
Shape				
Depth				


Meter 2
Bourne, MA
Level
Velocity
Flow Rate
Rainfall
in
2.5
2.0
1.5
1.0
ft/s
3
2
1
0
gpm
150
100
50
0
in
0.15
0.10
0.05
0
8 Mon
15 Mon
22 Mon
1 Thu
8 Thu
15 Thu
Mar 2021
3/3/2021 5:39:00 AM - 4/21/2021 3:04:00 PM

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-3-21 **INSPECTORS' INITIALS:** MK/BK/SP

TIME: 0857

SITE NAME: Bourne Meter 2 **METER SERIAL NUMBER:** EST 262

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☐ Sensor Cleaning
- ☐ Calibration Check
- ☐ Data Downloaded
- ☑ Other Meter Install

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 12.5

New voltage:_____

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.957**(in)**	**Actual:** 2.0 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 3.297**(ft/s)**	**Actual:** 3.3 **(ft/s)**	

Errors recorded: 125 GPM

Work to be performed/Additional Comments/Observations:_____

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-9-21 **INSPECTORS' INITIALS:** MK/ITA

TIME: 0830

SITE NAME: Bourne Meter 2 **METER SERIAL NUMBER:** EST 262

ADDRESS: _____

_____

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other _____

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 12.4

New voltage: _____

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** _____ **(in)**	**Actual:** _____ **(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.611 **(in)**	**Actual:** 1.75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 3.291 **(ft/s)**	**Actual:** 3.3 **(ft/s)**	

Errors recorded: _____

_____

_____

Work to be performed/Additional Comments/Observations: _____

_____

_____

_____

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-16-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0825

SITE NAME: Bourne Meter 2
ADDRESS: _____

METER SERIAL NUMBER: EST 262

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other _____

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: #MK _____]

Replace Batteries? (Y / N)

Existing voltage: 12.3
New voltage: _____

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.932 **(in)**	**Actual:** 2.0 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 2.381 **(ft/s)**	**Actual:** 2.4 **(ft/s)**	

Errors recorded: _____

Work to be performed/Additional Comments/Observations: _____

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-23-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0820

SITE NAME: Bourne Meter 2 **METER SERIAL NUMBER:** EST 262

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- [x] Sensor Cleaning
- [x] Calibration Check
- [x] Data Downloaded
- [ ] Other

Data Downloaded?

- [ ] By Modem: [date:_____]
- [x] To Laptop (Y / N) [SN: #MK]

Replace Batteries? (Y / N)

Existing voltage: 12.1

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.658 **(in)**	**Actual:** 1.75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 3.313 **(ft/s)**	**Actual:** 3.3 **(ft/s)**	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 3-31-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0835

SITE NAME: Bourne Meter 2 **METER SERIAL NUMBER:** EST 262

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other

Data Downloaded?

- ☐ By Modem: [date:]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 11.9

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** (in)	**Actual:** (in)	**Recalibrated**	☐
A/V Level Readings	**Meter:** 1.566 (in)	**Actual:** 1.5 (in)	**Recalibrated**	☐
Velocity Readings	**Meter:** 3.166 (ft/s)	**Actual:** 3.2 (ft/s)		

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 4-6-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0811

SITE NAME: Bourne Meter 2 **METER SERIAL NUMBER:** EST 262

ADDRESS:

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other

Data Downloaded?

- ☐ By Modem: [date:]
- ☑ To Laptop (Y / N) [SN: #mk]

Replace Batteries? (Y / N)

Existing voltage: 11.9

New voltage:

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** (in)	**Actual:** (in)	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.657 (in)	**Actual:** 1.75 (in)	**Recalibrated** ☐
Velocity Readings	**Meter:** 3.409 (ft/s)	**Actual:** 3.4 (ft/s)	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

FLOW MONITORING

DATE: 4-15-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0825

SITE NAME: Bourne Meter 2
ADDRESS: _____

METER SERIAL NUMBER: EST 262

SERVICES/ACTIONS PERFORMED:

- ☑ Sensor Cleaning
- ☑ Calibration Check
- ☑ Data Downloaded
- ☐ Other _____

Data Downloaded?

- ☐ By Modem: [date:_____]
- ☑ To Laptop (Y / N) [SN: # MK]

Replace Batteries? (Y / N)

Existing voltage: 11.8
New voltage: _____

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:** _____ **(in)**	**Actual:** _____ **(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.473 **(in)**	**Actual:** 1.5 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 3.290 **(ft/s)**	**Actual:** 3.3 **(ft/s)**	

Errors recorded: _____

Work to be performed/Additional Comments/Observations: _____

EST
Associates, Inc.

FLOW MONITORING

DATE: 4-21-21 **INSPECTORS' INITIALS:** MK/TA

TIME: 0816

SITE NAME: Bourne Meter 2
ADDRESS:

METER SERIAL NUMBER: EST 262

SERVICES/ACTIONS PERFORMED:

- [x] Sensor Cleaning
- [x] Calibration Check
- [x] Data Downloaded
- [x] Other Meter Removal

Data Downloaded?

- [ ] By Modem: [date:_____]
- [x] To Laptop (Y / N) [SN: #MK]

Replace Batteries? (Y / N)

Existing voltage: 11.6
New voltage:_____

Dessicant Status: Good

Replaced dessicant? (Y / N)

Meter Running? (Y / N)

METER READINGS

US Level Readings	**Meter:**_____**(in)**	**Actual:**_____**(in)**	**Recalibrated** ☐
A/V Level Readings	**Meter:** 1.686 **(in)**	**Actual:** 1.75 **(in)**	**Recalibrated** ☐
Velocity Readings	**Meter:** 2.856**(ft/s)**	**Actual:** 2.9 **(ft/s)**	

Errors recorded:

Work to be performed/Additional Comments/Observations:

EST
Associates, Inc.

Environmental Monitoring
Pipeline Services
Operations Maintenance

GROUNDWATER GAUGING INSTALLATION & MAINTENANCE CHART

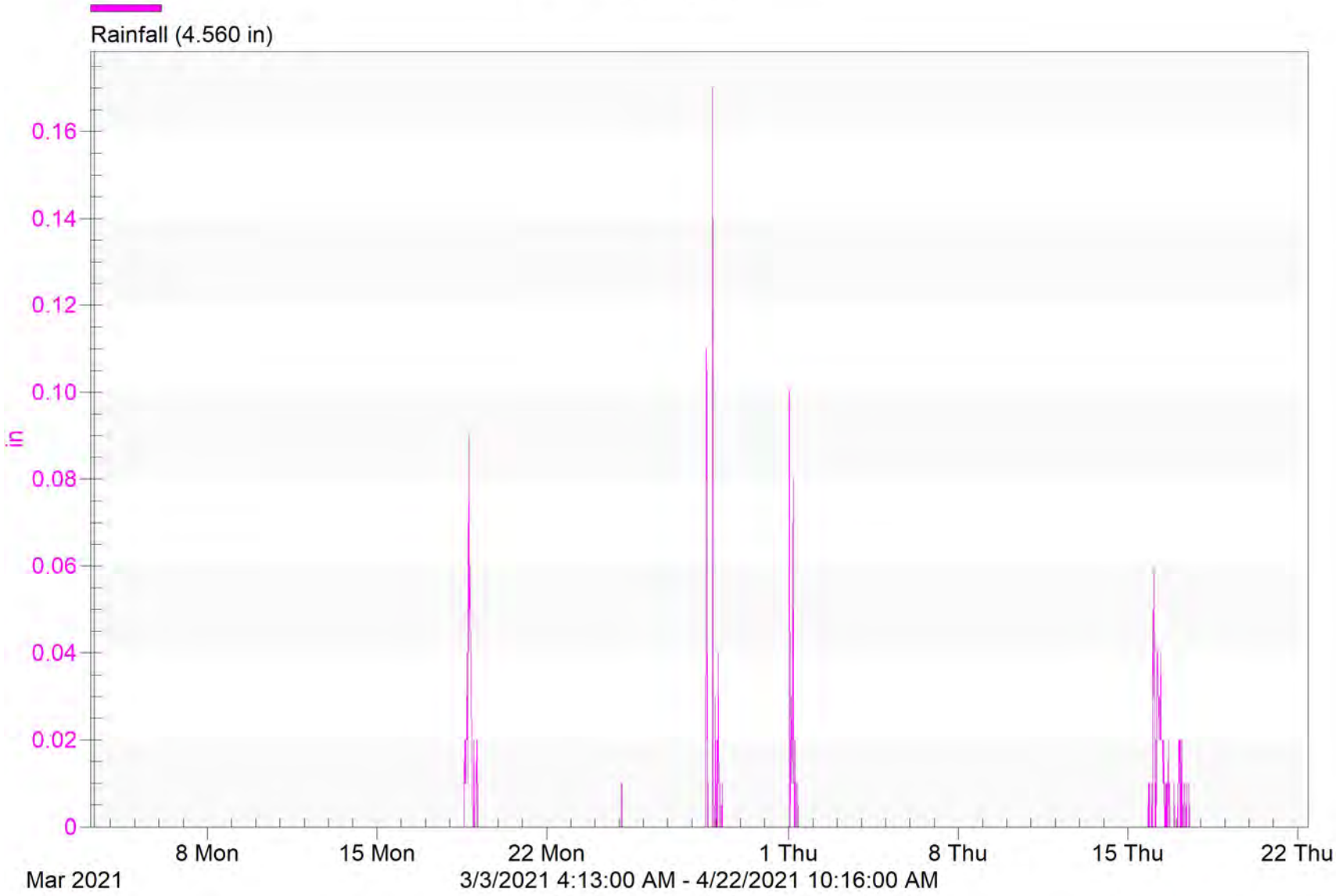
LOCATION: Perry Avenue & Everett Road Bourne, MA **MH NUMBER:** SMH-44

GPS COORDINATES: 41.747280, -70.602082 **MH DEPTH:** 9'2"

DATES MONITORED	COMMENTS	GROUNDWATER ABOVE INVERT
03/09/21	DRY	--
03/16/21	DRY	--
03/23/21	DRY	--
03/31/21	DRY	--
04/06/21	DRY	--
04/15/21	DRY	--
04/21/21	DRY	--

Pump Station Rain Gauge

Bourne, MA



EST Associates, Inc.

Pump Station Rain Gauge - Bourne, MA

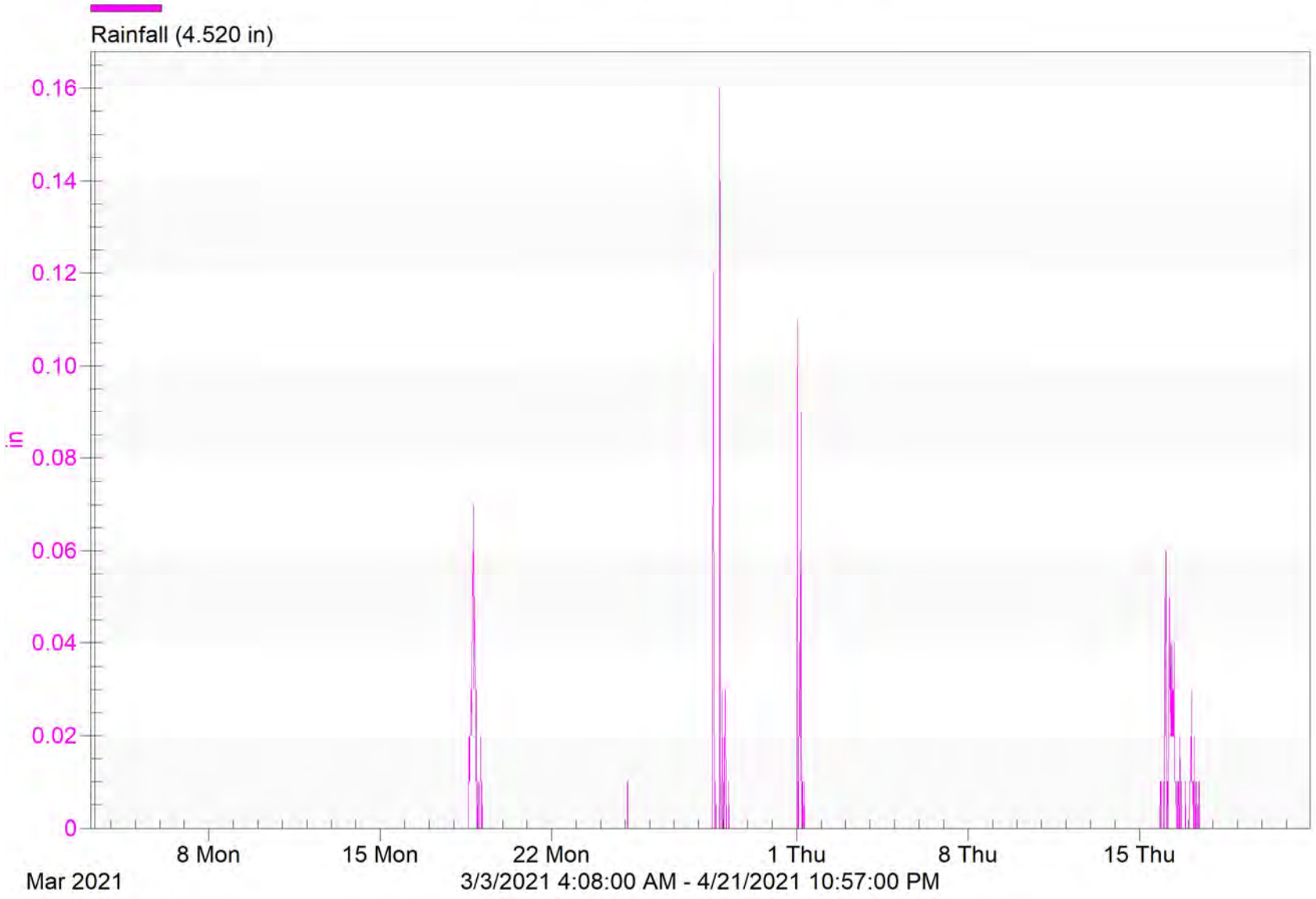
Daily Rainfall Table

Date	Average Rainfall (in)	Minimum Rainfall (in)	Time of Minimum Rainfall (hh:mm)	Maximum Rainfall (in)	Time of Maximum Rainfall (hh:mm)	Total Rainfall (in)
3/3/2021	0.000	0.000	8:00 AM	0.000	8:00 AM	0.000
3/4/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/5/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/6/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/7/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/8/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/9/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/10/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/11/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/12/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/13/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/14/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/15/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/16/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/17/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/18/2021	0.011	0.000	12:00 AM	0.090	7:15 PM	1.070
3/19/2021	0.001	0.000	12:30 AM	0.020	12:00 AM	0.130
3/20/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/21/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/22/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/23/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/24/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/25/2021	0.000	0.000	12:00 AM	0.010	2:15 AM	0.020
3/26/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/27/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/28/2021	0.009	0.000	12:00 AM	0.170	8:30 PM	0.890
3/29/2021	0.002	0.000	12:00 AM	0.040	1:45 AM	0.160
3/30/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/31/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/1/2021	0.008	0.000	12:00 AM	0.100	12:30 AM	0.760
4/2/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/3/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/4/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/5/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/6/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/7/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/8/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000

4/9/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/10/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/11/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/12/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/13/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/14/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/15/2021	0.000	0.000	12:00 AM	0.010	8:15 PM	0.040
4/16/2021	0.013	0.000	12:00 AM	0.060	1:45 AM	1.260
4/17/2021	0.002	0.000	12:00 AM	0.020	2:00 AM	0.230
4/18/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/19/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/20/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/21/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
Rainfall Total *(in)*	**Average Rainfall** *(in)*	**Minimum Rainfall** *(in)*	**Time of Minimum Rainfall** *(m/d/yyyy h:mm)*	**Maximum Rainfall** *(in)*	**Time of Maximum Rainfall** *(m/d/yyyy h:mm)*	**Average Total Rainfall** *(in)*
4.560	0.001	0.000	3/3/21 8:00 AM	0.170	3/28/21 8:30 PM	0.091

Old Bridge Road Rain Gauge

Bourne, MA



EST Associates, Inc.

Old Bridge Road Rain Gauge - Bourne, MA

Daily Rainfall Table

Date	Average Rainfall *(in)*	Minimum Rainfall *(in)*	Time of Minimum Rainfall *(hh:mm)*	Maximum Rainfall *(in)*	Time of Maximum Rainfall *(hh:mm)*	Total Rainfall *(in)*
3/3/2021	0.000	0.000	8:15 AM	0.000	8:15 AM	0.000
3/4/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/5/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/6/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/7/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/8/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/9/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/10/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/11/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/12/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/13/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/14/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/15/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/16/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/17/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/18/2021	0.010	0.000	12:00 AM	0.070	7:15 PM	0.990
3/19/2021	0.001	0.000	12:15 AM	0.020	2:45 AM	0.090
3/20/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/21/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/22/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/23/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/24/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/25/2021	0.000	0.000	12:00 AM	0.010	2:15 AM	0.020
3/26/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/27/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/28/2021	0.009	0.000	12:00 AM	0.160	8:30 PM	0.880
3/29/2021	0.002	0.000	12:00 AM	0.030	1:45 AM	0.160
3/30/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
3/31/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/1/2021	0.007	0.000	12:00 AM	0.110	1:00 AM	0.710
4/2/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/3/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/4/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/5/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/6/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/7/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/8/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000

4/9/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/10/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/11/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/12/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/13/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/14/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/15/2021	0.001	0.000	12:00 AM	0.010	8:15 PM	0.050
4/16/2021	0.014	0.000	12:00 AM	0.060	1:30 AM	1.340
4/17/2021	0.003	0.000	12:00 AM	0.030	3:15 AM	0.280
4/18/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/19/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/20/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
4/21/2021	0.000	0.000	12:00 AM	0.000	12:00 AM	0.000
Rainfall Total *(in)*	**Average Rainfall** *(in)*	**Minimum Rainfall** *(in)*	**Time of Minimum Rainfall** *(m/d/yyyy h:mm)*	**Maximum Rainfall** *(in)*	**Time of Maximum Rainfall** *(m/d/yyyy h:mm)*	**Average Total Rainfall** *(in)*
4.520	0.001	0.000	3/3/21 8:15 AM	0.160	3/28/21 8:30 PM	0.090

EST Associates, Inc.

Manhole Inspection Report

March 2021

Prepared For:

Environmental Partners Group

Completed At:

Bourne, MA

Prepared by:

EST Associates Inc.
124 Crescent Road, Needham, MA 02494
Tel: (781) 455-0003
ESTAssociates.com

Code	Description
B	BROKEN
BSV	BROKEN SOIL VISIBLE
BVV	BROKEN VOID VISIBLE
CC	CRACK CIRCUMFERENTIAL
CL	CRACK LONGITUDINAL
CM	CRACK MULTIPLE
CS	CRACK SPIRAL
DAE	DEPOSITS ATTACHED ENCRUSTATION
DAGS	DEPOSITS ATTACHED GREASE
DAR	DEPOSITS ATTACHED RAGGED
DAZ	DEPOSITS ATTACHED OTHER
DB	DISPLACED BRICK
DI	BRICKWORK DROPPED INVERT
DNF	DEPOSITS INGRESSED FINE
DSC	DEPOSITS SETTLED COMPACTED
DSF	DEPOSITS SETTLED FINE
DSGV	DEPOSITS SETTLED GRAVEL
DSZ	DEPOSITS SETTLED OTHER
FC	FRACTURE CIRCUMFERENTIAL
FL	FRACTURE LONGITUDINAL
FM	FRACTURE MULTIPLE
FS	FRACTURE SPIRAL
H	HOLE
HSV	HOLE SOIL VISIBLE
HVV	HOLE VOID VISIBLE
ID	INFILTRATION DRIPPER
IDB	INFILTRATION DRIPPER BARREL
IDC	INFILTRATION DRIPPER CONNECTION
IDJ	INFILTRATION DRIPPER JOINT
IG	INFILTRATION GUSHER
IGB	INFILTRATION GUSHER BARREL
IGC	INFILTRATION GUSHER CONNECTION
IGJ	INFILTRATION GUSHER JOINT
IR	INFILTRATION RUNNER
IRB	INFILTRATION RUNNER BARREL
IRC	INFILTRATION RUNNER CONNECTION
IRJ	INFILTRATION RUNNER JOINT
IS	INFILTRATION STAIN
ISB	INFILTRATION STAIN BARREL
ISC	INFILTRATION STAIN CONNECTION
ISJ	INFILTRATION STAIN JOINT

ISZ	INTRUDING SEALING MATERIAL OTHER
IW	INFILTRATION WEEPER
IWB	INFILTRATION WEEPER BARREL
IWC	INFILTRATION WEEPER CONNECTION
IWJ	INFILTRATION WEEPER JOINT
IWL	INFILTRATION WEEPER LATERAL
JAL	JOINT ANGULAR LARGE
JAM	JOINT ANGULAR MEDIUM
JOL	JOINT OFFSET LARGE
JOM	JOINT OFFSET MEDIUM
JSL	JOINT SEPERATED LARGE
JSM	JOINT SEPERATED MEDIUM
MB	MISSING BRICK
MML	MISSING MORTAR LARGE
MMM	MISSING MORTAR MEDIUM
MMS	MISSING MORTAR SMALL
MSA	MISCELLANEOUS SURVEY ABANDONED
MWM	MISCELLANEOUS WATER MARK
OBB	OBSTRUCTION BRICK OR MASONRY
OBC	OBSTRUCTION THROUGH CONNECTION
OBI	OBSTRUCTION INTRUDING THROUGH WALL
OBJ	OBSTRUCTION WEDGED IN THE JOINT
OBM	OBSTRUCTION PIPE MATERIAL IN INVERT
OBN	OBSTRUCTION CONSTRUCTION DEBRIS
OBP	OBSTRUCTION EXTERNAL PIPE OR CABLE
OBR	OBSTRUCTION ROCKS
OBS	OBSTRUCTION BUILT INTO STRUCTURE
OBZ	OBSTRUCTION OTHER
RBB	ROOTS BALL BARREL
RBC	ROOTS BALL CONNECTION
RBJ	ROOTS BALL JOINT
RFB	ROOTS FINE BARREL
RFC	ROOTS FINE CONNECTION
RFJ	ROOTS FINE JOINT
RFL	ROOTS FINE LATERAL
RMB	ROOTS MEDIUM BARREL
RMC	ROOTS MEDIUM CONNECTION
RMJ	ROOTS MEDIUM JOINT
RML	ROOTS MEDIUM LATERAL
SAM	SURFACE DAMAGE AGGREGATE MISSING
SAP	SURFACE DAMAGE AGGREGATE PROJECTING
SAV	SURFACE DAMAGE AGGREGATE VISIBLE
SCP	SURFACE DAMAGE CORROSION

SMW	SURFACE DAMAGE MISSING WALL
SRC	SURFACE DAMAGE REINFORCEMENT CORRODED
SRI	SURFACE DAMAGE ROUGHNESS INCREASED
SRP	SURFACE DAMAGE REINFORCEMENT PROJECTING
SRV	SURFACE DAMAGE REINFORCEMENT VISIBLE
SSC	SURFACE SPALLING OF DAMAGE COATING
SSS	SURFACE SPALLING OF DAMAGE
SZ	SURFACE DAMAGE OTHER
VC	VERMIN COCKROACH
VR	VERMIN RAT
VZ	VERMIN OTHER

EST Associates, Inc.

Manhole Inspections - March 2021

Bourne, MA

Manhole ID	Address
SMH-1	Wright Lane
SMH-44	Perry Avenue
SMH-95	Main Street
SMH-101	Head of the Bay Road
SMH-169	Main Street
SMH-172	Main Street
SMH-174	Main Street
SMH-178	Main Street
SMH-181	Main Street
SMH-182	Main Street

EST
Associates, Inc.

SMH-1 - Bourne, MA

124 Crescent Road, Needham, MA 02494
tel: 781-455-0003 fax: 781-455-8336

EST Associates, Inc.

Environmental Monitoring
Pipeline Services
Operations & Maintenance

Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** **SMH-1**

General Information

Inspector(s): MK
Certificate #:
Ft. to Downstream MH: 0
Purpose of Survey: I/I Study
Inspection Status: Complete
Inspection Level: Level 1

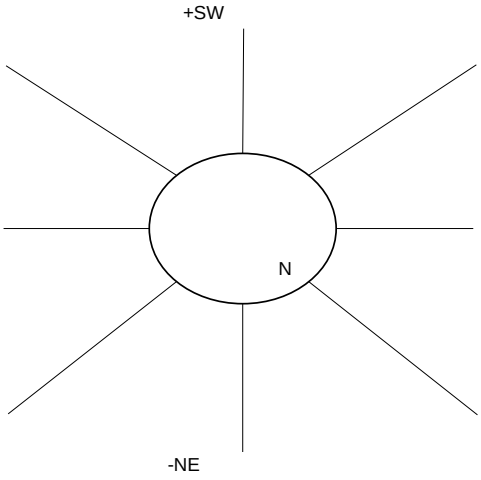
Location

Street: Wright Lane
City, State: Bourne, MA

Manhole Information

Cover:
Holes in Cover: [ ] *Yes* [X] *No* # of Holes: 0
Cover Condition: Sound Size (in.): 0
Grade: At
General Comments: Lifter station

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition: None
Drainage Area: 2x2

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Pitted	0		
Chimney	Block	Defective	0	FL MML	Brick, PIP
Cone	N/A	N/A			
Steps	Aluminum	Sound	0		
Walls	Precast	Defective	5	IR	
Bench	N/A	N/A			
Channel	N/A	N/A			

Surcharge from Invert Evident: [X] *Yes* [ ] *No* Currently: 0 ft. Marks to: 6 ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	NE	6ft 9in	3	PVC	0	0	0		
In	SW	N/A							Heavy groundwater coming in

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SMH-44 - Bourne, MA

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** SMH-44

General Information

Inspector(s): MK
Certificate #:
Ft. to Downstream MH: 156
Purpose of Survey: I/I Study
Inspection Status: Complete
Inspection Level: Level 1

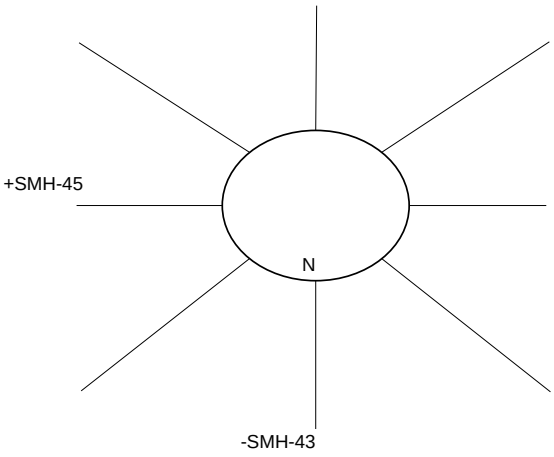
Location

Street: Perry Ave
City, State: Bourne, MA

Manhole Information

Cover:
Holes in Cover: [ ] *Yes* [X] *No* # of Holes: 0
Cover Condition: Sound Size (in.): 0
Grade: At
General Comments:

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition: Sound
Drainage Area: 4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Pitted	0		
Chimney	Brick	Sound	0		Precast
Cone	N/A	Sound	0		
Steps	Other	Sound	0		Plastic steps
Walls	Precast	Defective	0	SCP IS	H2S damage
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-43	9ft 2in	8	VCP	0	0	0		
In	SMH-45	4ft 5in	4	PVC	0	0	0		Forced main

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Manhole Inspection Form

Client: EPG **Date:** 03/31/2021 **MH #:** SMH -95

General Information

Inspector(s): MK TA
Certificate #:
Ft. to Downstream MH: 260
Purpose of Survey: I/I Study
Inspection Status: Complete
Inspection Level: Level 1

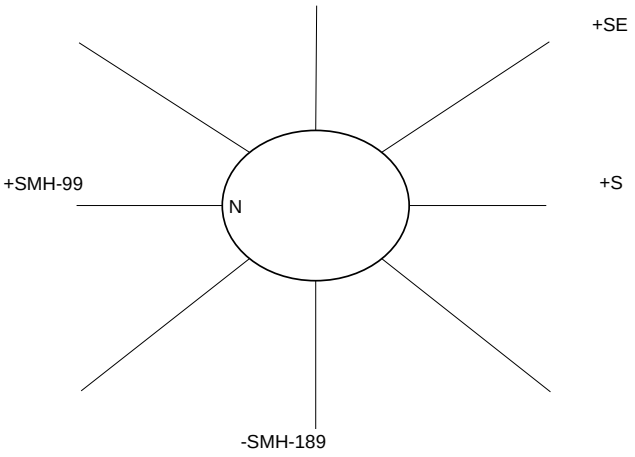
Location

Street: Main St.
City, State: Bourne, MA

Manhole Information

Cover:
Holes in Cover: [X] *Yes* [ ] *No* # of Holes: 2
Cover Condition: Sound Size (in.): 0.75
Grade: Above
General Comments:

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition: Broken
Drainage Area: 2x2

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Corroded	0	SCP	
Chimney	Precast	Defective	0	MMM	Brick, cracked bricks
Cone	Precast	Sound	0		
Steps	Other	Sound	0		Plastic steps
Walls	Precast	Sound	0		
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: 0 ft. Marks to: 0 ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-189	10'9"	8	PVC	1.5	0	0		
In	SMH-99	10'8"	8	PVC	1.5	0	0		
In	SE	5'10	4	PVC	0	0	0		
In	S	5'10"	4	PVC	0.25	0	0		

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Manhole Inspection Form

Client: EPG **Date:** 03/31/2021 **MH #:** SMH-101

General Information

Inspector(s):	MK TA
Certificate #:	
Ft. to Downstream MH:	320
Purpose of Survey:	I/I Study
Inspection Status:	Complete
Inspection Level:	Level 1

Location

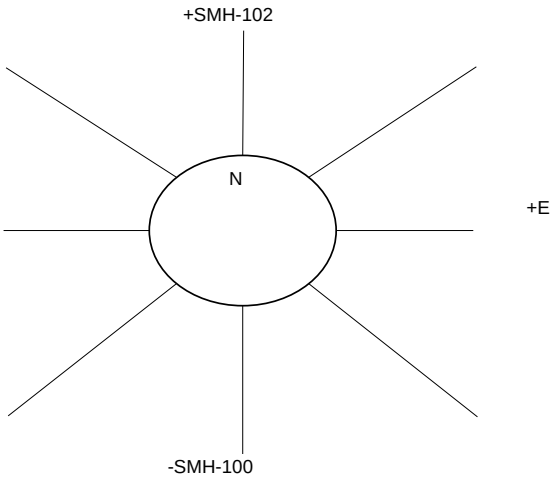
Street:	Head of the Bay Rd.
City, State:	Bourne, MA

Manhole Information

Cover:

Holes in Cover:	[X] *Yes*	[ ] *No*	# of Holes:	2	
Cover Condition:	Sound		Size (in.):	0.75	
Grade:	At				
General Comments:					

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition:	None
Drainage Area:	5x5

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Sound	0		
Chimney	Brick	Sound	0		
Cone	Precast	Sound	0		
Steps	Other	Sound	0		Plastic steps
Walls	Precast	Sound	0		
Bench	Brick	Sound	0	DSZ	Mud on bench
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: 0 ft. Marks to: 0 ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-100	7'3"	8	PVC	0.75	0	0		
In	SMH-102	7'2"	8	PVC	0.75	0	0		
In	E	6'6"	4	PVC	0	0	0		

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** **SMH-169**

General Information

Inspector(s):	MK
Certificate #:	
Ft. to Downstream MH:	275
Purpose of Survey:	I/I Study
Inspection Status:	Complete
Inspection Level:	Level 1

Location

Street:	Main St.
City, State:	Bourne, MA

Manhole Information

Cover:

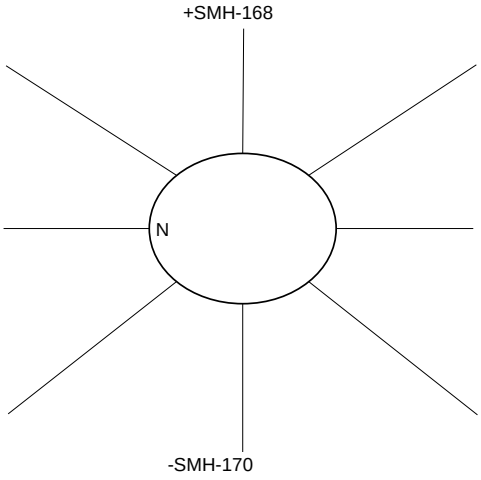
Holes in Cover: [ ] *Yes* [X] *No* # of Holes: 0

Cover Condition: Sound Size (in.): 0

Grade: At

General Comments:

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition:	None
Drainage Area:	4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Pitted	0		
Chimney	Brick	Defective	0	SCP	Precast, H2S damage
Cone	Precast	Defective	0	SCP	H2S damage
Steps	Other	Defective	0	SCP	H2S damage, plastic steps
Walls	Precast	Defective	0	SCP	H2S damage
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-170	9ft 5in	8	PVC	1	0	0		
In	SMH-168	9ft 4in	8	PVC	1	0	0		

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** SMH-172

General Information

Inspector(s): MK
Certificate #:
Ft. to Downstream MH: 80
Purpose of Survey: I/I Study
Inspection Status: Complete
Inspection Level: Level 1

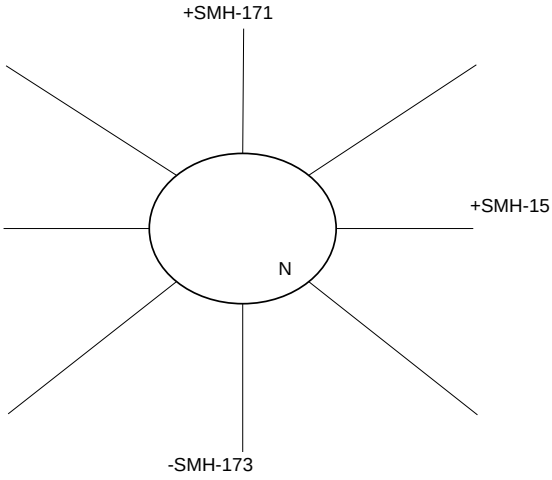
Location

Street: Main St
City, State: Bourne, MA

Manhole Information

Cover:
Holes in Cover: [ ] *Yes* [X] *No* # of Holes: 0
Cover Condition: Sound Size (in.): 0
Grade: At
General Comments: Flood Cover

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition: None
Drainage Area: 4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Pitted	0		
Chimney	Parged	Defective	0	SCP	Brick, H2S damage
Cone	Precast	Defective	0	SCP	H2S damage
Steps	Other	Sound	0		Plastic steps
Walls	Precast	Defective	0	SCP	H2S damage
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-173	11 ft 7in	8	PVC	0.75	0	0		
In	SMH-171	11ft 5in	8	PVC	0.75	0	0		
In	SMH-15	8ft 11in	8	PVC	0.25	0	0		

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** SMH-174

General Information

Inspector(s):	MK
Certificate #:	
Ft. to Downstream MH:	271
Purpose of Survey:	I/I Study
Inspection Status:	Complete
Inspection Level:	Level 1

Location

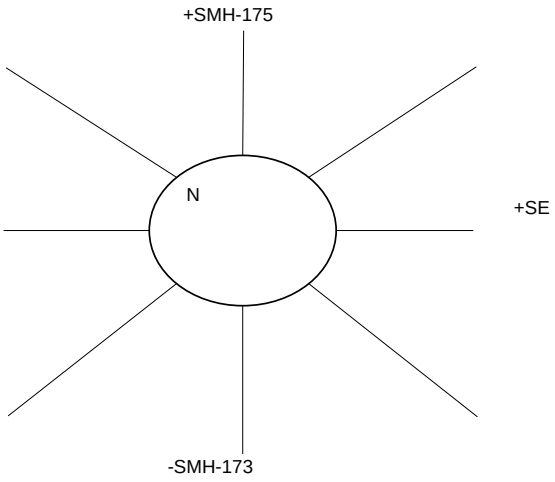
Street:	Main St.
City, State:	Bourne, MA

Manhole Information

Cover:

Holes in Cover:	[ ] *Yes*	[X] *No*	# of Holes:	0	
Cover Condition:	Restraint Missing/Defective		Size (in.):	0	
Grade:	At				
General Comments:					

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition:	None
Drainage Area:	4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Pitted			
Chimney	Parged	Sound			Precast
Cone	Precast	Sound			
Steps	Other	Sound			Plastic steps
Walls	Precast	Sound			
Bench	Brick	Sound			
Channel	Brick	Sound			

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-173	15 ft	12	PVC	1.75	0	0		
In	SMH-175	14 ft 10in	12	PVC	1.75	0	0		
In	SE	10 ft 9in	8	PVC	0.25	0	0		

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** SMH-178

General Information

Inspector(s):	MK
Certificate #:	
Ft. to Downstream MH:	183
Purpose of Survey:	I/I Study
Inspection Status:	Complete
Inspection Level:	Level 1

Location

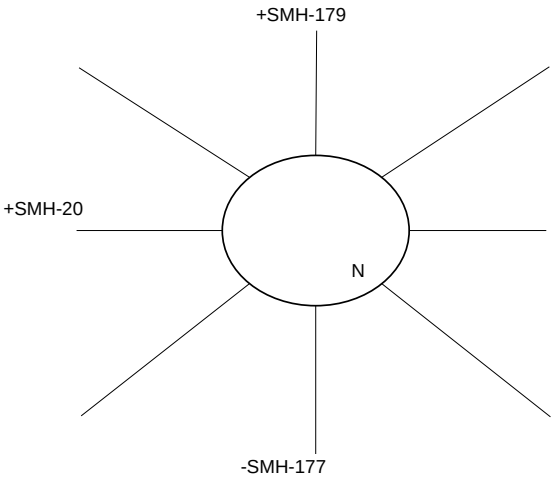
Street:	Main St
City, State:	Bourne, MA

Manhole Information

Cover:

Holes in Cover:	[ ] *Yes*	[X] *No*	# of Holes:	0	
Cover Condition:	Sound		Size (in.):	0	
Grade:	At				
General Comments:	Flood cover w/ broken handles, missing asphalt around rim				

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition:	None
Drainage Area:	4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Sound	0		
Chimney	Parged	Sound	0		Precast
Cone	Precast	Sound	0		
Steps	Other	Sound	0		Plastic
Walls	Precast	Sound	0		
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-177	14 ft 7in	12	PVC	2	0.5	0		
In	SMH-20	11ft 8in	8	PVC	0	2	0		
In	SMH-179	14ft 6in	12	PVC	2	0.5	0		

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SMH-181 - Bourne, MA

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** **SMH-181**

General Information

Inspector(s):	MK
Certificate #:	
Ft. to Downstream MH:	300
Purpose of Survey:	I/I Study
Inspection Status:	Complete
Inspection Level:	Level 1

Location

Street:	Main St.
City, State:	Bourne, MA

Manhole Information

Cover:

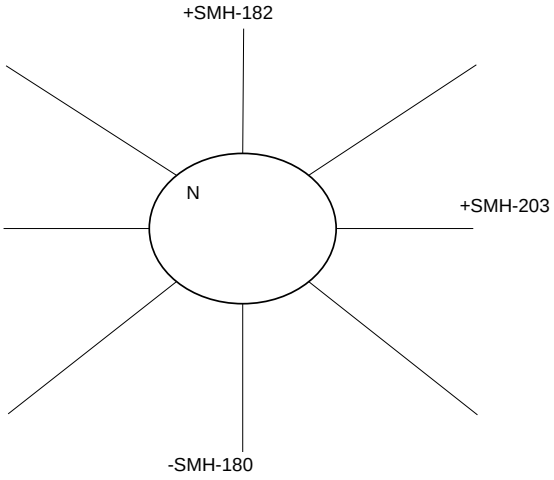
Holes in Cover: [ ] *Yes* [X] *No* # of Holes: 0

Cover Condition: Sound Size (in.): 0

Grade: At

General Comments:

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition:	None
Drainage Area:	4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Sound	0		
Chimney	Brick	Sound	0		Precast
Cone	Precast	Sound	0		
Steps	Other	Sound	0		Plastic steps
Walls	Precast	Sound	0		
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	180	14 ft 5in	12	PVC	2	0.5	0		
In	182	14ft 4in	12	PVC	2	0.5	0		
In	203	12ft 2in	12	PVC	0.5	0	0		

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Manhole Inspection Form

Client: EPG **Date:** 03/09/2021 **MH #:** SMH-182

General Information

Inspector(s):	MK
Certificate #:	
Ft. to Downstream MH:	292
Purpose of Survey:	I/I Study
Inspection Status:	Complete
Inspection Level:	Level 1

Location

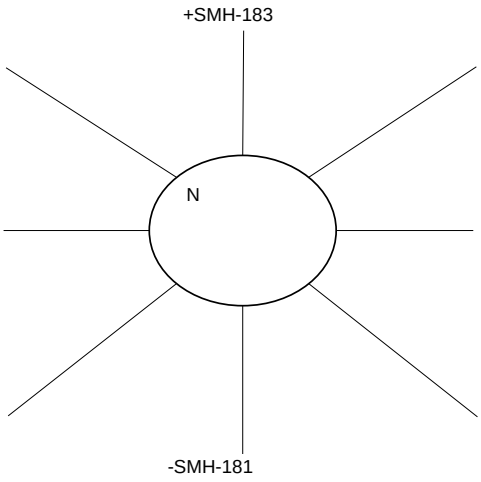
Street:	Main St.
City, State:	Bourne, MA

Manhole Information

Cover:

Holes in Cover:	X	*Yes*		*No*	# of Holes: 2
Cover Condition:	Sound				Size (in.): 0.75
Grade:	At				
General Comments:					

Manhole Sketch & Photo



Manhole Cover Adjustment Ring:

Ring Condition:	None
Drainage Area:	4x4

Internal Manhole Observations

ITEM	MATERIAL	CONDITION	LEAKS (gpm)	DEFECTS	COMMENTS
Frame	Cast Iron	Sound	0		
Chimney	Brick	Sound	0		Precast
Cone	Precast	Sound	0		
Steps	Other	Sound	0		Plastic steps
Walls	Precast	Sound	0		
Bench	Brick	Sound	0		
Channel	Brick	Sound	0		

Surcharge from Invert Evident: [ ] *Yes* [X] *No* Currently: ft. Marks to: ft.

Line Conditions

Directon (in/out)	Connect Assets	Rim to Invert Depth (ft., in.)	Pipe Diameter (in.)	Pipe Material	Flow Depth (in.)	Debris Depth (in.)	Pipe Conn. Leak (gpm)	Photo	Comments
Out	SMH-181	14ft 3in	10	PVC	1.75	0	0		
In	SMH-183	14ft 2in	10	PVC	1.75	0	0		

ENVIRONMENTAL PARTNERS

1900 Crown Colony Drive, Suite 402
Quincy, MA 02169
P: 617.657.0200 F: 617.657.0201

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