



# Sewer System Evaluation Survey (SSES) Infiltration Study



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## EXECUTIVE SUMMARY

### INTRODUCTION

The City of Portsmouth, New Hampshire (City) is a community of 16.8 square miles located along the Piscataqua River that was originally settled in 1623. Consequently, portions of the approximately 94 miles of the gravity sewer collection system are over 100 years old and have deteriorated over time. As a result of the City's aging infrastructure, the sanitary sewer collection system has areas that are structurally deficient and subject to high infiltration/inflow (I/I) rates due to condition and high groundwater. The City's wastewater needs are serviced by a combined (16 miles) and separated sanitary sewer (78 miles) collection system that flows to two separate facilities: the Peirce Island and Pease Wastewater Treatment Facilities (WWTF). The Pease WWTF serves the area known as Pease International Tradeport, while the Peirce Island WWTF serves the residents, businesses, and industrial areas of Portsmouth and Newcastle, NH. The Peirce Island WWTF currently has an average design flow of 4.8 million gallons per day (MGD) with plans to upgrade to 6.1 MGD average design flow.

In addition to the cost of treating clean groundwater and stormwater entering the collection system, the increased volume is contributing to operational problems such as surcharged pipes and manholes and more frequent discharges from combined sewer overflows (CSOs) in the collection system.

During the Spring of 2015, Woodard & Curran completed a wastewater metering study of the separated sanitary system that delineated sewer basins and measured each basin's wastewater flows. The results of this metering study were compiled into the *City of Portsmouth Infiltration/Inflow Analysis* dated 30 June 2016. As a result of the metering study, sewer basins were characterized as having excessive infiltration, inflow, or both. A total of 14 sewer basins accounting for 187,125 LF of sanitary sewer pipe were found to experience excessive infiltration. The purpose of this study is to investigate each sewer basin using standard Sewer System Evaluation Survey (SSES) techniques with the goal of locating sources of infiltration. The investigative techniques utilized were manhole inspections, flow isolation, and closed-circuit television (CCTV) sewer pipe inspection. This report will present recommended rehabilitation methods and associated construction costs to eliminate/reduce the amount of infiltration entering the City's collection system. During the course of the investigation structural defects (fractured or broken structures) were located and when severe enough, these defects were recommended for rehabilitation as well, even if infiltration was not observed at the time of CCTV inspection. Although, it may not be fiscally feasible to address all defects or remove all the I/I from the system, addressing the major structural defects and removing a significant volume of I/I can be achieved over the course of the phased plan and will reduce risk associated with the City's collection system. It should be noted that the plan to address active defects in the system may take several years and we recommend that the City continue to conduct a regular SSES/asset management/maintenance plan in parallel to keep the system operating effectively.

A total of nine sewer basins accounting for approximately 202,510 LF of sanitary sewer pipe were found to experience excessive inflow. To further determine the sources of inflow entering the wastewater collection system, the City of Portsmouth is conducting a Phase 2 I/I Study, Sewer System Evaluation Survey (SSES) Inflow Program. The program includes smoke testing of the sewer system to identify inflow sources, and home inspections to attempt to identify I/I sources from private property such as sump pumps. This memo discusses the field investigations and recommendations resulting from the smoke testing program, including a summary of pipe segments smoke tested, a summary of suspected sources, field sketches and photos of suspected sources, and the estimated inflow contribution from each identified source. The other task (house inspections) associated with the SSES Inflow Program has been presented in a separate document (Underwood Engineers Report dated June 2019).

## FINDINGS FROM INVESTIGATIONS

From April-July of 2017, Woodard & Curran in conjunction with sub-consultants (Flow Assessment Services and Ted Berry Company) performed flow isolation, CCTV inspection, manhole inspections in the areas experiencing excessive infiltration. Woodard & Curran also partnered with Underwood Engineers (UE) to complete a detailed “Pilot Area” study in defined locations in the City that share public and private infrastructure. The result of this study showed that 90% of the I/I visually observed and estimated in these pilot areas originates from private laterals and therefore private infrastructure rehabilitation should be addressed. UE also completed a feasibility assessment that concluded that Woodlands Avenue Pump Stations and West Road Pump Station flow data could be used as an estimate for future I/I reduction in the area. Figure ES-1 – *2017 Field Investigation Summary* illustrates fieldwork conducted by Woodard & Curran and sub-consultants in the City during the calendar year. Investigations revealed a varying degree of both structural and operational and maintenance (O&M) related defects throughout the collection system consistent with older New England municipalities. Table ES-1 – *Summary of Sewer Infrastructure Investigations Findings* shows the quantity of work completed and percentage of investigations resulting in rehabilitation recommendations. Measurements taken during springtime flow isolation of the City’s sanitary sewer pipe showed that approximately 30% of the sanitary sewer investigated experienced high rates of infiltration (> 1,750 gallons per day per inch-diameter mile) and yielding as much as 913,000 gallons per day of groundwater entering the collection system. CCTV inspection of 46,066 linear feet (LF) of pipe located an estimated 140,400 gallons per day of infiltration entering the sewer system. Of the 428 manholes successfully inspected, approximately 143,136 gallons per day of infiltration was located.

As part of the scope of services, Woodard & Curran performed a review of existing CCTV data collected by City crews. The data consisted of manhole to manhole segments of at least 1,000 linear feet that had been investigated during high groundwater conditions. The results of this analysis were transmitted to the City in July 2017. A copy of this report is included as an Appendix to this report.

Table ES-1: Summary of Sewer Infrastructure Investigations Findings

Investigation Activity	Type of I/I Sources and Defects Identified	Work Completed	% Defective or Additional Investigation
Flow Isolation	Infiltration	174,070 LF	30%
CCTV Inspection	Infiltration, Structural, and O&M Defects	33,359 LF	74%
Manhole Inspections	Infiltration, Structural, and O&M Defects	403 Manholes	40%
City Existing CCTV Review	Infiltration, Structural, and O&M Defects	14,500 LF	27%
Pilot Area Study	Infiltration, Structural, and O&M Defects	25 Manholes & 12,707 LF CCTV	0% & 9%
Smoke Testing	Inflow and Structural	186,570 LF	20% House Inspections
House Inspections	Private I/I	345 Buildings	8%

## RECOMMENDATIONS FOR FUTURE INVESTIGATION

During the SSES program, various potential I/I and structural/O&M defects could not be inspected for reasons including but not limited to: buried manhole covers, inability to locate a manhole, or intruding laterals in a pipeline. It is recommended that the City continue their infiltration study by completing the asset investigations outlined in Appendices A and B.

## RECOMMENDATIONS FOR FUTURE REHABILITATION

The City's collection system is aging and requires rehabilitation and maintenance to reduce blockages or sanitary sewer overflows (SSOs) and maintain service to residents and businesses. As part of the 2017 SSES investigation, Woodard & Curran identified approximately \$1,890,000 in recommended collection system rehabilitation and improvements work. Of the total recommended rehabilitation, approximately \$1,240,000 is aimed at removal of infiltration. Woodard & Curran recommends that a 20% engineering fee and 30% contingency be included, resulting in a total estimated Program cost of \$2,957,000. A summary of estimated costs to rehabilitate all collection system defects identified during the 2017 SSES investigation is included in Table ES-2 – *Collection System Rehabilitation Summary of Costs*.

Table ES-2: Collection System Rehabilitation Summary of Costs

Investigation Type	Work Completed	Rehabilitation Recommendations	Infiltration Rehabilitation	Structural and O&M Rehabilitation	Total Estimated Cost
CCTV	32,329 <sup>1</sup> LF	Infiltration, Structural, and O&M	\$880,000	\$300,000	\$1,180,000
Manhole Inspection	393 <sup>1</sup> Manholes	Infiltration, Structural, and O&M	\$310,000	\$290,000	\$600,000
Pilot Area Study	24 Manholes & 12,000 LF CCTV	Infiltration, Structural, and O&M	\$10,000	\$20,000	\$30,000
City CCTV Review	14,500 LF CCTV	Infiltration, Structural, and O&M	\$35,000	\$40,000	\$75,000
Smoke Testing	37,871 LF	Inflow and Structural	\$312,000	\$0	\$312,000
Total Rehabilitation Cost:			\$1,550,000	\$650,000	\$2,200,000
Contingency (30%):			\$465,000	\$195,000	\$660,000
Engineering Cost (20%):			\$403,000	\$170,000	\$572,000
Total Estimated Cost:			\$2,420,000	\$1,015,000	\$3,432,000

A prioritized database of each manhole and pipeline rehabilitation recommendation has been developed as part of this report and can be found in Section 4, as well as Appendices A and B. While it would be ideal to rehabilitate every collection system defect or infiltration source uncovered during the 2017 SSES investigations, the cost to perform this operation may be uneconomical, with reducing returns (in terms of infiltration removed from the system) for lower priority rehabilitation items. In order to mitigate the risk of future conveyance failures in the collection system, we recommend a phased sewer system rehabilitation program focused on addressing sources with the highest infiltration rate and most severe defects encountered during the SSES investigations while maintaining a database of the remaining defects for future rehabilitation consideration.

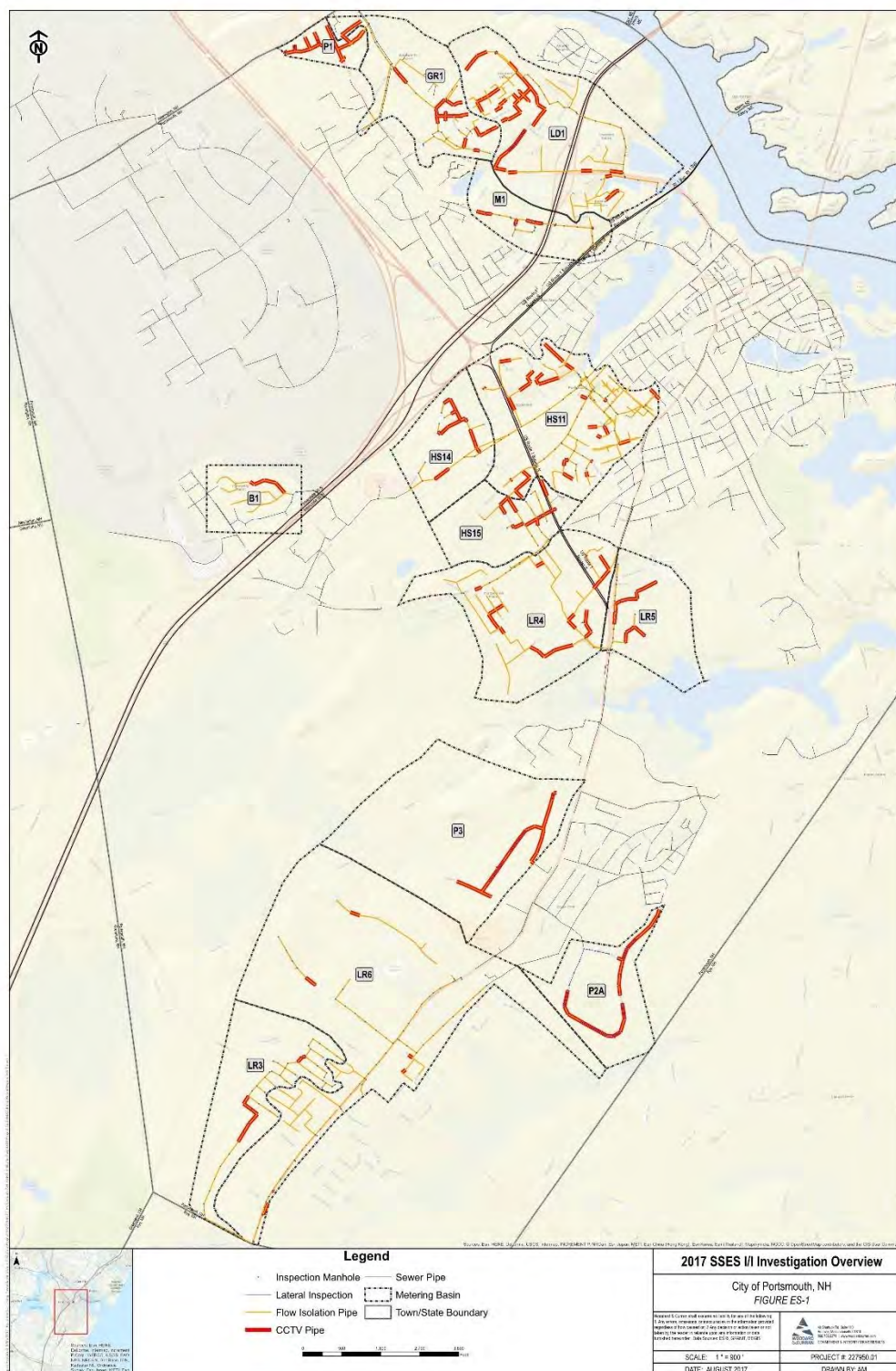
Table ES-3 summarizes the costs associated with the recommended plan, termed the Collection System Infiltration Removal Plan.

Table ES-3: Collection System I/I Removal Plan Summary of Costs

Phase	Contract #1	Contract #2	Contract #3	Contract #4	Totals
Basins Included	LR3, LR4, LR6, GR1	HS11, LR5	LD1, B1, LR1, LR2	HS14, HS15, M1	
Total Infiltration Observed	174,460	31,400	28,300	27,580	261,740
Infiltration Rehabilitation Cost	\$323,000	\$242,000	\$225,000	\$307,000	\$1,097,000
Inflow Rehabilitation Costs	\$35,000	\$165,000	\$97,000	\$15,000	\$312,000
Structural/O&M Rehabilitation Costs	\$63,000	\$163,000	\$63,000	\$105,000	\$394,000
Contingency Cost (30%)	\$127,000	\$171,000	\$116,000	\$129,000	\$543,000
Total Construction Cost	\$548,000	\$741,000	\$501,000	\$556,000	\$2,346,000
Engineering Costs (20%)	\$110,000	\$149,000	\$101,000	\$112,000	\$472,000
Total Estimated Contract Cost	\$658,000	\$890,000	\$602,000	\$668,000	\$2,818,000

The data from this report is incorporated in the City's existing GIS database. The database includes spatial and attribute data for both public and private wastewater infrastructure located within the City's jurisdiction. Through the field investigations completed as part of this study a few spatial updates can be incorporated into the database, allowing for an even more accurate representation. Much of the field data collected by Woodard & Curran and sub-consultants is digital and has been incorporated into ESRI accepted data (shapefiles, feature classes, etc.) that the City can use to inform and update their asset management programs.

Figure ES-1: 2017 Field Investigation Summary



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## 1. PROJECT UNDERSTANDING

### 1.1 BACKGROUND

The City of Portsmouth, New Hampshire (City) is a community of 16.8 square miles located along the Piscataqua River that was originally settled in 1623. The gravity sewer collection system includes approximately 104 miles of pipe, and portions of the system are over 100 years old. As a result, portions of the collection system are structurally deficient and subject to high infiltration/inflow (I/I) rates due to age, condition, and location of the sewer system. The City's wastewater needs are serviced by a combined and separated sanitary sewer collection system that flows to two separate facilities: the Peirce Island and Pease Wastewater Treatment Facilities (WWTF). The Pease WWTF serves the area known as "Pease International Tradeport" while the Peirce Island WWTF serves the residents and businesses of Portsmouth and Newcastle, NH.

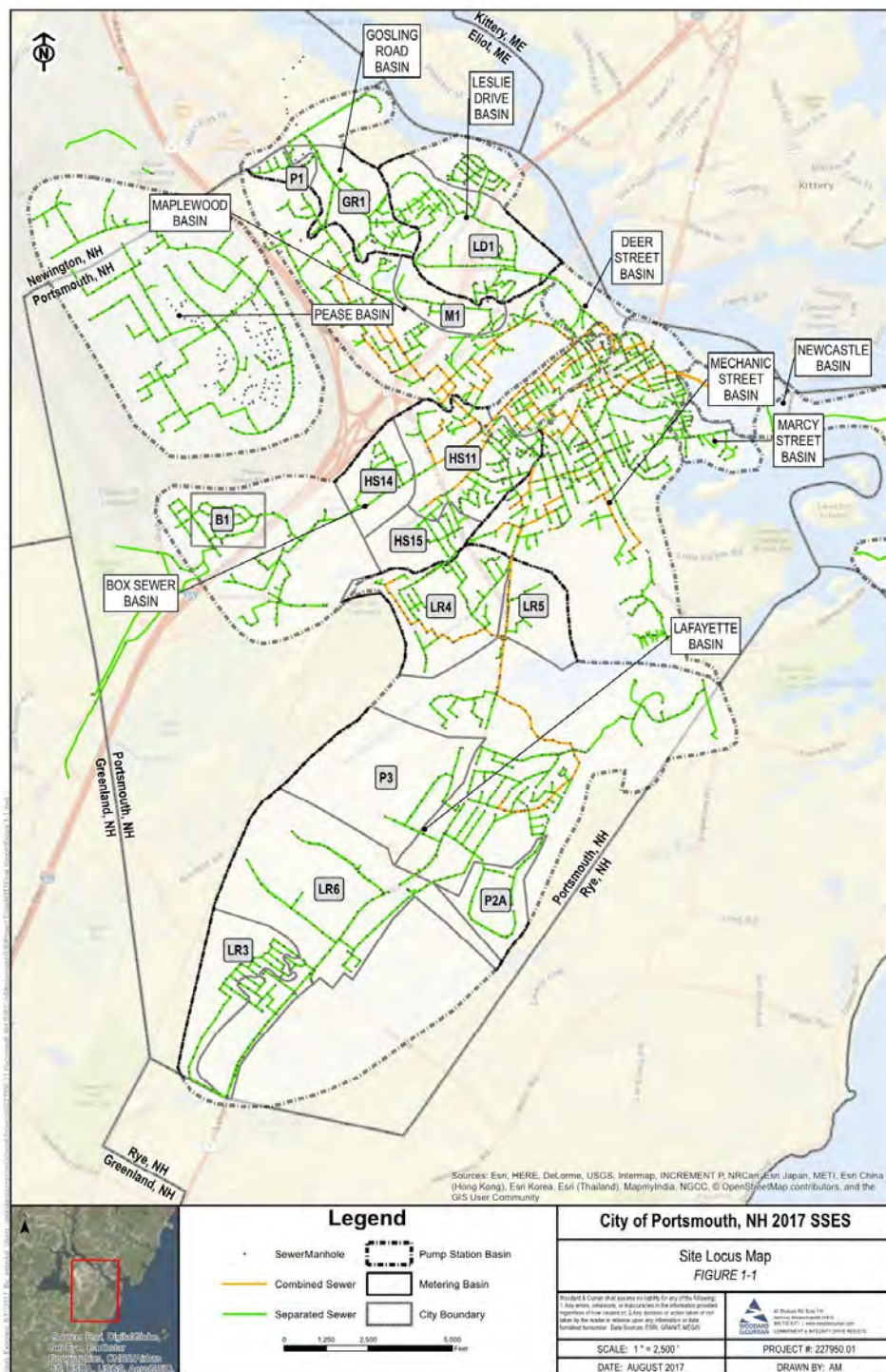
The collection system in the City utilizes an arrangement of combined (sanitary and stormwater) and separate sanitary pipe. Materials currently used in the systems to convey flow are vitrified clay (VC), brick, polyvinyl chloride (PVC), ductile iron (DI), cast iron (CI), high-density polyethylene (HDPE) pipe, reinforced concrete pipe (RCP), non-reinforced concrete pipe (Concrete), and asbestos cement (AC). Manholes in the City are typically mortared brick or precast concrete. The City's collection system consists of approximately 104 miles of sewer, siphon, and force main. Of this amount, approximately 86 miles is sanitary sewer and 18 miles is combined sewer. Within the City's limits, there is approximately 13 miles of private gravity and pressurized sewers. This study focuses only on the gravity sanitary sewer collection system. The combined system comprises is located mostly in the densely populated downtown region as shown in Figure 1-1 – *Site Locus Map*.

Treatment of sanitary wastewater occurs at the Peirce Island and Pease WWTF's. The Pease WWTF is located in the northwest part of the city and treats flows from Pease International Tradeport, an area comprised largely of industrial and commercial buildings. This facility has an average daily design flow of 1.2 MGD of wastewater and discharges effluent to the Piscataqua River. The Peirce Island WWTF is located on Peirce Island adjacent to Prescott Park and Downtown Portsmouth. This facility has an average daily design flow of 4.8 MGD of wastewater from the residential, commercial, and industrial properties of Portsmouth and Newcastle, NH outside of the Pease International Tradeport. The Peirce Island WWTF discharges to the Piscataqua River downstream Pease WWTF outfall. High volume or intense storm events, may cause wet weather flows to exceed the capacity of the collection system and/or treatment plant leading to the activation of the City's combined sewer overflows (CSOs). The City maintains a total of three CSOs, two of which are located on South Mill Pond adjacent to City Hall and the third is located adjacent to Granite State Minerals and discharges to the Piscataqua River.

In accordance with the City's Consent Decree, the City must provide secondary treatment at the Peirce Island WWTF and eliminate its remaining CSOs. As part of the EPA's Nine Minimum Controls Compliance Plan, it is recommended that the City eliminate inflow and infiltration when possible as part of their regular collection system repair and replacement procedures. The purpose of this study is to identify locations that contribute I/I to the City's collection sewer collection system. Once these areas are identified and evaluated, a systematic plan to address significant structural deficiencies and remove major infiltration and inflow (I/I) sources from the system will be developed. It is not fiscally feasible to address all defects and remove all I/I from the system, but addressing the major structural defects and removing a significant volume of I/I can be achieved over the course of the phased plan. It should be noted that the plan to address active defects in the system may take many years and we recommend that the City conduct a regular SSES/asset management/maintenance plan in parallel to keep the system operating effectively.



Figure 1-1: Site Locus Map





## 1.2 PROJECT FOCUS

Throughout this report, extraneous sewer flow from groundwater and stormwater, will be referred to as Infiltration and Inflow (I/I). Infiltration is generally defined as groundwater that enters the collection system through leaking pipes or manholes. Infiltration occurs when existing sewer lines experience material and/or joint degradation and deterioration. Infiltration also can occur when sewer lines are poorly designed and constructed.

Inflow is generally defined as stormwater or river water that enters the collection system directly through open manholes, manhole covers, frame seals or indirect connections with storm sewers.

As described in the *City of Portsmouth Infiltration/Inflow Analysis* (Woodard & Curran, 2016), pump station basins (i.e. areas of the City's sewer infrastructure that drain to a particular sewer pump station) were delineated into smaller "metering basins" that would allow for more precise investigation areas. In each basin, continuous depth-velocity flow meters were installed for a period of twelve weeks to estimate levels of I/I entering the sewer system. The metering program measured sanitary flow, infiltration, and inflow at the discharge manhole of each of these metering basins. Of the metering basins studied, 14 were identified for further infiltration study due to high infiltration rates. Table 1-1 shows the results from the *City of Portsmouth Infiltration/Inflow Analysis*. Sewer basins with high infiltration rates (>1,750 gallons per day per inch-diameter mile, gpd/idm) were studied during the Spring of 2017 (Study Period) and the resulting analysis and recommendations are described in this report. Figure 1-2 – *Sewer System Metering Basins* displays the metering basins investigated as part of the 2017 Infiltration Study.

Table 1-1: 2015 Metering Results

Pump Station Basin	Metering Basin	High Inflow, High Infiltration, or Both	Estimated Infiltration Rate (based on 2015 metering), gpd/idm
Box	B1	Both	2,717
	HS14	High Infiltration	13,969
	HS15	Both	7,557
	HS11	Both	5,198
Maplewood	M1	High Infiltration	3,777
Gosling Road	P1	Both	5,612
	GR1	High Infiltration	4,308
Leslie Drive	LD1	Both	5,194
Lafayette Road	LR4	Both	4,106
	LR5	High Infiltration	7,524
	LR3	High Infiltration	3,842
	LR6	Both	5,806
	P2A <sup>1</sup>	High Infiltration	4,773 <sup>1</sup>
	P3	High Infiltration	6,573
Lafayette Road	LR1	High Inflow	N/A
	LR2	High Inflow	N/A
Box	HS12	N/A	Combined Area - Not Studied
Maplewood	HS13	N/A	Combined Area - Not Studied
Leslie Drive	P2	N/A	1,172

1. Private inflow area P2A was studied as part of this report and falls within metering basin LR2

The purpose of this Sewer System Evaluation Survey (SSES) is to perform a comprehensive and systematic investigation of the City's sewer basins that were identified to experience excessive infiltration. Through this investigation structural and O&M related defects are located, prioritized, and recommended for rehabilitation to address specific deficiencies. At the conclusion of this report, each manhole and pipe segment will have its most significant defects listed with associated rehabilitation methods and estimated budgetary construction cost.

Through the successful removal of infiltration and inflow, peak flows (via high groundwater and rainfall-induced infiltration) to the City's pump stations and wastewater treatment facilities will be reduced. This will lead to decreased wear and tear of the City's mechanical equipment, chemical and energy usage, and SSOs and CSOs. The removal of infiltration an inflow may also lower the WWTF's 12-month rolling average flow. As shown in Table 1-2 – *SSES Investigations Techniques*, the field investigative procedures utilized to identify infiltration are flow isolation, Closed Circuit Television (CCTV) inspection, and manhole inspections. Figure 1-2 – *Sewer System Metering Basins* shows the locations in the City where the SSES was conducted, based on the results of the 2015 metering.

Table 1-2: SSES Investigation Techniques

Investigation Activity	Type of I/I Sources and Defects Identified
Flow Isolation	Infiltration
CCTV Inspection	Infiltration, Structural, and O&M Defects
Manhole Inspections	Infiltration, Structural, and O&M Defects
Smoke Testing	Inflow, Structural
House Inspections	Private I/I



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### 1.3 CITY GEOGRAPHIC INFORMATION SYSTEM (GIS) COORDINATION

Woodard & Curran utilized the City's geographic information system (GIS) wastewater system database current as of April 26<sup>th</sup>, 2017, as a basis for this report. Field maps were created to guide investigation activities. Field data collected during the investigation phases as well recommendations for rehabilitation was successfully linked to the City's existing GIS and a geodatabase/shapefile were ultimately produced that spatially show findings. Many of the figures show the resulting data analysis performed by Woodard & Curran through the field work completed by Flow Assessment Services and Ted Berry Company. Variances between the City's GIS database and the sewer observed in the field (pipe diameter, locations, flow directions, etc.) were noted during field investigations and are provided in Appendix H: Sewer Map Revisions.

## 2. SEWER INFRASTRUCTURE INVESTIGATIONS

In addition to assessing infiltration in the areas of the City identified to experience excessive infiltration, field investigations were conducted to evaluate the structural integrity of the City's sewer infrastructure, and create an infrastructure database that allows the City to prioritize rehabilitation efforts in the immediate and long-term future. The following tasks were completed to locate structural and O&M related defects and quantify infiltration within the City's sewer system:

- Review of existing CCTV data
- Flow isolation
- CCTV inspection
- Manhole inspections

Table 2-1: Summary of Sewer Infrastructure Investigations

Investigation Activity	Type of I/I Sources and Defects Identified	Work Completed
Review of City's Existing CCTV data	Infiltration, Structural, and O&M Defects	14,500 LF
Flow Isolation	Infiltration	174,070 LF
CCTV Inspection	Infiltration, Structural, and O&M Defects	46,066 LF
Manhole Inspections	Infiltration, Structural, and O&M Defects	428 Manholes
Smoke Testing	Inflow, Structural	186,570 LF
House Inspections	Private I/I	345 Buildings

### 2.1 REVIEW OF EXISTING CCTV DATA

As part of the City's Infiltration and Inflow (I/I) program, the City of Portsmouth performs Closed Circuit Television (CCTV) inspection of gravity sewers throughout the City. A portion of these inspection videos were provided to Woodard & Curran for review as part of the Phase 2 Sanitary Sewer Evaluation Survey (SSES) program. Approximately 14,500 linear feet of sanitary sewer pipeline inspection was reviewed to determine the presence of I/I as well as structural defects within the sanitary sewage collection system. The *Sanitary Sewer Collection System DPW CCTV Inspection Results Technical Memorandum* dated 17 July 2017 is included in Appendix E of this report and summarizes the results of the review.

### 2.2 FLOW ISOLATION

#### 2.2.1 DEVELOPMENT OF FLOW ISOLATION PROGRAM

Based on the flow metering program in the *City of Portsmouth Infiltration/Inflow Analysis*, the flow isolation program described herein was developed and implemented to further define sources of excessive infiltration within the City's separated sewer system. Flow isolation was conducted by Flow Assessment Services was conducted on sewer pipes during high groundwater periods from May 1<sup>st</sup> to July 26, 2017 to identify segments in the system that allow infiltration to enter the sewer and should be inspected in detail via sewer pipe CCTV inspection and surface manhole inspection. These sources can include cracked pipe, leaking joints, and service connections incorrectly connected to the sewer

pipe and manholes. Areas to be tested were scheduled with public safety officials and residents in advance to maximize awareness of the investigation.

Flow isolation was conducted on each scheduled manhole-to-manhole segment between the hours of 12:00 A.M. and 6:00 A.M. on dry days during high groundwater levels. It is assumed that between these hours, sanitary flow from residential buildings is negligible and the majority of flow in the sewer system is infiltration. For each flow-isolated segment, a pre-calibrated weir was placed in the downstream end of the pipe segment to measure the depth and velocity of flow. The resulting flow rate is then mathematically compared against measured flows from sewer system upstream to calculate the "Net Line Flow" or the measured rate of infiltration for each flow isolation segment.

The flow rates calculated for each flow-isolated segment were normalized into units of gallons per day per inch-diameter mile (gpd/idm), allowing for the comparison of relative infiltration severity between different lengths and diameters of sewer pipe. The measured infiltration rates were compared to a benchmark value for excessive infiltration of 4,000 gpd/idm. Studies define this value as the infiltration rate at which the cost to transport and treat infiltration is greater than the cost to remove it from the system (i.e. the point at which rehabilitation is cost-effective). The recommended threshold of 4,000 gpd/idm was used as the benchmark to recommend pipe segments for CCTV inspection. As approved by the City the threshold was lowered to 1,750 gpd/idm to increase the quantity of sewer line segments to undergo CCTV inspection to locate additional infiltration sources.

All observations from flow isolation are entered into a Microsoft Excel and GIS database for review and analysis. This database is then used to develop recommendations for additional investigation such as CCTV, manhole inspections, or building inspections. This data can be imported into the City's GIS database.

## 2.2.2 FLOW ISOLATION FINDINGS

A total of 174,070 LF of sewer pipe was investigated, which is approximately 42% of the City's separated sewer system. The study successfully flow isolated 93% of the sanitary sewer system located in the basins identified for excessive infiltration during the *City of Portsmouth Infiltration/Inflow Analysis*. The flow isolation program identified approximately 913,000 gallons per day of possible infiltration entering the sewer system in the investigated areas that is the result of infiltration measured at three locations in the sanitary sewer system:

- Pipe Infiltration – Infiltration originating from sewer pipes and service connections, as measured by pre-calibrated weirs. A total of 174,070 LF of sewer pipe was flow isolated during this phase of work.
- Manhole Defect Infiltration – Infiltration originating from defects in the manhole structures, as estimated by visual observation.
- Manhole Service Infiltration – Infiltration originating from direct service connections to manholes that are not considered to be city-owned mainline sewers, as measured by pre-calibrated weirs.

Based on the findings of the Flow Isolation work, 51,257 LF of sewer had measured infiltration rates greater than 1,750 gpd/idm or 30% of the sewer pipe flow isolated during this study. Sewer pipes that measured above 1,750 gpd/idm accounted for approximately 630,000 gallons per day, while pipes experiencing less severe infiltration rates accounted for 56,000 gallons per day. Therefore, it can be reasoned that 90% of the infiltration due to sanitary sewer pipes is located in just 30% of the pipes. Visual observations of each manhole during flow isolation set up located a total of 37 manholes with active infiltration and 39 manholes with service connections that show active infiltration.

Figure 2-1: *Flow Isolation Results* illustrates sewer pipes investigated during the flow isolation program along with those pipe segments with infiltration rates in excess of 1,750, and 4,000 gpd/idm.

Table 2-2: *Flow Isolation Pipe Findings* summarizes observed infiltration rates associated with each sewer subarea. Raw data provided by Flow Assessment is included in Appendix C.

Table 2-3: *Flow Isolation Manhole Findings* summarizes observed infiltration rates located and measured during flow isolation. Although, typical flow isolation measurements only include infiltration located inside of the sewer pipe, Flow Assessment Services also separately documented infiltration occurring at the sanitary sewer manholes via field comments and photos.

Table 2-4: *Summary of Infiltration Measured during Flow Isolation* summarizes infiltration found at both the sewer pipes and sewer manholes during flow isolation per basin.

Table 2-2: Flow Isolation Pipe Findings

Meter Basin	Sewer System Flow Isolated (LF)	Sewer System Flow Isolated > 4000 gpd/idm (LF)	Sewer System Flow Isolated > 1750 gpd/idm (LF)	Total Observed Infiltration (gpd)
B1	4,800	111	951	6,120
GR1	14,558	2,910	4,330	65,909
HS11	28,298	3,494	7,984	88,488
HS14	6,139	2,209	3,167	39,240
HS15	7,306	1,923	3,820	35,712
LD1	26,214	7,447	12,011	129,067
LR3	12,143	1,626	1,626	54,072
LR4	19,510	3,692	5,894	80,208
LR5	5,186	1,857	2,902	23,184
LR6	27,334	982	1,415	64,224
M1	5,568	1,239	1,740	32,112
P1	6,926	3,146	4,649	59,198
P2A	5,134	134	767	8,568
P3	4,954	-	-	360
Total	174,070	30,769	51,257	686,462

Table 2-3: Flow Isolation Manhole Findings

Meter Basin	Number of Manholes with Infiltration	Estimated Manhole Defect Infiltration (gpd)	Number of Manholes with Service Flow	Estimated Service Flow Infiltration (gpd)	Total Manhole Infiltration (gpd)
B1	1	720	-	-	720
GR1	4	34,704	5	11,376	46,080
HS11	5	11,088	7	24,192	35,280
HS14	-	-	2	504	504
HS15	3	2,592	2	2,160	4,752
LD1	7	9,000	9	11,016	20,016
LR3	-	-	-	-	-
LR4	10	23,328	4	9,720	33,048
LR5	-	-	1	2,880	2,880
LR6	2	7,560	8	70,920	78,480
M1	-	-	-	-	-
P1	4	2,520	1	1,440	3,960
P2A	-	-	-	-	-
P3	1	1,080	-	-	1,080
Total	37	92,592	39	134,208	226,800

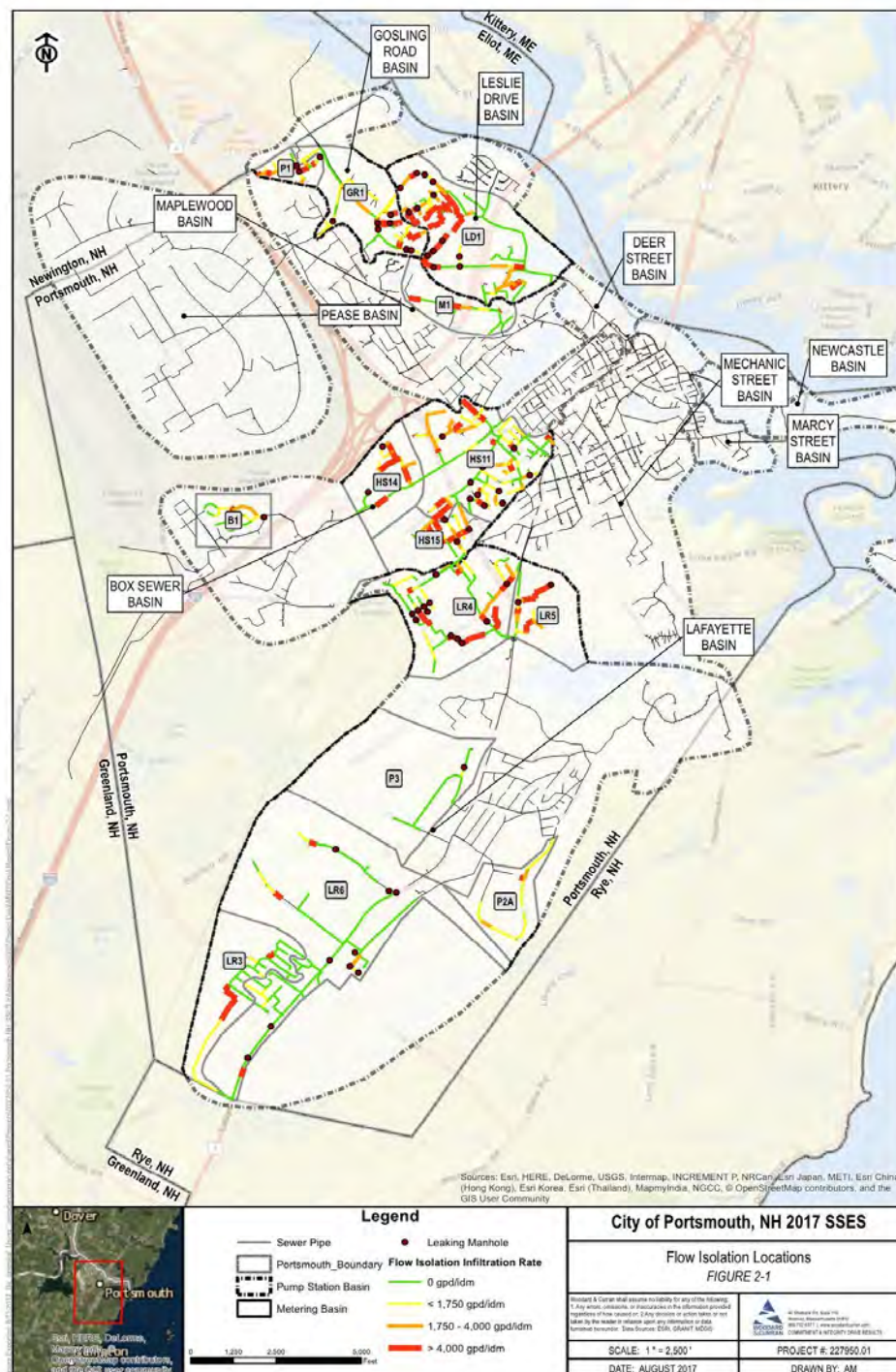
Table 2-4: Summary of Infiltration Measured During Flow Isolation

Meter Basin	Pipe Infiltration (gpd)	Manhole Defect Infiltration (gpd)	Manhole Service Infiltration (gpd)	Total Infiltration (gpd)
B1	6,120	720	-	6,840
GR1	65,909	34,704	11,376	111,989
HS11	88,488	11,088	24,192	123,768
HS14	39,240	-	504	39,744
HS15	35,712	2,592	2,160	40,464
LD1	129,067	9,000	11,016	149,083
LR3	54,072	-	-	54,072
LR4	80,208	23,328	9,720	113,260
LR5	23,184	-	2,880	26,064
LR6	64,224	7,560	70,920	142,704
M1	32,112	-	-	32,112
P1	59,198	2,520	1,440	63,158
P2A	8,568	-	-	8,568
P3	360	1,080	-	1,440
Total	686,462	92,592	134,208	912,110

Flow isolation measurements and observations successfully located sewer pipes and manholes with excessive infiltration. The investigations following flow isolation, and described in the sections below, are aimed to locate, assess, and recommend rehabilitation for the specific defects that cause infiltration in the City's sanitary sewer system. Sewer pipe that was measured to have infiltration rates greater than 1,750 gpd/ldm were recommended for CCTV inspection and manholes that were observed to have infiltration were recommended for surface manhole inspection.



Figure 2-1: Flow Isolation Locations



## 2.3 SEWER PIPE CCTV INVESTIGATIONS

### 2.3.1 DEVELOPMENT OF CCTV INVESTIGATION PROGRAM

The CCTV investigation program described herein was developed and implemented to identify infiltration, assess structural condition, and locate defects causing operational issues in the City's sewer pipes.

CCTV inspections were concentrated in areas of the City with excessive infiltration as identified by the flow isolation program discussed in Section 2.2. The field CCTV investigation program was conducted by Ted Berry Company, Inc., under subcontract to Woodard & Curran, between March 30, 2017 and July 26, 2017 as well as September 12 & 13, 2017. Ted Berry inspected sewer pipes that were measured to have excessive infiltration ( $>1,750$  gpd/ldm). Therefore, of the 174,000 LF of sewer system flow isolation conducted, approximately 51,000 LF was scheduled for CCTV inspection.

All CCTV inspections were conducted in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP). Using NASSCO's pipeline assessment standards, sewer pipes are graded using a sum of the individual defects occurring within the manhole-to-manhole reach. Defects are ranked per NASSCO's standards on a scale of 1 through 5, with 1 defined as the most minor defect with no immediate action required and 5 defined as a major defect with immediate action required. For detailed information on the NASSCO grading system and guidelines, the NASSCO website can be accessed at <https://www.nassco.org/>.

### 2.3.2 CCTV INSPECTION FINDINGS

CCTV inspection revealed structural and O&M issues throughout the City's sewer system. A total of 46,066 LF of sewer pipe was successfully inspected, which is approximately 9% of the City's sewer system. Of the pipe investigated, CCTV inspection pinpointed infiltration defects as well as structural defects such as fractures and broken pipes as well as O&M issues such as grease and root intrusion. Structural damage such as collapsed pipes, or maintenance issues such as large root masses, can severely limit the hydraulic capacity of sewer pipes and cause backups or SSOs. Figure 2-2– *CCTV Inspection Locations* illustrates the locations of pipe segments that were inspected. All inspections were digitally recorded onto external hard drives and will be delivered to the Portsmouth Department of Public Works for incorporation into the City's GIS. CCTV inspection reports are included in Appendix D, and provide the following information for inspected pipe segments: unique pipe identification (ID) number, street name, inspection date, inspected length, pipe size and material, location of service connections, location and severity of defects, photos of pipe condition, and NASSCO ratings.

These reports, as well as the digital recordings of the inspections, were reviewed and analyzed by Woodard & Curran for accuracy regarding defects located during field inspection. Pipe defects were classified using the standard NASSCO coding system on a scale of 1 through 5 as described in Section 2.3.1. A summary of defects found throughout CCTV inspection can be found in Table 2-7 – *Summary of Pipeline Defects*. NASSCO pipe rankings are used as a tool to help prioritize pipe segments for future rehabilitation and can be incorporated into the City's risk analysis software VueWorks.

This report focuses on locating and quantifying infiltration in the City's sewer system and therefore, each pipe segment was evaluated for mainline and lateral infiltration. Table 2-5 – *Summary of Mainline and Lateral Infiltration* provides a breakdown of estimated infiltration observed during CCTV inspection per basin. Mainline infiltration is groundwater observed entering directly into the main sewer line via defects (e.g. fractures, holes, etc.) or leaking pipe joints; lateral infiltration is clear water observed flowing from laterals entering the main line. It is typical of lateral infiltration to appear at a constant flow rate, in contrast to the flush of a toilet or laundry system. Approximately 63,500 gpd of mainline

infiltration and 77,000 gpd of lateral infiltration were observed based on review of the CCTV inspections. CCTV inspection activities are summarized in Table 2-6 – *CCTV Investigation Summary by Pipe Diameter*.

Table 2-5: Summary of Mainline and Lateral Infiltration

Metering Basin	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Total Infiltration (gpd)
B1	-	2,016	2,016
GR1	15,120	4,320	19,440
HS11	3,024	20,160	23,184
HS14	1,728	4,032	5,760
HS15	5,328	4,608	9,936
LD1	5,184	15,984	21,168
LR3	5,760	-	5,760
LR4	12,528	7,344	19,872
LR5	720	-	720
LR6	12,240	720	12,960
M1	-	-	
P1	1,728	7,920	9,648
P2A	-	7,776	7,776
P3	-	1,872	1,872
Total:	63,360	77,040	140,112

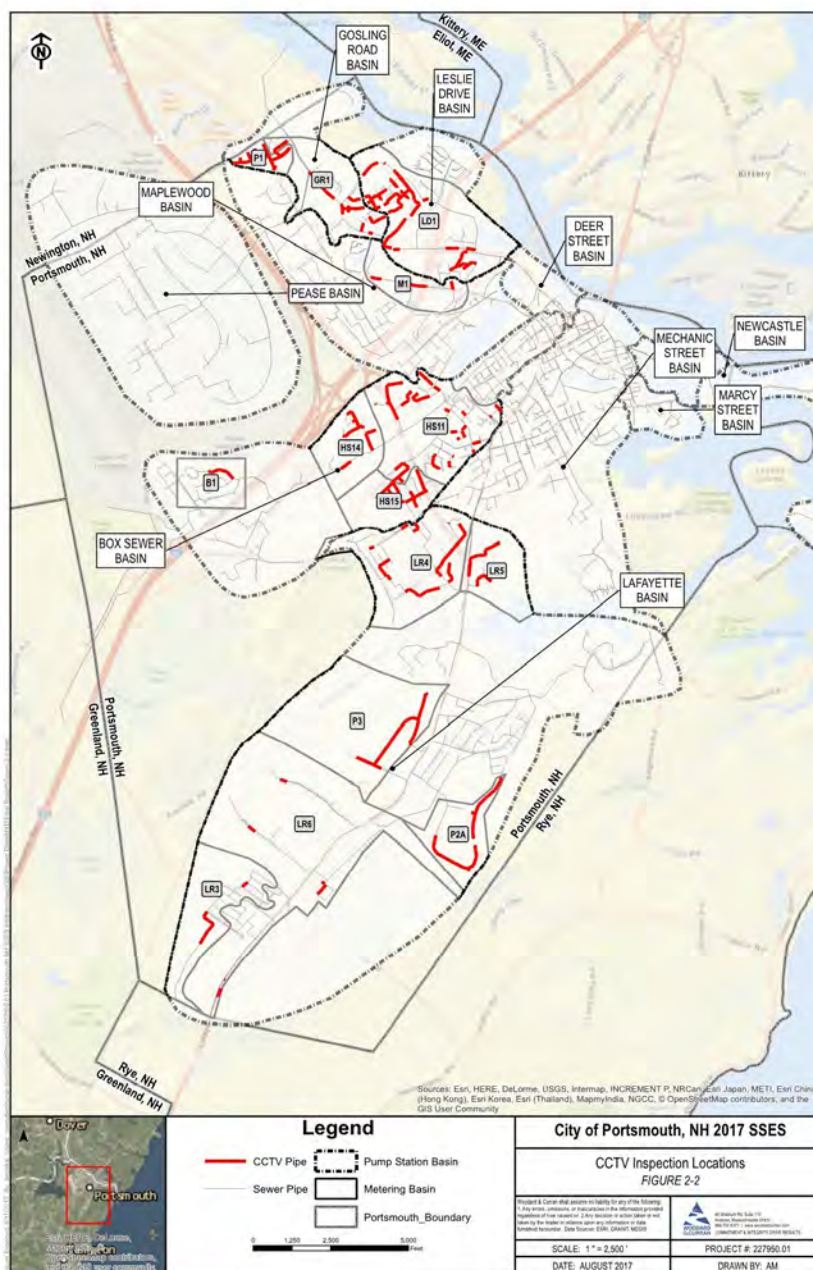
Table 2-6: CCTV Investigation Summary by Pipe Diameter

Metering Basin	6"	8"	10"	12"	>12"	Total
B1	0	759	0	0	0	759
GR1	1,140	942	460	0	0	2,542
HS11	203	4,031	930	1,007	0	6,171
HS14	0	1,480	213	575	393	2,661
HS15	0	2,478	677	290	0	3,445
LD1	1,195	4,672	893	0	0	6,760
LR3	0	234	1,417	0	0	1,650
LR4	0	4,349	1,303	0	0	5,652
LR5	0	495	804	0	0	1,299
LR6	0	1,458	0	0	0	1,458
M1	33	569	359	0	0	961
P1	108	2,643	683	217	0	3,651
P2A	0	5,047	0	0	0	5,047
P3	64	3,946	0	0	0	4,010
Total:	2,744	33,103	7,738	2,089	393	46,066

Table 2-7: Summary of Pipeline Defects

Category	Type of Defect	Total Count
Structural	Collapsed Pipe	2
Structural	Deformed Pipe	15
Structural	Broken Pipe	46
Structural	Hole	24
Structural	Fracture/Crack	219
Structural	Offset/Separated Joint	408
Structural	Other - STR	18
O&M	Infiltration	425
O&M	Grease	113
O&M	Roots	392
O&M	Debris	117
O&M	Protruding Lateral	92
O&M	Other - O&M	13
Total		1884

Figure 2-2: CCTV Inspection Locations





## 2.4 MANHOLE INSPECTIONS

### 2.4.1 DEVELOPMENT OF MANHOLE INSPECTION PROGRAM

Based on recommendations from the flow metering program included in the *City of Portsmouth Infiltration/Inflow Analysis* and the observations from the flow isolation study described above, the manhole inspection program described herein was developed and implemented to assess manhole condition, locate sources of infiltration and to identify structural defects and surcharged conditions in the City's sewer manholes. All manholes that were observed to have infiltration entering directly into the manhole during flow isolation were inspected via surface inspection during this phase.

Of the sewer basins that were metered during the spring of 2015, the following areas shown to have the highest I/I rates were selected for manhole investigation in 2017: GR1, LD1, HS11, LR3, LR6, LR5, HS14, HS15, M1, LR4, and B1. In these sewer basins, 96 manholes were inspected by Flow Assessment between May 22<sup>nd</sup> and May 26<sup>th</sup> of 2015 and consequently excluded from the 2017 field program that forms the basis of this report. Manhole Inspections were completed by Flow Assessment, under subcontract with Woodard & Curran, between June 20<sup>th</sup> and July 13<sup>th</sup> of 2017 as well as on September 8<sup>th</sup>, 2017.

During the inspection, Flow Assessment utilized the City's existing GIS database to identify sewer manholes as prescribed by Woodard & Curran. Each inspection consisted of a digital report, a surface photograph, and a "top-down" photograph looking into the manhole with the northern direction at the top of the photo. Manhole inspection data was compiled into a Microsoft Access database for reporting purposes. The data collected during each individual manhole inspections includes the following:

- Material and condition of manhole cover, frame, chimney, walls, invert and bench
- Inflow potential due to ponding or flooding
- Size, material, and location of pipe connections
- Evidence of surcharging
- Location of all observed leaks and defects
- Manhole depth

Material and condition of each manhole attribute (cover, frame, chimney, walls, invert, and bench) was graded on a 1-5 scale developed by Flow Assessment as presented in Table 2-8. The data collected during manhole inspections was organized into an electronic database to serve as a tool in prioritizing rehabilitation for each asset. Data collected during the manhole inspection process can be exported to the City's GIS database.

Table 2-8: Manhole Condition Grading

Grade	Description	Rehabilitation Recommendation
1	Good Condition	No Further Action Needed
2	Minor Defects Observed	No Immediate Action Needed No I/I Observed
3	Minor Defects or I/I Potential	Needs Attention or Rehabilitation
4	Significant Defects and or I/I	Corrective Action Should Be Scheduled in Near Future
5	Manhole or Connecting Pipes in Extremely Poor Condition	Failure Eminent, Needs Immediate Attention

## 2.4.2 MANHOLE INSPECTION FINDINGS

Manhole inspections revealed structural and O&M issues throughout the City's sewer system access structures. Structural defects such as missing bricks, missing mortar, cracked walls, bench and invert defects can contribute to I/I and lead to manhole failure and create maintenance issues such as SSOs or roadway damage. A total of 490 manholes (or 13% of the City's sewer manholes) were scheduled for inspection and 428 were successfully inspected via surface inspection. Manholes that were not successfully inspected via surface inspection could either not be located (i.e. overgrown, buried, inaccessible) or could not be inspected (i.e. broken cover, manhole abandoned, cover too large to open per typical operation). Table 2-9 summarizes the manhole inspection program results by metering basin.

Table 2-9: Manhole Inspection Summary

Metering Basin	Manholes Attempted	Surface Inspection Completed	Manhole Not Located	Manhole Cannot be Inspected
B1	5	5	0	0
GR1	64	52	11	1
HS11	88	66	16	6
HS14	26	26	0	0
HS15	30	25	5	0
LD1	33	25	5	3
LR3	55	52	3	0
LR4	22	21	1	0
LR5	29	23	6	0
LR6	73	72	0	1
M1	38	36	2	0
P1	0	0	0	0
P2A	27	25	2	0
P3	0	0	0	0
Total	490	428	51	11

Manholes that were successfully inspected via surface inspection were assessed for infiltration, structural defects, and operational and maintenance defects. During the inspection, as described above, each component of the manhole was assessed (on a scale of 1-5) in the field by Flow Assessment Services and confirmed by Woodard & Curran by desktop analysis for rehabilitation priority. Where desktop analysis identified defects not originally recorded during field inspection, rehabilitation is recommended. For example, if initial field inspection did not identify infiltration at a manhole joint, but review of the manhole photo located infiltration then the inspection database would be updated, and the manhole would be recommended for the necessary rehabilitation.

Infiltration at each manhole was estimated by Flow Assessment in the field during each surface inspection. Where manholes were identified to experience greater infiltration during flow isolation than during manhole inspection, the flow isolation observed infiltration rate is reported to represent worst case scenario.

Table 2-10 and 2-11 summarize manhole defects, the infiltration observed during manhole inspection as well as a count of manhole components that require rehabilitation based on field observation by Flow Assessment Services.

Table 2-10 provides a count of the defects located compared to the number of defects severe enough to require rehabilitation. For example, there were 105 manholes that were observed to have debris in the manhole, but only 71 manholes that are in imminent need of cleaning in order to reduce hydraulic restriction. The counts for the structural category reflect the logic described in Table 2-8. Rehabilitation was recommended for all observations of surcharge or infiltration.

Table 2-10: Summary of Manhole Defects

Category	Type of Defect	# Defect Observations	# Observations Recommended for Rehabilitation
Structural	Cover	11	11
Structural	Frame	39	39
Structural	Corbel	129	129
Structural	Wall	108	108
Structural	Bench/Invert	147	86
O&M	Debris	105	71
O&M	Surcharge	11	11
O&M	Roots	27	14
I/I	Infiltration	74	74
Total:		651	541

Table 2-11 provides a count of the manholes that showed infiltration in each meter basin. The total amount of manhole infiltration per metering basin is also summarized.

Table 2-11: Summary of Manhole Infiltration

Metering Basin	Count of Manholes with Infiltration	Observed Infiltration Rate (gpd)
B1	1	720
GR1	18	53,496
HS11	16	14,904
HS14	5	4,248
HS15	6	4,320
LD1	4	5,760
LR3	3	6,048
LR4	7	40,680
LR5	3	864
LR6	8	11,088
M1	3	1,008
P1	0	-
P2A	0	-
P3	0	-
Total	74	143,136

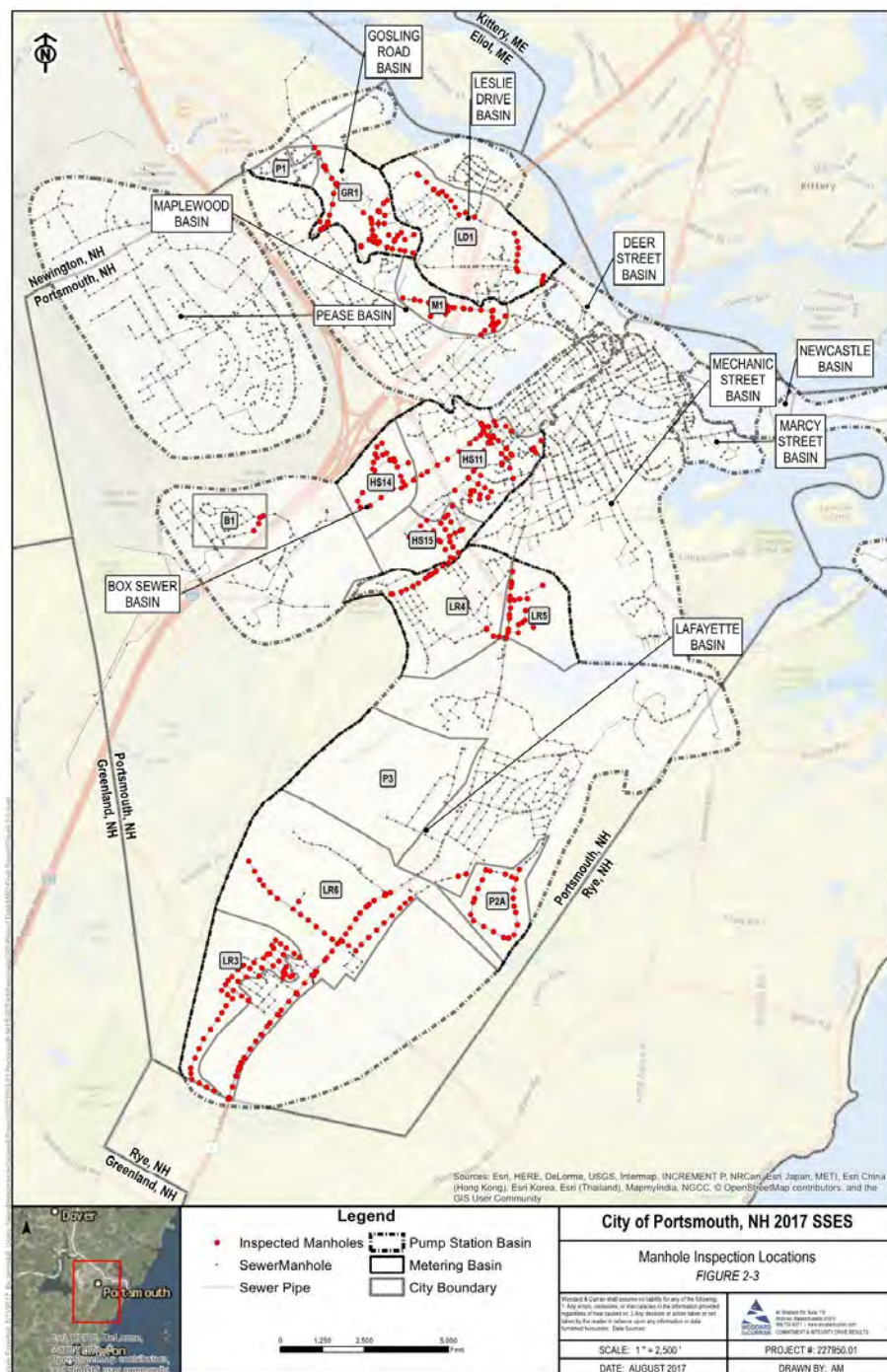


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Manhole inspections identified 179 manholes with defects significant enough to warrant rehabilitation recommendations. Defects included broken manhole covers, missing mortar, missing bricks, infiltration, surcharge, settled debris, and root intrusion. A total of 249 manholes do not require rehabilitation.

Figure 2-3 – *Manhole Inspection Locations*. Of the 428 inspected manholes, approximately 74 manholes showed signs of infiltration during manhole inspection, totaling an estimated 143,136 gallons per day. Inspection reports are included in Appendix C.

Figure 2-3: Manhole Inspection Locations



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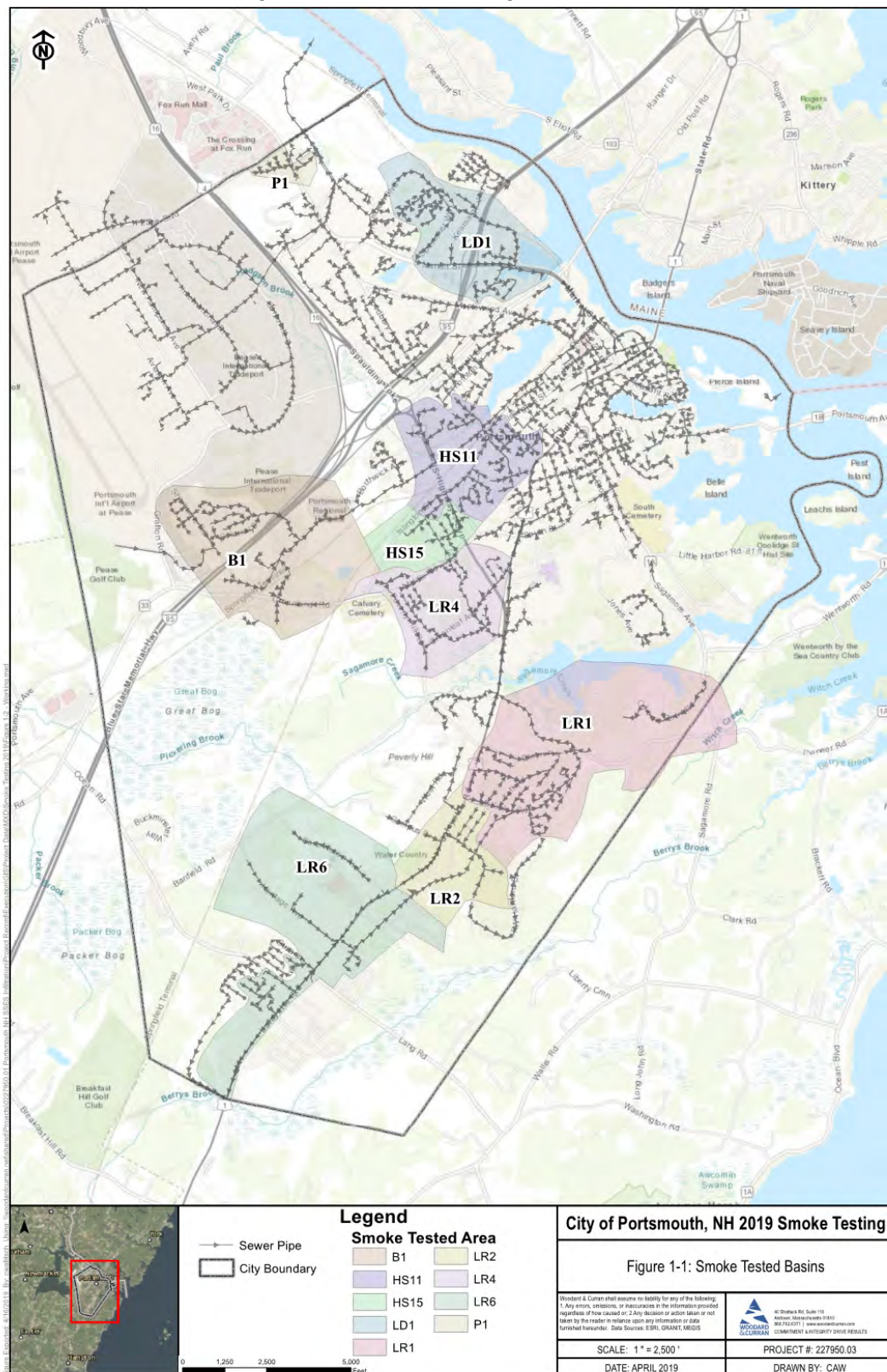
## 2.5 SMOKE TESTING

### 2.5.1 DEVELOPMENT OF THE SMOKE TESTING PROGRAM

As the first step in a comprehensive I/I – SSES Program, a flow metering program was conducted in the Spring of 2015 for the entire City of Portsmouth. The flow metering program identified subareas where infiltration and inflow are present in the system, prioritized the areas by the volume of infiltration and inflow identified, and recommended those subareas with excessive I/I for further study. Based on the recommendations from the flow metering program, the smoke testing program described herein was developed and implemented to address inflow sources within the sewer system.

The smoke testing program recommended in the 2015 I/I Report included the testing of approximately 202,510 linear feet of pipe in nine subareas of the wastewater collection system. These areas are shown in Figure 2-4. The field program was completed by Flow Assessment Services, LLC during the months of September and October 2018. Smoke testing is ideally conducted on sewer pipes during dry weather and low groundwater to identify points in the system that allow inflow to enter the sewer. These point sources can be cracked manhole covers, broken cleanouts, storm drains incorrectly connected to the sewer system, roof leaders, and yard drains.

Figure 2-4: Smoke Testing Subareas





A comprehensive public notification program was developed in conjunction with DPW, fire and police officials. Areas to be tested were scheduled with public safety officials and residents in advance to maximize awareness of the program. Residents were notified one week and 24-hours in advance of the work.

The smoke testing involved the introduction of a non-toxic smoke into the sewer system using a container of smoke-producing liquid and a blower. The smoke travels through the pipe and service connections, typically exiting through building vent stacks and from non-waterproof manhole covers. Where service cleanouts are broken; manholes have cover or corbel cracks; drains are directly connected to the sewer, etc. smoke will be observed exiting from them and these sources are easily identified as being potential contributors of inflow to the sewer system. In cases where smoke is emanating from drain structures, dye water testing and flooding of the suspect drain system can be used to verify the presence of an inflow-contributing source.

Table 2-12 presents a summary of the Smoke Testing Program showing the subareas recommended for smoke testing in the I/I Report, the actual length of sewers tested and the number of locations where smoke was observed. Observations are further broken down into those that were determined to be direct connections (heavy smoke indicating a direct link between the stormwater source and the wastewater collection system) or indirect connections (lighter smoke indicating a possible broken pipe or another path). Direct connections typically result in significantly higher volumes of inflow, and therefore are generally more cost effective to rehabilitate.

Table 2-12: Summary of Smoke Testing Program

Area	Actual Footage of Smoke Testing Total (LF)	Footage of Smoke Testing with Defects (LF)	Number of Defects Identified
Subarea B1	25,413	4,363	3
Subarea HS11	29,902	12,559	23
Subarea HS15	6,814	2,594	1
Subarea LD1	26,942	6,372	8
Subarea LR1	34,050	4,541	9
Subarea LR2	14,543	973	2
Subarea LR4	19,506	2,433	4
Subarea LR6	25,697	3,592	5
Subarea P1	3,703	444	0
Total	186,570	37,871	55

## 2.5.2 ESTIMATED INFLOW VOLUME

Peak inflow was calculated for the flow metering program based on one inch of rain. This value is used to calculate the peak inflow quantity at each location identified as a potential source. The Rational Method is used to calculate peak inflow at each location in cubic feet per second, using the following formula:

$$Q = CiA$$

The values of C (runoff co-efficient) and A (in acres) were estimated in the field by Flow Assessment and are included in the attached Smoke Testing Report. The rainfall intensity (i) is the design storm intensity used to evaluate the metering results: 1 inch /hour for the storm's peak hour. Q (flow) is in cubic feet per second (cf/sec) and is converted to gallons per day (gpd). A summary of estimated inflow per subarea is presented in Table 1-2. Full details of each direct connection, such as location data, and pictures/sketches of the inflow source are included in Appendix B to this report.

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### 2.5.3 FINDINGS OF THE SMOKE TESTING PROGRAM

The findings of the smoke testing program are summarized below by area. A full listing of all pipe segments and findings of the smoke testing program is included as Appendix A to this report.

#### 2.5.3.1 Subarea B1

Smoke testing was conducted on 121 line sections in Subarea B1. Smoke was observed from three potential inflow sources in this subarea, all of which were on Greenland Road. One source was a direct connection to catch basin #2908 on Greenland Road. The second source is suspected to be a buried cleanout on Greenland Road, but the manhole could not be located. The third source was a broken cover, also located on Greenland Road. The catch basin is estimated to drain approximately 3,600 square feet (SF) resulting in approximately 2,000 gallons of inflow per inch of rain. The other sources are in unpaved areas and likely do not allow significant flows to enter the system. It is recommended that the direct connection to catch basin #2908 be redirected. For the remaining direct connections, fixing the frames and covers is recommended. All inflow sources identified, regardless of the estimated drainage area, are recommended for repair.

#### 2.5.3.2 Subarea HS11

Smoke testing was conducted on 171 line sections in Subarea HS11. Smoke was observed from 23 potential inflow sources in this subarea. Thirteen (13) of these sources were direct connections, including nine catch basins, two driveway drains, one roof leader, and a frame and cover which needs repairs. These sources are estimated to contribute approximately 53,000 gallons of inflow per inch of rain from the 7,300 SF drainage area. The remaining nine sources were classified as indirect sources. Recommended repairs for the direct connections include redirecting catch basin piping and repairing broken cleanout caps. It is recommended that indirect connections are monitored to track whether inflow problems increase.

#### 2.5.3.3 Subarea HS15

Smoke testing was conducted on 29 line sections in Subarea HS15. Smoke was observed from one potential inflow source in this subarea. This source was a catch basin with a direct connection and is located on Middle Road. The catch basin is estimated to drain approximately 6,900 SF, resulting in approximately 2,200 gallons of inflow per inch of rain. This pipe segment is one of the largest drainage areas and highest flow contributors throughout the entire collection system that was evaluated and is recommended for repair.

#### 2.5.3.4 Subarea LD1

Smoke testing was conducted on 152 line segments in Subarea LD1. Smoke was observed from eight potential inflow sources in this subarea. Six of these sources were direct connections, while two were indirect connections. Missing covers were observed on two of the seven potential direct inflow sources. Three of the direct connections were observed along Market Street, and showed smoke from the sidewalk, curb, and ground. The final direct connection was from a cracked, exposed chimney on an unmapped manhole located in the shoulder of Market Street. The flows contributed from these defects are minimal, contributing approximately 190 gallons of flow per inch of rain over a drainage area of approximately 1,000 SF. All direct connection inflow sources identified, regardless of the estimated drainage area, are recommended for repair.

#### 2.5.3.5 Subarea LR1

Smoke testing was conducted on 153 line segments in the LR1 subarea. Smoke was observed from nine potential inflow sources. Seven of these sources were direct connections, while 2 were indirect connections. Five of the direct

connections are the result of broken infrastructure, such as corbels and covers, requiring the frames, covers and/or cleanouts of these connections to be repaired. The other two direct connections require redirecting a catch basin, and a yard drain. Combined, these two sources account for approximately 4,000 gallons of inflow from a drainage area of 11,200 SF. Redirecting the yard drain and catch basin at these locations is recommended. The indirection connections were attributed to catch basin connections, and monitoring is recommended for these areas. These sources do not have a large drainage area but do contribute significant flow. All inflow sources identified, regardless of the estimated drainage area, are recommended for repair.

#### 2.5.3.6 Subarea LR2

Smoke testing was conducted on 63-line segments in the LR2 subarea. Smoke was observed from two potential inflow sources. The first potential source is a direct source, due to a missing cap from an at grade cleanout. The other source is an indirect connection between catch basins indicating the potential for a cracked pipe. The drainage areas and peak hourly inflow for the sources are minimal.

#### 2.5.3.7 Subarea P1

Smoke testing was conducted for 21-line segments in the P1 subarea. No smoke was observed from any of these pipe segments

Table 2-13: Estimated Inflow Summary

Area	Footage of Smoke Testing with Defects (LF)	Number of Locations with Direct Connections	Number of Locations with Indirect Connections	Estimated Inflow per Inch of Precipitation (gallons)
Subarea B1	4,363	3	0	2,000
Subarea HS11	12,559	13	10	53,300
Subarea HS15	2,594	1	0	2,200
Subarea LD1	6,372	6	2	200
Subarea LR1	4,541	7	2	4,100
Subarea LR2	973	1	1	<100
Subarea LR4	2,433	3	1	1,000
Subarea LR6	3,592	5	0	<100
Subarea P1	444	0	0	0
Total	37,871	39	16	62,000

### 2.5.3.8 Conclusions and Recommendations

The results show that Subareas B1, HS11, LR1, and HS15 contribute the most amount of inflow to the overall collection system. In addition to contributing the most inflow, approximately 53,300 gallons per inch of precipitation, subarea HS11 also has the highest number of defects identified (22). This area accounts for approximately 85% of the total estimated inflow and should be prioritized for the repairs that were discussed previously in the report. The next highest contributor, LR1, contributes approximately as much flow as B1 and HS15 combined. Addressing these three areas, which account for approximately 92% of the remaining flow, should be completed once subarea HS11 has been addressed. Targeting all four of these areas first will address 98% of the total estimated inflow.

It is recommended that repairs be made to all direct sources identified herein, because addressing these direct sources is more cost-effective for the City than attempting to address every identified defect. The indirect sources identified during the smoke testing were all estimated to contribute minor volumes of inflow to the system compared to other sources identified. These sources did not warrant further testing by dye testing or flooding due to their limited impact. Instead, we recommend that the City continue to monitor these locations to confirm that conditions which contribute to inflow are not deteriorating and causing additional inflow and/or structural issues with the pipe or roadway.

The estimated cost to rehabilitate each of the inflow sources identified is based on typical efforts required to redirect an inflow source from the wastewater collection system to a storm drain. We have used the following estimated costs to calculate the costs listed in Table 1-3: Redirecting a catch basin was estimated to cost \$15,000. Redirecting a driveway drain, roof leader, or repairing a frame and cover was estimated to cost \$7,500. Repairing a cleanout cap was estimated to be \$1,000 and monitoring for indirect sources was estimated at \$0. All repair costs were calculated based on the type of repair, and then totaled for each subarea, resulting in a total estimated cost to redirect inflow. However, each inflow source will vary and the cost to rehabilitate is highly dependent on the proximity of the closest storm drain line. These cost estimates should be used for planning level purposes only. A more detailed analysis of the remediation required, and construction cost estimate to redirect flows can be developed on a case-by-case basis in the design phase.

A summary of the construction cost to redirect the direct inflow sources by subarea, and the cost-effectiveness of the work is included as Table 2-14. A summary of the types of defects found in each subarea is shown in Table 2-15.

Table 2-14: Estimated Rehabilitation Cost – Direct Sources

Area	Number of Direct Connection Defects Identified	Number of CB redirections	Number of DD/RL relocations	Number of F&C repairs	Number of Cleanout repairs	Estimated Inflow per Inch of Precipitation (gallons)	Estimated Cost to Redirect Inflow	Cost per Gallon of Inflow Removed
Subarea B1	3	1	0	0	2	2,000	\$17,000	\$8.34
Subarea HS11	13	9	3	1	0	53,300	\$165,000	\$3.10
Subarea HS15	1	1	0	0	0	2,200	\$15,000	\$6.75
Subarea LD1	6	0	0	3	3	200	\$25,500	\$132.65
Subarea LR1	7	1	1	4	1	4,100	\$53,500	\$13.10
Subarea LR2	1	0	0	0	1	<100	\$1,000	\$118.85
Subarea LR4	3	1	0	1	1	1,000	\$17,000	\$17.85
Subarea LR6	5	0	1	1	3	<100	\$18,000	\$3208.55
Subarea P1	0	0	0	0	0	0	0	0
Total	39	13	5	10	11	63,000	\$312,000	\$5.00



Table 2-15: Types of Defects Found by Subarea

Area	Re-direct Catch Basin	Re-direct Roof Leader	Re-direct Driveway/ Yard Drain	Repair Cleanout Cap	Replace Frame & Cover	Monitor (indirect source)	Repair Manhole
Subarea B1	1	0	0	2	0	0	0
Subarea HS11	9	1	2	0	1	10	0
Subarea HS15	1	0	0	0	0	0	0
Subarea LD1	0	0	0	3	3	2	0
Subarea LR1	1	0	1	1	4	2	0
Subarea LR2	0	0	0	1	0	1	0
Subarea LR4	1	0	0	1	0	1	1
Subarea LR6	0	0	1	3	1	0	0
Subarea P1	0	0	0	0	0	0	0
Total	13	1	4	11	9	16	1

## 2.6 BUILDING INSPECTIONS

Building Inspections were conducted in three “pilot areas” where previous investigations had concluded that significant volume of I/I was coming from private sources rather than defects in the City-owned infrastructure. Building inspections were conducted by Flow Assessment Services, Inc. in January and February 2019. The building inspections targeted 345 buildings. Flow Assessment’s crews made up to three attempts to gain entry to each building in the study area. However, some residents did not respond to attempts to schedule an inspection or denied access to their property for the inspection. Field crews were successful in accessing 75% of the buildings. Of the completed inspections, approximately 8% of the buildings had a sump pump connected to the sanitary sewer. The results of these inspections are summarized below:

Table 2-16: Building Inspection Results

Area	Building Units	Inspections Completed	Buildings with Sump Pump	Buildings with Sump Pump Connected to Sewer
Wedgewood	134	127 (95%)	9 (7%)	6 (5%)
Woodlands	87	53 (61%)	35 (66%)	7 (13%)
Lincoln	124	80 (65%)	53 (66%)	9 (12%)

Infiltration and Inflow from private sources is the responsibility of the property owner and does not necessarily result in recommendations for capital improvements to be conducted by the City. Additional information related to the Building Inspections and recommendations for actions to address the findings is included in the Underwood Engineers Report dated August 2019, included as Appendix G.

## 2.7 SEWER INVESTIGATIONS SUMMARY

Sewer system investigations completed included flow isolation, CCTV pipe inspections, surface manhole inspections, smoke testing, and manhole inspections. Flow isolation investigations were conducted between April and June 2017, CCTV investigations were conducted between April and September of 2017, and surface manhole inspections were completed during the month of June and September of 2017. Smoke Testing was conducted in September and October 2018. House Inspections took place in January and February 2019.

The results of each type of investigation completed during 2017 are shown in Table 2-17 – *Summary of 2017 Sewer Infrastructure Investigations Findings*.

Table 2-17: Summary of Sewer Infrastructure Investigations Findings

Investigation Activity	Investigation Duration	Type of I/I Sources and Defects Identified	Work Completed
Flow Isolation	May 19 – June 9	Infiltration	174,070 LF
CCTV Inspection	May 22 – July 26, September 8	Infiltration, Structural, and O&M Defects	46,066 LF
Manhole Inspections	June 20 – July 13, September 12 & 13	Infiltration, Structural, and O&M Defects	428 Manholes
Smoke Testing	September & October 2018	Inflow & Structural	186,570 LF
Building Inspections	January & February 2019	Private I/I	345 Buildings

Field inspections were related to structural and O&M defects rather than I/I, although both issues are intrinsically intertwined. Addressing structural and O&M issues will reduce infiltration and exfiltration from pipe segments and manholes; improve the hydraulic function of the collection system; and reduce the likelihood of emergencies such as pipe collapses, sinkholes, and SSOs.

It may not be feasible to remove all collection system defects or I/I from the system, but by utilizing best practices for rehabilitation, an appropriate level of infiltration removal can be achieved over the course of a phased plan. It should be noted that the plan to address active defects in the system may take several years and Woodard & Curran recommends that the City continue regular SSES/asset management/maintenance plan in parallel with future rehabilitation to keep the system operating effectively. Specific rehabilitation recommendations, along with discussions of prioritization and cost effectiveness, are included in Section 4.

## 2.8 ENVIRONMENTAL MONITORING

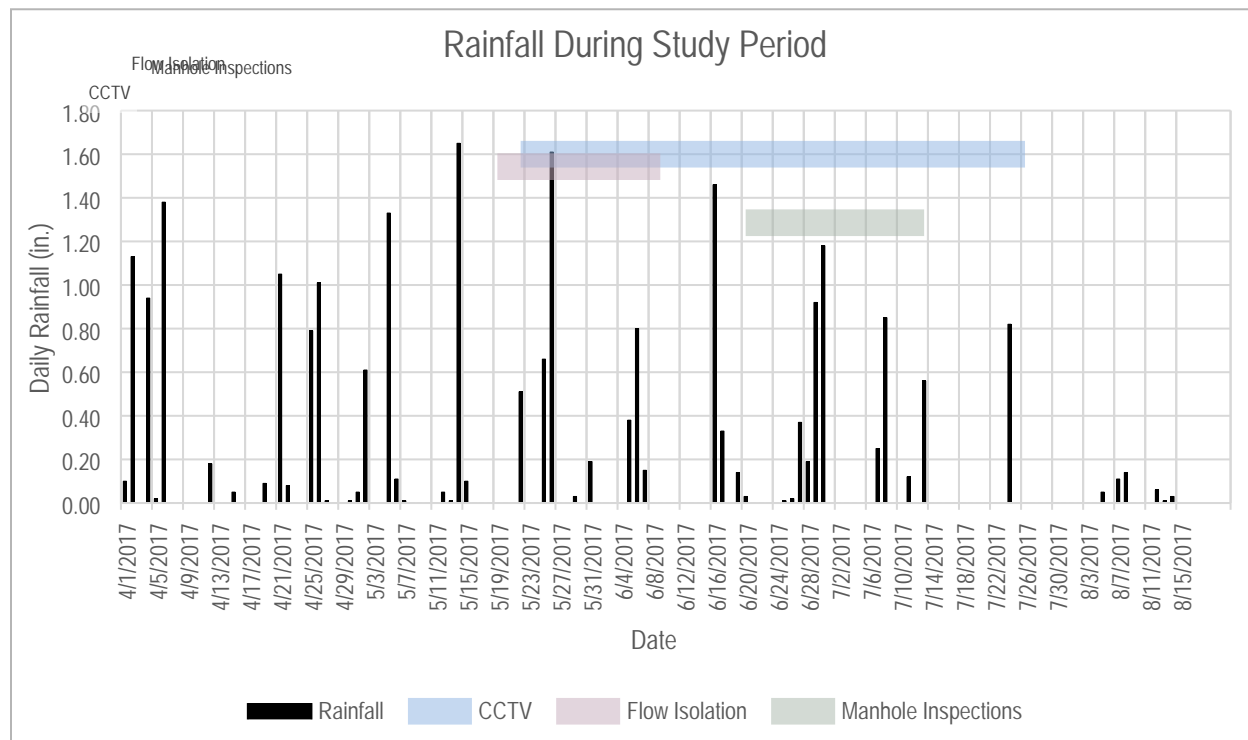
Throughout the duration of the field efforts completed during the Spring/Summer of 2017, various environmental factors were monitored. Groundwater gauging and rainfall data was monitored to provide context to the sewer investigations and to better understand or explain data trends or anomalies that may exist. For example, did the presence of rainfall increase flows during CCTV inspection? How did the groundwater elevation influence flow isolation results?

### 2.8.1 RAINFALL MONITORING

Woodard & Curran utilized the City's two permanent rain gauges to measure rainfall during the study period. The City's two rain gauges are located at Portsmouth City Hall and the Lafayette Road Pump Station. The City Hall rain gauge is a tipping bucket system by Nova Lynx and the Lafayette Road Pump Station gauge is similar by Hach Inc.

During the study period, a total of 23-inches of rainfall occurred over approximately 19 storm events. Figure 2-5 shows the measured rainfall over the course of the study period. All flow isolation activities were restricted to dry-weather, defined by at least 24 hours of dry weather following a rainfall of 0.5 inches or greater to mitigate any inflow impacts. For example, during the period of May 25-27, approximately 2.3 inches of rain fell, and flow isolation activities were halted until a dry period of 24 hours had passed. Where rainfall occurred in lesser intensities (<0.5-inches/event), flow isolation was completed under the standard operating procedure. No infiltration investigations were scheduled during rain events.

Figure 2-5: Measured Rainfall During the Study Period



## 2.8.2 GROUNDWATER MONITORING WELL READINGS

Groundwater levels were monitored at several sites for the duration of the field investigations to gauge groundwater levels in the sewered areas. Groundwater elevations can fluctuate throughout the year and are estimated to be at the highest point during the springtime and gradually recede when temperatures rise during the summer. In order to measure peak infiltration rates, it is important to understand the elevation of the groundwater relative to the sewer system. In general, higher groundwater elevation leads to increased infiltration rates as the hydrostatic pressure surrounding the sewer system increases. Lower infiltration rates will be observed when the groundwater recedes below the level of the sewer system. Five groundwater monitoring wells were used for the study. The wells were located at the Woodlands 2 Pump Station, the Griffin Road Pump Station, and three wells located within the Peverly Hill Road DPW Yard.

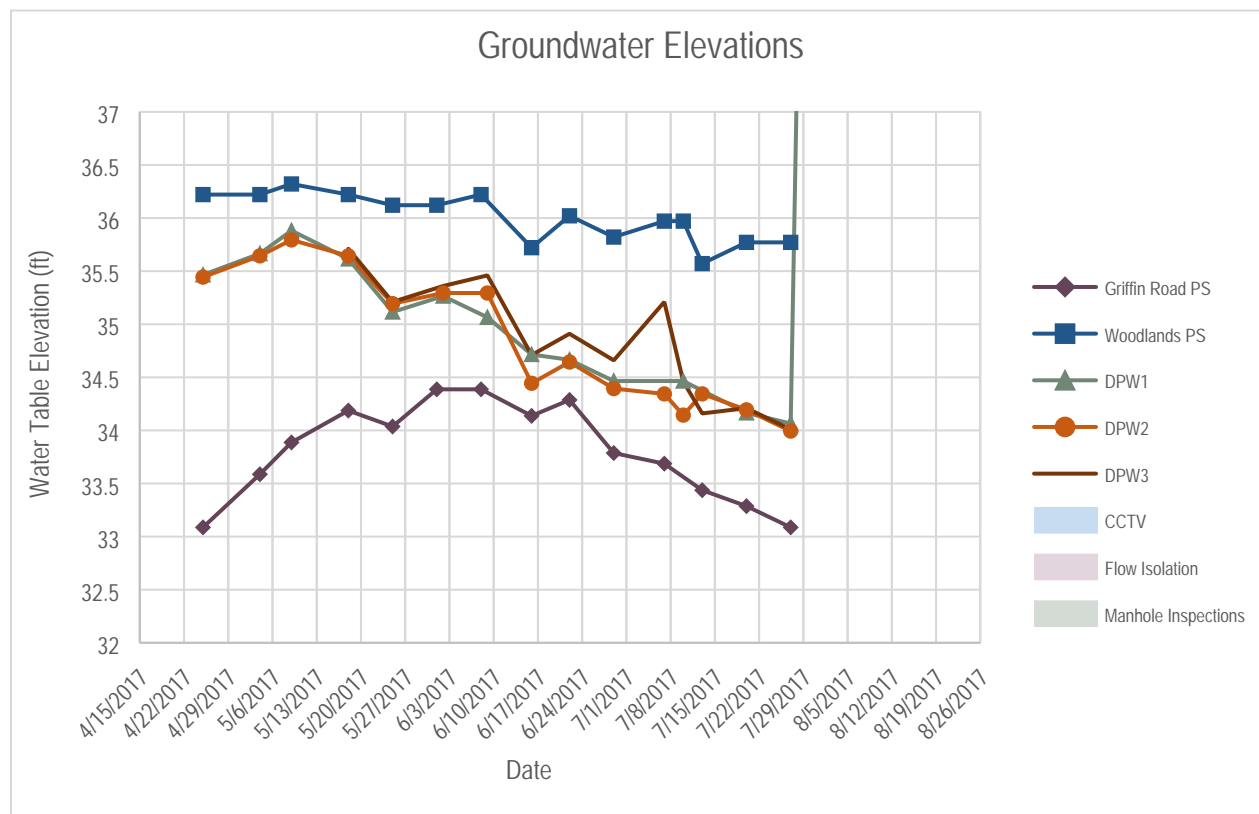
Table 2-18 presents information on each well, including location, well depth, and elevation at top of pipe. Wells were monitored on a weekly basis and the depth to groundwater recorded. The wells were located in several geographic locations in the City to approximate overall groundwater levels for the metered areas. Griffin Road PS is in the west central area, Woodlands PS is located in the southeast area of the City while DPW-1, 2, and 3 are located in the east central area at the DPW Facility on Peverly Hill Road.

Table 2-18: Groundwater Monitoring Wells

Well ID	Location	Metering Basin	Depth of Well (ft.)	Top of Pipe Elevation (ft.)
Griffin Road	Griffin Road Pump Station	B1	14.8	39.99
Woodlands	Woodlands 2 Pump Station (F.W Hartford Drive)	P2A	11.0	39.42
DPW-1	Peverly Hill Road (new DPW site)	P3	30.4	59.47
DPW-2	Peverly Hill Road (new DPW site)	P3	25.4	57.79
DPW-3	Peverly Hill Road (new DPW site)	P3	32.8	55.86

Figure 2-6 shows a plot of the groundwater elevation for each well over the study period. Groundwater elevations at the Griffin Road PS well rose steadily from late April to mid-May to an elevation of 34.4-feet, then receded steadily through the remainder of the study period to an elevation of 33.2-feet. Woodlands PS remained fairly constant at near 36-feet throughout the study period. Levels at DPW-1, 2, and 3 peaked at 35.9-feet around May 8<sup>th</sup> then receded steadily throughout the study period to a level of 34.2-feet. Groundwater levels remained were highest near the beginning of the field investigations (for flow isolation) and receded during the end of the field investigations (for portions of the CCTV and manhole investigations). This corresponded to varying levels of infiltration rates observed – flow isolation measured more infiltration more than what was observed during the corresponding later-season CCTV investigation due to lower groundwater elevations and smaller inspected quantities. Although it would be optimal to perform CCTV inspection during the highest recorded groundwater elevation in order to maximum observed infiltration, it was not possible for the entirety of this study due to scheduling and warm-dry weather.

Figure 2-6: Groundwater Well Readings



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Flow isolation measured approximately 913,000 gpd, while CCTV inspection and MH inspection located 140,400 gpd and 143,000 gpd respectively). Woodard & Curran concludes that the disparity between infiltration measured during flow isolation and infiltration observed during CCTV pipe inspection and surface manhole inspections can be attributed to the following:

- Seasonal and yearly variation of the groundwater table
- Groundwater lowering during the study period
- Presence of sump pumps not identified during mainline CCTV inspection
- CCTV and MH inspections only comprising a partial record of all of the infrastructure within a sewer basin
- Areas near salt marshes may be tidally influenced in addition to typical groundwater fluctuations.

Lowering groundwater during flow isolation and CCTV inspections is expected as work progresses during the spring. Accordingly, it is likely that infiltration rates from sources identified later in the work period could be somewhat higher at times of high groundwater as compared with the observed rate during CCTV inspection. However, this is typical for these studies and should not significantly impact the findings of this report.

### 3. DESKTOP INVESTIGATIONS, PILOT STUDY, AND SEWER REPAIRS

#### 3.1 REVIEW OF EXISTING CCTV DATA

The City has dedicated staff and resources to perform CCTV inspection of their sewer system. As part of the project scope, Woodard and Curran reviewed CCTV video of manhole-to-manhole segments of approximately 1,000 linear feet of sewer pipe that had been completed by City staff during estimated high groundwater conditions (March-May). A Technical Memorandum discussing recommended sewer rehabilitation based on the review of these CCTV videos was prepared and is attached as Appendix E. It is recommended that approximately 3,784 LF of sewer should be rehabilitated in order to remove the risk of structural failure, infiltration, and O&M related problems at an estimated construction cost of \$240,000. The total amount of infiltration identified was 14,000 gpd during observations.

#### 3.2 PILOT AREAS STUDY

Underwood Engineers completed a detailed infiltration study of the pilot areas P1, P2A, and P3 as recommended in the 2016 I/I Study. Flow isolation, CCTV inspection of mainline and sewer laterals, and MH inspections were completed. Detailed findings and recommendations from these investigations can be found in Appendix F. The study found that infiltration in these areas is a result of leaking laterals. However, it is likely that excessive flow in these areas is from inflow and rain-induced infiltration rather than seasonal high groundwater. The study found that approximately 90% of the I/I in Pilot Areas 1, 2A and 3 originated from private laterals and concluded that private source I/I must be addressed for effective I/I reductions in these areas to be realized. Recommendations for further investigations in the Pilot Areas are summarized in Table 3-1.

Table 3-1: Summary of Pilot Area Recommendations

Recommendation	Number	Pilot Area/Location	Comment
Pilot Area Building Inspections	300	1*, 2A and Drainage Problem Areas	With public education mailer
Smoke Testing	6,926 LF	1	
Perform point repairs	5	1 and 3	
Clear main line blockage	1	1	
Monitor main line deformations	5	2A and 3	Repair if required
Evaluate/update Sewer Ordinance to address private I/I	NA	NA	
Develop private I/I mitigation program	NA	NA	

\*Excluding manufactured homes within Oriental Gardens

The building inspections; mailer; smoke testing; and sewer ordinance review and updating; and I/I mitigation program are included in the scope of work for the upcoming SSES Inflow Program.

Overall cost and recommendations have been added to the Summary of Recommendations table in Section 4.5.

#### 3.3 SEWER ORDINANCE REVIEW

As part of the scope of work for this study, the City's existing Sewer Use Ordinances were reviewed and compared with current best practices and recommendations from the New Hampshire Department of Environmental Services (NHDES). This review resulted in several recommendations to update the ordinances, to address private I/I sources, facilitate enforcement of the ordinances by the City, and update the ordinances to comply with NHDES recommendations. These proposed modifications are summarized in the Underwood Engineers report dated August 2019, included as Appendix G to this report

### 3.4 SEWER CLEANING AND REPAIRS

Under subcontract to Woodard & Curran, Ted Berry Company was responsible for the CCTV inspection of sewer pipe. However, Ted Berry was not initially contracted to perform rehabilitation on sewer pipes that were deemed too full of debris to inspect or other blockages due to pipe condition (e.g. excessive root growth, protruding services, and high-water level.) Defects of this type may reduce the hydraulic capacity of pipes and do not allow for effective inspection. To facilitate the ongoing investigations and reduce future issues, coordination between the City and Ted Berry Company led to the cutting of protruding services under contract to the City. This coordination made the completion of CCTV inspection of pipes that were, at their existing condition, not possible to complete.

Segments that were previously inaccessible due to protruding laterals were repaired to facilitate CCTV investigation. Three pipe segments were repaired and are listed in Table 3-2.

Table 3-2: Lateral Cutting

Pipe SewerID	US MH	DS MH	Street	Quantity
327	1412	1413	Boyd Road	1
1327	2240	2239	Cottage Street	1
837	767	769	Maplewood Avenue	2
Total				4

Six other locations were recommended by Woodard & Curran to Ted Berry for protruding service cutting, but could not be completed due to parked cars or heavy debris (Wedgewood Road, Boyd Street Off Ramp at US 1B, Bartlett Street, Easement off Woodbury Avenue, and Oriental Gardens).



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## 4. RECOMMENDATIONS

The field investigations conducted revealed sewer infrastructure defects varying from minor roots and grease to severe fractures and broken pipe that requires short-term priority rehabilitation. Infiltration was located, quantified, and recommended for rehabilitation.

Utilizing CCTV pipeline inspection and surface manhole inspection, a prioritized database of each rehabilitation recommendation has been developed as part of this report. The recommendations are prioritized by infiltration removal, max defect score, and basin in Appendix A & B. I/I issues discovered during flow isolation, CCTV investigation, manhole inspections, and smoke testing were evaluated using a cost-effective analysis to determine the extent of infiltration removal per dollar spent on repair.

### 4.1 REHABILITATION PRIORITY

Identifying assets in the greatest need of rehabilitation is a challenging task that takes into consideration several factors including but not limited to: severity of defect, quantity of infiltration, and rehabilitation cost. The condition of Portsmouth's collection system will continue to deteriorate with time. The rate and extent of collection system degradation is dependent upon several factors including, age, pipe material, soundness of original construction, concentration of wastewater constituents, type and duration of external loading, surrounding soils and internal flow geometry. Addressing the defects found during CCTV inspection and manhole inspection will assist the City in both reducing I/I flows in the sewer system and removing risk of failure. Removing I/I from the collection system will benefit the City by improved collection system performance, reduced treatment and transport costs, assistance in maintaining wastewater discharge at the mandated limits, extending the service life of its sewer assets, and reducing operational costs.

Review of CCTV footage was performed using the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) condition scoring. The PACP scoring is a nationally recognized condition grading system utilized to rank structural and operational/maintenance defects. The assessment performed by Ted Berry was graded in PACP format. The overall scoring was used to reflect the highest of the peak scores and develop rehabilitation recommendations.

Using the PACP condition grade and type(s) of defects, recommendations for rehabilitation were made using the 0-5 scale where 0 typically indicates no action required and 5 indicates a priority repair should be made. Based on the review of the CCTV inspections, recommendations were developed to address any defects found in each pipe segment. The recommended repair method was selected based on the type of defect found and the severity of the defect, as well as the overall condition of the pipe segment.

In an effort to effectively reduce I/I flows to the sewer system, it is recommended that rehabilitation be completed in a systematic fashion where the highest intensity of infiltration is removed first. The movement of groundwater near the City's sewer assets is hard to predict, however it is recommended that sewer rehabilitation be completed in lengths of >1,000 LF in order to eliminate or reduce groundwater migration from a rehabilitated area to a non-rehabilitated area. With this taken into account, the rehabilitation recommendations described in Appendix A have been organized by metering basin first, street second, and defect score third, in order to consolidate assets in the greatest need of rehabilitation by location. Prioritizing rehabilitation in such a fashion typically reduces mobilization costs during construction and produces the best overall reduction in I/I.

## 4.2 COST EFFECTIVE ANALYSIS

To prioritize I/I rehabilitation, a cost-effective analysis was performed on each pipe segment to compare cost to rehabilitate a pipe segment to the I/I reduction achieved from the associated repairs. To create a relative comparison between amongst pipes of differing repair costs and infiltration severity, a ratio was developed which related the annual quantity of infiltration entering a pipe segment to the cost of rehabilitation and is expressed in dollars spent per gallon per day removed. For the purposes of this system, removal of the infiltration is estimated at 100%. This metric has been included on the rehabilitation recommendations found in Appendix A and B.

## 4.3 RECOMMENDATIONS FROM SEWER INVESTIGATIONS

### 4.3.1 CCTV INSPECTION RESULTS

Over 51% of sewer pipes inspected had issues warranting rehabilitation recommendations to prevent hydraulic failures, reduce I/I into the sewer system, or improve O&M activities. The City should also continue to monitor the remaining pipes that did not show defects requiring rehabilitation.

Observations from the CCTV inspection were entered into a database for review and analysis. This database was used to develop rehabilitation recommendations as described below:

*Clean:* High pressure water wash is recommended for pipe segments exhibiting significant debris and build-up for a pipe segment.

*Complete CCTV:* High pressure water wash is recommended for pipe segments exhibiting significant debris and build-up, and/or pipe segments that could not be fully inspected during the initial SSES fieldwork and a recommendation could not be recommended.

*Locate Manhole:* CCTV is recommended for pipe segments that could not be fully inspected during the initial SSES fieldwork. Segments recommended for cleaning are also to be CCTV inspected to identify potential deficiencies.

*Inspect Lateral:* Closed circuit television inspection of laterals is recommended for service laterals that display clear water flowing consistently and no visible source could be determined from mainline CCTV inspection. This recommendation also carries the cost to perform building inspections for each lateral to determine sump pump connectivity as well as the removal of lateral infiltration through lateral grouting as explained below. Laterals to be inspected are denoted in Appendix A by a comment that identifies the location of the lateral with an unknown source of infiltration.

*Grout Lateral:* Testing and sealing of laterals is recommended where infiltration is observed in the service lateral from leaking joints, holes, and/or other defects.

*Test, and Seal Mainline Joints (T&S):* Testing and sealing joints is recommended in pipe segments that are without observable structural deficiencies but exhibit active leaks, separated joints or circumferential cracks that could allow infiltration, and/or lie in areas of high groundwater influence. Does not include cleaning costs.

*Cut Protruding Service:* Protruding services not only reduce the cross-sectional area of the pipe and impede the hydraulic conditions at that location but limit the ability to inspect the pipe with a CCTV camera. Such a defect is recommended to be cut from within the pipe to rectify flow. Includes cleaning costs.

*Root Treatment:* Chemical root treatment is recommended in pipe segments that exhibit roots growing through joints and/or defects and often includes segments where the majority of the pipe cross section is restricted by root ball growths. Includes cleaning costs.

*Short Liner (SL):* A varying length cured-in-place-pipe (CIPP) liner is recommended in pipe reaches where identified leaks, cracks, or other defects occur sporadically in pipe segments that are otherwise in sound condition. Short liners include extra strength for pipe segments to provide structural support. The length of the short liner will be based on the size of the individual deficiency observed. Includes cleaning costs.

*Cured-In-Place-Pipe (CIPP) Liner:* A manhole-to-manhole structural CIPP liner is recommended in pipe segments where leaking joints, cracks, or other structural defects are recurring throughout the majority of the pipe segment. A CIPP liner creates a pipe within the existing pipe that reinstates the structural integrity of the pipe and removes infiltration. Includes cleaning costs.

*Open Cut:* An open cut repair is manhole to manhole excavation recommended in pipe segments that are damaged beyond repair by means of trenchless rehabilitation.

*Point Repair:* Refers to segments of pipe that must be rehabilitated by means of open cut excavation, yet do not require a full manhole to manhole pipe replacement. Point repairs include rehabilitation of defective service connections as well as defective mainline sewers.

*Continue to Monitor:* In pipe segments where defects are non-existent or minor in significance and no immediate rehabilitation is recommended, continued monitoring is the best practice.

Cleaning and CCTV inspection is recommended in several areas where protruding services and/or heavy debris buildup obstructed the initial inspection. Woodard & Curran recommends protruding services be cut flush with the wall of the pipe, using either a lateral cutter or grinder, to facilitate pipe cleaning and inspection. In addition to these targeted CCTV investigations, the City should also consider adopting a preventative inspection schedule to further their knowledge of the system and decrease reactive repairs.

Table 4-1 – *Pipeline Rehabilitation Unit Cost* lists the estimated cost per unit for the recommended rehabilitation method. The costs shown in this report are conservative and were developed from recent bid tabulations for projects designed by Woodard & Curran.

Table 4-2 through Table 4-4 summarize the estimated quantity and cost of each rehabilitation recommendation category based on CCTV inspection findings.

Table 4-1: Pipeline Rehabilitation Unit Costs

Method	Clean	CITS	Grout Lateral	CCTV Lateral	CIPP	Cut Service	Complete CCTV	SL	Open Cut	Point Repair	Root Treatment	Monitor
Pipe Size (in)	(LF)	(Per Joint)	(EA)	(EA)	(LF)	(EA)	(LF)	(LF)	(LF)	(LF)	(LF)	(EA)
6	\$5.50	\$75	\$450	\$750	\$80	\$430	\$5.50	\$420	\$200	\$250	\$6	\$0
8	\$5.50	\$75	\$450	\$750	\$60	\$430	\$5.50	\$420	\$250	\$250	\$6	\$0
10	\$5.50	\$75	\$450	\$750	\$60	\$430	\$5.50	\$430	\$275	\$300	\$6	\$0
12	\$6.00	\$75	\$450	\$750	\$60	\$430	\$6.00	\$470	\$300	\$350	\$6	\$0
18	\$6.00	\$125	\$450	\$750	\$113	\$430	\$6.00	\$2,000	\$400	\$450	\$10	\$0

Table 4-2: Summary of Pipe Rehabilitation Recommendations

Rehabilitation Recommendation	Unit	Estimated Quantity
T&S	Linear Foot	15,314
Grout Lateral	Each	44
CCTV Lateral	Each	63
CIPP	Linear Foot	9,183
Cut Service	Each	63
Cleaning	Linear Foot	7,739
CCTV	Linear Foot	8,909
SL	Linear Foot	58
Open Cut	Linear Foot	0
Spot Repair	Each	426
Root Treatment	Linear Foot	8,303
Monitor	Linear Foot	8,622

Table 4-3: Pipe Rehabilitation Recommendations by Subarea

Metering Basin	Cleaning	T&S	Grout Lateral	CCTV Lateral	CIPP	Cut Service	CCTV	SL	Open Cut	Spot Repair	Root Treatment	Monitor
B1	-	252	4	3	951	14	252	-	-	-	381	-
GR1	452	1,473	1	3	673	-	463	-	-	10	423	542
HS11	495	2,574	11	23	2,298	32	3,249	12	-	90	2,147	1,040
HS14	642	730	2	1	1,262	-	-	-	-	40	648	1,047
HS15	479	2,462	9	2	2,008	11	644	18	-	20	1,437	306
LD1	818	2,482	10	18	1,525	1	2,050	22	-	195	2,630	1,994
LR3	1,626	1,626	-	-	-	-	-	-	-	20	-	-
LR4	1,900	2,582	6	11	466	2	464	6	-	30	407	1,620
LR5	727	301	-	-	-	-	1,545	-	-	10	-	799
LR6	600	829	1	2	-	2	-	-	-	11	230	302
M1	-	-	-	-	-	1	242	-	-	-	-	971
Total	7,739	15,314	44	63	9,183	63	8,909	58	-	426	8,303	8,622

Table 4-4: Pipe Rehabilitation Cost by Subarea

Metering Basin	Cleaning	T&S	Grout Lateral	CCTV Lateral	CIPP	Cut Service	CCTV	SL	Open Cut	Spot Repair	Root Treatment	Total
B1	\$0	\$6,314	\$1,800	\$2,250	\$57,076	\$6,020	\$1,389	\$0	\$0	\$0	\$2,285	\$77,134
GR1	\$2,487	\$20,421	\$450	\$2,250	\$40,359	\$0	\$2,549	\$0	\$0	\$2,500	\$2,540	\$73,557
HS11	\$3,072	\$53,680	\$4,950	\$17,250	\$142,263	\$13,760	\$18,139	\$5,040	\$0	\$23,500	\$12,884	\$294,539
HS14	\$3,736	\$7,494	\$900	\$750	\$75,746	\$0	\$0	\$0	\$0	\$10,000	\$3,889	\$102,515
HS15	\$2,633	\$61,588	\$4,050	\$1,500	\$120,453	\$4,730	\$3,688	\$7,620	\$0	\$5,000	\$8,620	\$219,881
LD1	\$4,497	\$51,099	\$4,500	\$13,500	\$91,519	\$430	\$11,278	\$9,240	\$0	\$48,750	\$15,783	\$250,596
LR3	\$8,945	\$11,612	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$5,000	\$0	\$25,557
LR4	\$10,451	\$22,196	\$2,700	\$8,250	\$27,954	\$860	\$2,550	\$2,580	\$0	\$8,000	\$2,440	\$87,981
LR5	\$3,999	\$2,261	\$0	\$0	\$0	\$0	\$8,496	\$0	\$0	\$3,000	\$0	\$17,756
LR6	\$3,298	\$6,223	\$450	\$1,500	\$0	\$860	\$0	\$0	\$0	\$2,750	\$1,379	\$16,460
M1	\$0	\$0	\$0	\$0	\$0	\$430	\$1,329	\$0	\$0	\$0	\$0	\$1,759
Total	\$43,119	\$242,889	\$19,800	\$47,250	\$555,370	\$27,090	\$49,416	\$24,480	\$0	\$108,500	\$49,820	\$1,167,735

As described in Section 4.1, rehabilitation priority was organized based on infiltration rate, metering basin, street, and defect score to consolidate assets in the greatest need of rehabilitation by location. Detailed rehabilitation recommendations can be found for each pipe segment in Appendix A. Table 4-5 summarizes the cost of rehabilitation based on repair type. Infiltration costs include repairs to a pipe segment that are associated with removal of infiltration (e.g. CITS and CIPP of a pipe with leaking joints and fractures). Structural repairs include the costs associated with resolving significant structural deficiencies in the absence of infiltration (e.g. Point Repairs on a pipe with collapsed segments). O&M rehabilitation includes the costs to resolve any issues that reduce the hydraulic capacity of the pipe or are causing operational issues (e.g. roots intruding into a pipe segment).

Table 4-5: Summary of Pipeline Rehabilitation Costs

Metering Basin	Total Infiltration Observed (gpd)	Infiltration Removal Cost	Structural and O&M Cost	Total Rehabilitation Cost	Average Cost Effectiveness (Infiltration Removal Cost / Gallon per Day Infiltration Removed)
M1	0	\$0	\$1,759	\$1,759	\$0.00
LR3	5,760	\$6,011	\$19,546	\$25,557	\$1.04
LR6	12,960	\$16,460	\$0	\$16,460	\$1.27
GR1	19,440	\$59,378	\$14,179	\$73,557	\$3.05
LR4	19,872	\$78,456	\$9,525	\$87,981	\$3.95
HS11	23,184	\$204,505	\$90,034	\$294,539	\$8.82
LD1	21,168	\$192,083	\$58,513	\$250,596	\$9.07
LR5	720	\$6,918	\$10,837	\$17,756	\$9.61
HS14	5,760	\$68,845	\$33,670	\$102,515	\$11.95
HS15	9,936	\$186,940	\$32,941	\$219,881	\$18.81
B1	2,016	\$58,046	\$19,088	\$77,134	\$28.79
Total	120,816	\$877,642	\$290,092	\$1,167,734	\$7.26

Note that during the writing of this report, the City completed a dig and replace of MH767-MH769, located in Metering Basin M1, which is expected to remove 288 gallons per day of infiltration – therefore the cost of this replacement has been removed from this report.

Figures included in Appendix A illustrate the locations and recommendations developed during the CCTV inspection program. Pipeline rehabilitation is shown as either infiltration removal or related to structural and O&M rehabilitation. For pipeline rehabilitation, these two types of rehabilitation are mutually exclusive (i.e. rehabilitation associated with a given pipe will either aid in removal of infiltration or will not). For pipes where infiltration was observed during CCTV inspection, rehabilitation was for infiltration removal. Whereas pipes that did not show infiltration during CCTV inspection were recommended as part of a structural and O&M related rehabilitation. For this analysis, it is assumed that 100% of infiltration removal can be achieved. Design for construction should consider both types of rehabilitation as well as economics of scale, sequencing, mobilization costs, and other construction related costs.

#### 4.3.2 MANHOLE INSPECTION

Approximately 40% of the sewer manholes inspected had issues warranting rehabilitation to prevent hydraulic failures or improve O&M activities. The City should continue to monitor the remaining manholes that did not show defects requiring rehabilitation.

All observations from the manhole inspections were entered into a database for review and analysis. This database was then used to develop repair recommendations as described below:

*Clean:* Recommended for manholes where debris is present.

*Cementitious Liner:* Recommended for manholes with light to moderate infiltration present and/or structural damage such as loss of mortar, missing brick, or holes.

*Corbel Repair:* Recommended for manholes with missing/broken bricks and/or mortar from the corbel section.

*Epoxy Liner:* Recommended for manholes displaying evidence of degradation due to H<sub>2</sub>S (Hydrogen Sulfide) corrosion and/or severe infiltration.

*Curtain Grout Manhole:* Recommended for manholes with infiltration present.

*Locate Manhole:* Manhole not inspected during the manhole inspection program due to unknown location. Manholes that are located along overgrown easements, buried under pavement, or in need of GIS spatial adjustment should be located.

*Rebuild Bench and Invert:* Recommended for manholes with damage to the bench and invert requiring repairs to increase hydraulic capacity.

*Remove and Replace:* Recommended for manholes with severe structural damage or extreme infiltration that cannot be repaired by means of trenchless rehabilitation.

*New Frame and Cover:* Recommended for manholes where frame and cover are damaged and may result in failure.

*Raise Frame and Cover:* Recommended for manholes buried or set below grade, which make the manhole more susceptible to inflow.

*Continue to Monitor:* Defects are not significant and do not need to be recommended for rehab, continued monitoring is best practice.

Table 4-6 – *Manhole Rehabilitation Unit Costs* provides detail into the estimated construction costs for reach of the rehabilitation methods. Note that the recommendation for continue to monitor is estimated as zero cost as no work is required for these manholes in the foreseeable future. Table 4-7 – *Manhole Rehabilitation Recommendations* provides a count of the number of manholes requiring a particular rehabilitation recommendation.

Table 4-6: Manhole Rehabilitation Unit Costs

Recommended Rehabilitation	Unit	Unit Cost
Clean	EA	\$550
New Frame and Cover	EA	\$820
Chimney Repair	EA	\$1,000
Rebuild Bench and Invert	EA	\$2,200
Root Treatment	EA	\$2,200
Curtain Grout Manhole	Vertical Feet	\$200
Cementitious Liner	Vertical Feet	\$170
Epoxy Liner	Vertical Feet	\$500
Remove and Replace	EA	\$13,100
Raise Frame and Cover	EA	\$1,100
Locate Manhole	EA	\$100
Continue to Monitor	EA	\$0

Table 4-7: Manhole Rehabilitation Recommendations

Recommended Rehabilitation	Rehabilitation Type	# Manhole Recommendations
Clean	O&M	71
New Frame and Cover	O&M	31
Chimney Repair	Structural	37
Rebuild Bench and Invert	O&M	45
Root Treatment	O&M	14
Curtain Grout Manhole	Infiltration	73
Cementitious Liner	Structural/Infiltration	73
Epoxy Liner	Structural	5
Remove and Replace	Structural	1
Raise Frame and Cover	O&M	8
Locate Manhole	O&M	50
Continue to Monitor	O&M	256
Total:		664

As described in Section 4.1, rehabilitation priority was organized based on infiltration, metering basin, street, and defect score to consolidate assets in the greatest need of rehabilitation by location.

Detailed rehabilitation recommendations can be found for each manhole in Appendix B. Table 4-8 summarizes the cost of rehabilitation based on repair type. The total observed infiltration shown includes infiltration observed during manhole inspections and flow isolation. Infiltration rehabilitation costs include repairs to manholes in order to remove infiltration, including curtain grouting of manhole walls and cementitious liners for manholes that show infiltration. Structural repairs include the costs associated with resolving significant structural deficiencies in the absence of infiltration (e.g. Chimney Repair on a manhole with missing bricks from chimney or cementitious liner for defective manhole walls that do not show infiltration). O&M rehabilitation includes the costs to address any issues that reduce



the hydraulic capacity of the manhole or are causing operational issues (e.g. rebuild bench and invert on a manhole where debris has built up due to the lack of an invert).

Table 4-8: Summary of Manhole Rehabilitation Costs

Metering Basin	Total Observed Infiltration (gpd)	Infiltration Removal	Structural and O&M Repairs	Total Rehabilitation Cost	Average Cost Effectiveness (Infiltration Removal Cost / Gallon per Day Infiltration Removed)
GR1	53,496	\$59,750	\$46,460	\$106,210	\$1.12
LR3	6,048	\$7,400	\$5,960	\$13,360	\$1.22
LR4	40,680	\$53,400	\$17,490	\$70,890	\$1.31
LR6	11,088	\$24,000	\$33,310	\$57,310	\$2.16
B1	720	\$1,800	\$10,030	\$11,830	\$2.50
HS11	14,904	\$58,540	\$54,010	\$112,550	\$3.93
HS14	4,248	\$17,760	\$20,700	\$38,460	\$4.18
LD1	5,760	\$34,410	\$21,770	\$56,180	\$5.97
M1	1,008	\$6,760	\$16,350	\$23,110	\$6.71
HS15	4,320	\$29,850	\$34,300	\$64,150	\$6.91
LR5	864	\$12,580	\$19,810	\$32,390	\$14.56
Total	143,136	\$306,250	\$280,190	\$586,440	\$2.14

Figures included in Appendix B illustrate the locations and recommendations developed during the manhole inspection program. Manhole rehabilitation is either related to infiltration removal, structural/O&M repairs, or both. For manhole rehabilitation, these two types of rehabilitation are not mutually exclusive (i.e. rehabilitation associated with a O&M may not aid in the removal of infiltration, e.g. new frame and cover will not reduce infiltration). Cost effectiveness of infiltration removal per basin is summarized below and is an estimate of the dollar value for infiltration rehabilitation compared to the volume of infiltration that could be removed. For this analysis, it is assumed that 100% of infiltration removal can be achieved. Design for construction should consider both types of rehabilitation as well as economics of scale, sequencing, mobilization costs, and other construction related costs.

#### 4.3.3 SMOKE TEST RESULTS

The results show that Subareas B1, HS11, LR1, and HS15 contribute the most amount of inflow to the overall collection system. In addition to contributing the most inflow, approximately 53,300 gallons per inch of precipitation, subarea HS11 also has the highest number of defects identified (22). This area accounts for approximately 85% of the total estimated inflow and should be prioritized for the repairs that were discussed previously in the report. The next highest contributor, LR1, contributes approximately as much flow as B1 and HS15 combined. Addressing these three areas, which account for approximately 92% of the remaining flow, should be completed once subarea HS11 has been addressed. Targeting all four of these areas first will address 98% of the total estimated inflow.

It is recommended that repairs be made to all direct sources identified herein, because addressing these direct sources is more cost-effective for the City than attempting to address every identified defect. The indirect sources identified

during the smoke testing were all estimated to contribute minor volumes of inflow to the system compared to other sources identified. These sources did not warrant further testing by dye testing or flooding due to their limited impact. Instead, we recommend that the City continue to monitor these locations to confirm that conditions which contribute to inflow are not deteriorating and causing additional inflow and/or structural issues with the pipe or roadway.

The estimated cost to rehabilitate each of the inflow sources identified is based on typical efforts required to redirect an inflow source from the wastewater collection system to a storm drain. We have used the following estimated costs to calculate the costs listed in Table 4-9: Redirecting a catch basin was estimated to cost \$15,000. Redirecting a driveway drain, roof leader, or repairing a frame and cover was estimated to cost \$7,500. Repairing a cleanout cap was estimated to be \$1,000 and monitoring for indirect sources was estimated at \$0. All repair costs were calculated based on the type of repair, and then totaled for each subarea, resulting in a total estimated cost to redirect inflow.

However, each inflow source will vary and the cost to rehabilitate is highly dependent on the proximity of the closest storm drain line. These cost estimates should be used for planning level purposes only. A more detailed analysis of the remediation required, and construction cost estimate to redirect flows can be developed on a case-by-case basis in the design phase.

A summary of the construction cost to redirect the direct inflow sources by subarea, and the cost-effectiveness of the work is included as Table 4-9. A summary of the types of defects found in each subarea is shown in Table 4-10.

Table 4-9: Estimated Rehabilitation Cost – Direct Sources

Area	Number Direct Connection Defects Identified	Number CB Redirections	Number DD/RL Relocations	Number F&C Repairs	Number Cleanout Repairs	Est Inflow per Inch of Precipitation (gallons)	Est Cost Redirect Inflow	Cost per Gallon of Inflow Removed
Subarea B1	3	1	0	0	2	2,000	\$17,000	\$8.34
Subarea HS11	13	9	3	1	0	53,300	\$165,000	\$3.10
Subarea HS15	1	1	0	0	0	2,200	\$15,000	\$6.75
Subarea LD1	6	0	0	3	3	200	\$25,500	\$132.65
Subarea LR1	7	1	1	4	1	4,100	\$53,500	\$13.10
Subarea LR2	1	0	0	0	1	<100	\$1,000	\$118.85
Subarea LR4	3	1	0	1	1	1,000	\$17,000	\$17.85
Subarea LR6	5	0	1	1	3	<100	\$18,000	\$3208.55
Subarea P1	0	0	0	0	0	0	0	0
Total	39	13	5	10	11	63,000	\$312,000	\$5.00

Table 4-10: Types of Defects Found by Subarea

Area	Re-direct Catch Basin	Re-direct Roof Leader	Re-direct Driveway/ Yard Drain	Repair Cleanout Cap	Replace Frame & Cover	Monitor (indirect source)	Repair Manhole
Subarea B1	1	0	0	2	0	0	0
Subarea HS11	9	1	2	0	1	10	0
Subarea HS15	1	0	0	0	0	0	0
Subarea LD1	0	0	0	3	3	2	0
Subarea LR1	1	0	1	1	4	2	0
Subarea LR2	0	0	0	1	0	1	0
Subarea LR4	1	0	0	1	0	1	1
Subarea LR6	0	0	1	3	1	0	0
Subarea P1	0	0	0	0	0	0	0
Total	13	1	4	11	9	16	1

#### 4.3.4 GEOGRAPHIC INFORMATION SYSTEM UPDATES

Throughout the 2017 SSES investigation activities some asset locations were found to vary from those in the City's GIS database. Field notes and map changes from Flow Assessment have been provided in Appendix C to assist the City in making updates and/or changes to their asset database in GIS.

#### 4.4 SUMMARY OF RECOMMENDATIONS AND ESTIMATED COSTS

The City's collection system is aging and requires an aggressive rehabilitation and maintenance schedule to reduce I/I and ensure uninterrupted wastewater flows and or SSOs. The tables below break down the overall costs to complete rehabilitation of infiltration and structural/O&M related defects located during this infiltration study.

Table 4-11 presents a summary of infiltration removal cost by metering basin. As can be seen, the cost per gallon for infiltration removal is under \$3.00/gpd for the first four basins. The cost then jumps to over \$6.00/gpd for the fifth basin.

Table 4-11: Summary of Infiltration Removal Costs Per Basin

Basin	Total Infiltration Observed in Pipeline (gpd)	Total Infiltration Observed Manhole (gpd)	Total Infiltration Observed Per Basin	Cost of Infiltration Removal Per Basin	Average Cost Effectiveness \$ Spent / Gallon per Day Infiltration Removed
LR3	5,760	6,048	11,808	\$13,411	\$1.14
GR1	19,440	53,496	72,936	\$119,128	\$1.63
LR6	12,960	11,088	24,048	\$40,460	\$1.68
LR4	19,872	40,680	60,552	\$131,856	\$2.18
M1	-	1,008	1,008	\$6,760	\$6.71
HS11	23,184	14,904	38,088	\$263,045	\$6.91
LD1	21,168	5,760	26,928	\$226,493	\$8.41
HS14	5,760	4,248	10,008	\$86,605	\$8.65
LR5	720	864	1,584	\$19,498	\$12.31
HS15	9,936	4,320	14,256	\$216,790	\$15.21
B1	2,016	720	2,736	\$59,846	\$21.87
Total:	120,816	143,136	263,952	\$1,183,832	\$4.77

Table 4-12 – *Collection System Rehabilitation Summary of Costs* summarizes the estimated cost to address identified collection system defects including engineering and contingencies. For convenience, all recommendations for sewer improvements located in the pilot areas has been separated by its own line item.

Table 4-12: Collection System Rehabilitation Summary of Costs

Investigation Type	Work Completed	Rehabilitation Recommendations	Infiltration/Inflow Rehabilitation	Structural and O&M Rehabilitation	Total Estimated Cost
CCTV	32,329 <sup>1</sup> LF	Infiltration, Structural, and O&M	\$880,000	\$300,000	\$1,180,000
Manhole Inspection	393 <sup>1</sup> Manholes	Infiltration, Structural, and O&M	\$310,000	\$290,000	\$600,000
Pilot Area Study	24 Manholes & 12,000 LF CCTV	Infiltration, Structural, and O&M	\$10,000	\$20,000	\$30,000
City CCTV Review	14,500 LF CCTV	Infiltration, Structural, and O&M	\$35,000	\$40,000	\$75,000
Smoke Testing	186,570 LF	Inflow & Structural	\$312,000	\$0	\$312,000
Total Rehabilitation Cost:			\$1,550,000	\$650,000	\$2,200,000
Contingency (30%):			\$465,000	\$195,000	\$660,000
Engineering Cost (20%):			\$403,000	\$170,000	\$572,000
Total Estimated Cost:			\$2,420,000	\$1,015,000	\$3,432,000

As detailed above, Woodard & Curran identified approximately \$1,890,000 in collection system rehabilitation and improvements work. It is recommended that a 30% construction contingency and 20% engineering fee be added for a total design and construction cost of approximately \$3,000,000.

#### 4.5 RECOMMENDED REHABILITATION PROGRAM

It is recommended that the City prioritize pipeline and manhole rehabilitation using infiltration removal cost-effectiveness, structural integrity, and maintenance necessity. This approach provides the City with reduction of the risk of failure while removing costly infiltration that causes excess flow to pump stations and the treatment plant.

Woodard & Curran, in conjunction with input from the City's Department of Public Works staff, have recommended a phased approach to collection system rehabilitation based on the findings of this report. This phased approach is estimated to be completed in four projects that meet the needs of the City as explained above. The first phase will aim to remove infiltration in the City's metering basins that are estimated to be the most cost-effective as well as grouped together geographically. The basis of this plan is the pipe and manhole rehabilitation recommendations made in this report as well as the recommendations made in Task 4, which reviewed the City's recent CCTV inspection data and is attached in Appendix E. This will lead to decreased construction costs and ultimately cost savings for the City. The total infiltration observed accounts for infiltration located during pipe or manhole inspections, and does not account for infiltration measured during flow isolation. Lateral infiltration removal is considered only for pipes that have significant mainline infiltration or have significant structural or O&M related defects. Removal of specific lateral infiltration and rehabilitation should be approached during design phase of future construction projects for feasibility and cost-effectiveness and during the 2017 Inflow Study which will complete a sump pump inspection program. Per instruction from the City, where open-cut pipe replacement may be necessary it was noted in Table 4-14, however the estimated cost assumes cured-in-place pipe rehabilitation. Actual construction costs for each plan will be developed during final designs.

The phased Collection System Infiltration Removal Plan is outlined in Table 4-13. This purpose of this plan is to allow the City to understand budgetary requirements for both construction and engineering services as they build their wastewater capital improvement program. Continuing inspection during the 2017 Inflow Study and through ongoing inspectional/maintenance programs will inform the City's Department of Public Works of additional collection system needs that can be used to further develop the City's collection system rehabilitation improvement plans.

Table 4-13: Phased Collection System Infiltration Removal Plan

Phase	Contract #1	Contract #2	Contract #3	Contract #4	Totals
Basins Included	LR3, LR4, LR6, GR1	HS11, LR5	LR1, LR2, LD1, B1	HS14, HS15, M1	
Total Infiltration Observed	174,460	31,400	28,300	27,580	261,740
Infiltration Rehabilitation Cost	\$323,000	\$242,000	\$225,000	\$307,000	\$1,097,000
Structural/O&M Rehabilitation Costs	\$35,000	\$165,000	\$97,000	\$15,000	\$312,000
Smoke Testing Repairs	\$63,000	\$163,000	\$63,000	\$105,000	\$394,000
Contingency Cost (30%)	\$127,000	\$171,000	\$116,000	\$129,000	\$543,000
Total Construction Cost	\$548,000	\$741,000	\$501,000	\$556,000	\$2,346,000
Engineering Costs (20%)	\$110,000	\$149,000	\$101,000	\$112,000	\$472,000
Total Estimated Contract Cost	\$658,000	\$890,000	\$602,000	\$668,000	\$2,818,000

All data and spreadsheets are in electronic format and included with this report. This allows the City to incorporate collection system data into future rehabilitation planning. Table 4-14 and Table 4-15 summarize the recommended improvements that form the basis of the City's Phased Collection System Infiltration Removal Plan. Figure 4-3 illustrates probable locations of future construction projects and the recommended rehabilitation work as summarized in the tables below. This figure was created using ESRI software and can be exported to the City via shapefiles or other GIS database formats.

Table 4-14: Pipeline Rehabilitation Recommendations

Contract Number	Metering Basin	Street	Sewer ID	US MH	DS MH	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab Cost	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 1	GR1	Blue Heron Dr	3021	921	920	8	VCP	139	Roots fine joint at 26' US. Roots fine joint at 63' US. Crack spiral at 75' US. Roots ball joint at 120' US. Roots ball barrel at 125' US. Rag in joint at 135' US.	Root Treatment	4	0	0	0	\$0	\$836	\$836	\$0.00
CONTRACT 1	GR1	Blue heron Dr	3017	913	914	6	PVC	231	Clear water running from lateral at 131' DS. Roots ball joint and fine joint throughout pipe.	T&S, Grout Lateral, Root Treatment	4	720	0	720	\$3,167	\$0	\$3,167	\$4.40
CONTRACT 1	GR1	Blue Heron Dr	3023	916	919	8	VCP	238	Fracture multiple and broken pipe with soil visible at 150.2' US. Hole void visible at 152.2' US causing abandoned survey (no reversal attempted)	Complete CCTV, Spot Repair	5	0	0	0	\$0	\$3,809	\$3,809	\$0.00
CONTRACT 1	GR1	Osprey Drive	2994	821	819	8	VCP	55	Piece of pipe from repair stuck in pipe @ 4' (approx.). Infiltration stains joint throughout, Roots fine joint & infiltration joint light @ 69'. Roots medium joint from 70-90'. (MISLABELED PIPE NEED TO CONFIRM)	T&S, Root Treatment	3		0			\$0	\$1,300	\$3.01
CONTRACT 1	GR1	Osprey Drive	2992	EOP	821	6	VCP	218	Fracture circumferential @ 0' w/infiltration high.	Short Liner	5	720	0	720	\$3,000	\$0	\$3,000	\$4.17
CONTRACT 1	GR1	Portsmouth Blvd	3210	5852	818	8	VCP	103	Infiltration throughout with runners and gushers. Survey abandoned due to debris (no reversal attempted)	T&S, CIPP	5	9,072	0	9,072	\$8,720	\$0	\$8,720	\$0.96
CONTRACT 1	GR1	Portsmouth Blvd	3001	819	639	8	VCP	335	Fractures and infiltration throughout pipe, survey abandoned at 211' DS due to settled debris	T&S, CIPP	4	2,880	0	2,880	\$28,479	\$0	\$28,479	\$9.89
CONTRACT 1	GR1	Portsmouth Blvd	3209	816	5852	10	VCP	182	Fractures and infiltration throughout pipe	T&S, CIPP	4	2,448	0	2,448	\$15,462	\$0	\$15,462	\$6.32
CONTRACT 1	GR1	Portsmouth Boulevard	3008	2372	813	10	VCP	152	Infiltration in lateral @ 57', large debris in pipe @ 124' blocking remaining survey. Infiltration joint light can be seen approximately 10' further ahead in pipe	T&S	5	576	0	576	\$2,600	\$0	\$2,600	\$4.51
CONTRACT 1	GR1	Portsmouth Boulevard	3009	813	814	10	VCP	60	Crack longitudinal @ 27'. Crack spiral @ 30', infiltration stains @ joints throughout, large deposit @ 30', infiltration stains in manhole 814	Clean, T&S, Short Liner	3	144	0	144	\$5,500	\$0	\$5,500	\$38.19
CONTRACT 1	LR3	Suzanne Dr	1513	2595	2593	8	AC	78	Infiltration gusher from hole at 15' US	Clean, T&S, Spot Repair	5	5,760	0	5,760	\$6,011	\$0	\$6,011	\$1.04
CONTRACT 1	LR4	Greenleaf Ave	1881	394	392	10	AC	321	Infiltration stains throughout pipe with gusher and runner at 238 and 248' DS, respectively. Protruding lateral at 256.8' DS	Clean, T&S, Cut Service, Spot Repair	5	5,040	0	5,040	\$7,599	\$0	\$7,599	\$1.51
CONTRACT 1	LR4	Greenleaf Ave	555	1056	1047	8	AC	305	Fractures and infiltration stains throughout pipe. Clear water running from laterals at 24.5' and 138.5' US. Clear water coming from lateral at 217.2' US (unknown source).	T&S, Grout Lateral, Inspect Lateral, CIPP	5	144	864	1,008	\$22,229	\$0	\$22,229	\$154.37
CONTRACT 1	LR4	Greenleaf Ave	4753	392	391	8	AC	274	Clear water running from lateral at 13.4' US (Unknown Source). Debris buildup at MH 392	Inspect Lateral	4	0	288	288	\$750	\$0	\$750	\$0.00
CONTRACT 1	LR4	Greenleaf Ave XC	1834	372	5872	10	AC	184	Clear water dripping from lateral at 22.2' DS, Infiltration runner at DS MH connection	Clean, T&S, Grout Lateral	4	1,440	288	1,728	\$2,842	\$0	\$2,842	\$1.97
CONTRACT 1	LR4	Greenleaf Ave XC	1833	395	372	10	AC	216	Survey abandoned at 214' DS due to severe root ball. Infiltration dripper at MH372.	T&S, Root Treatment	5	288	0	288	\$2,921	\$0	\$2,921	\$10.14
CONTRACT 1	LR4	Middle Rd	4142	554	555	8	VCP	161	Infiltration stains, roots, and fractures throughout pipe. Clear water coming from protruding lateral at 96' DS. reversal complete	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	4	0	432	432	\$15,537	\$0	\$15,537	\$0.00
CONTRACT 1	LR4	Parking lot	5120	5421	5422	8	AC	237	Clear water coming from laterals at 59', 75', and 154.9' US (Unknown Source). Broken pipe void visible with infiltration dripper at 65' US. Infiltration drippers and stains throughout pipe	Clean, T&S, Inspect Lateral, Spot Repair	5	144	1,296	1,440	\$7,837	\$0	\$7,837	\$54.43
CONTRACT 1	LR4	Parking lot	5122	5423	5421	8	AC	325	Infiltration stains throughout pipe, Fractures at 120.5' DS.	Clean, T&S	4	0	0	0	\$0	\$4,220	\$4,220	\$0.00
CONTRACT 1	LR4	Sylvester St	640	562	565	8	AC	199	Clear water coming from lateral at 160.3' DS. Infiltration gusher from hole in pipe at 190' DS	Clean, T&S, Grout Lateral, Spot Repair	5	2,880	144	3,024	\$5,533	\$0	\$5,533	\$1.92
CONTRACT 1	LR4	X-Country	1845	545	420	8	AC	195	Infiltration gusher at US MH Connection, roots at DS MH Connection	Clean, T&S	5	1,152	0	1,152	\$2,537	\$0	\$2,537	\$2.20
CONTRACT 1	LR4	X-Country Greenleaf woods Dr	1892	374	375	10	AC	231	Infiltration runner joint at 116' US. Roots at US MH Connection	Clean, T&S	4	1,440	0	1,440	\$3,000	\$0	\$3,000	\$2.08

Contract Number	Metering Basin	Street	Sewer ID	US MH	DS MH	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab Cost	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 1	LR4	X-Country Greenleaf Woods Dr	1893	375	376	10	AC	214	Broken pipe at 34.8' US	Short Liner	5	0	0	0	\$0	\$2,580	\$2,580	\$0.00
CONTRACT 1	LR6	Constitution Ave	1640	237	236	8	AC	230	Clear water coming from lateral at 97.1' US (Unknown Source). Roots medium barrel at 104' US. Infiltration gusher at 107' US. Roots fine joint at 118' US.	T&S, Inspect Lateral, Root Treatment	4	4,320	0	4,320	\$3,853	\$0	\$3,853	\$0.89
CONTRACT 1	LR6	Heritage Rd	1587	2641	136	8	AC	285	Heavy grease and debris buildup in pipe. Infiltration gusher at 9.6' DS from defective wye. Infiltration stains at 127' DS	Clean, T&S, Spot Repair	5	4,320	0	4,320	\$3,961	\$0	\$3,961	\$0.92
CONTRACT 1	LR6	Lafayette Rd	2000	2484	2479	8	AC	284	Clear water running from lateral at 96.3' DS (Unknown Source), Infiltration runner from broken pipe/fracture spiral at 265' DS.	Inspect Lateral, Spot Repair	5	2,880	720	3,600	\$3,250	\$0	\$3,250	\$1.13
CONTRACT 1	LR6	Lafayette Road	1613	2530	2629	8	AC	189	Deformed pipe (minor) @ 0', intruding lateral at 156'	Cut Service	4	0	0	0	\$0	\$600	\$600	\$0.00
CONTRACT 1	LR6	Lafayette Road	1617	2628	2627	12	AC	260	Infiltration joint @ 1' (first joint)	T&S, Short Liner	4	432	0	432	\$5,100	\$0	\$5,100	\$11.81
CONTRACT 1	LR6	Lafayette Road	1618	2627	118	12	AC	218	Infiltration stains throughout, Crack circumferential at 84' (infiltration light), eroding pipe surface @ 89' (5" piece broken off). Intruding lateral @ 94' (void visible around lateral), steady clear water running .	Cut Service	3	1440	0	1440	\$600	\$0	\$600	\$0.42
CONTRACT 1	LR6	Lafayette Road	1619	118	117	12	AC	314	Clear water coming from service @ 38' evidence of infiltration around service. Deterioration pipe surface throughout. Service @ 146' has steady clear water running with infiltration stains visible. Cavity in pipe @ 148' (infiltration stains visible), Unknown pipe at MH117 coming from East (potentially abandoned pipe)	Short Liner	2	1440	0	1440	\$3,000	\$0	\$3,000	\$2.08
CONTRACT 1	LR6	Lafayette Road	1528	2626	2625	12	AC	234	Crack longitudinal at joint 5', crack spiral @ 79', infiltration joint @ 143' (0.3 gpm)	T&S, Short Liner	4	432	0	432	\$7,900	\$0	\$7,900	\$18.29
CONTRACT 1	LR6	Ricci Ave	1988	2652	143	8	AC	314	Infiltration runner at intruding lateral 26.6' DS. Intruding lateral at 106' DS. Debris buildup at 307' DS	Clean, T&S, Grout Lateral, Cut Service	4	720	0	720	\$5,396	\$0	\$5,396	\$7.49
CONTRACT 2	HS11	Bartlett St	1329	1400	1399	8	VCP	20	Broken pipe soil visible at 13.2' US.	CIPP	5	0	0	0	\$0	\$1,216	\$1,216	\$0.00
CONTRACT 2	HS11	Bartlett St	343	1399	1398	8	VCP	219	Hole void visible at 4' DS. Hole void visible in lateral at 25.4' DS. Hole soil visible at 26.2' DS. Protruding laterals at 48.4' DS and 215.9' DS blocking complete survey (reversal unsuccessful)	CIPP, Cut Service, Complete CCTV	5	0	0	0	\$0	\$15,199	\$15,199	\$0.00
CONTRACT 2	HS11	Boyd Rd	328	1413	1414	8	VCP	271	Intruding taps at 59' and 90' DS. Clear water coming from tap break-ins at 59' and 90' DS. Roots and infiltration stains throughout pipe with infiltration runner at 192.3' DS. Fractures at 157.1' and 189.2' DS. Broken pipe void visible at 133.2' and 258' DS.	T&S, Grout Lateral, CIPP, Cut Service, Spot Repair, Root Treatment	5	144	864	1,008	\$28,968	\$0	\$28,968	\$201.17
CONTRACT 2	HS11	Boyd Rd	327	1412	1413	8	VCP	260	Hinge fracture 3 with void visible at 108' DS. Roots fine joint throughout. Intruding laterals at 123.7, 154.6, 199.6', and 233.2' DS.	Cut Service, Spot Repair, Root Treatment	5	0	0	0	\$0	\$5,781	\$5,781	\$0.00
CONTRACT 2	HS11	Cottage St	1327	2239A	2239	8	VCP	339	Roots medium and ball throughout pipe, clear water running from lateral at 125.5' US (Unknown Source).	Inspect Lateral, Root Treatment	4	0	288	288	\$2,783	\$0	\$2,783	\$0.00
CONTRACT 2	HS11	Cottage St	334	1419	1418	8	VCP	298	Roots and infiltration throughout pipe, Fracture spiral at 32.8' US. Broken lateral at 38' US (Fernco disconnected). Protruding lateral at 228.4' US. Clear water running from lateral at 228.4' US (Unknown Source)	T&S, Inspect Lateral, CIPP, Spot Repair, Root Treatment	4	0	720	720	\$30,355	\$0	\$30,355	\$0.00
CONTRACT 2	HS11	Fields Rd	210	1310	1311	12	FRP	176	Infiltration drippers and runners throughout pipe. Broken pipe with infiltration weeper at 51.2' DS. Clear water running from laterals at 32.2' DS, 81.7' DS, and 156.8' DS. Candidate for Dig & Replace.	CIPP	5	432	2,016	2,448	\$10,553	\$0	\$10,553	\$24.43
CONTRACT 2	HS11	Hannaford	239	1364	1363	6	AC	218	This is a 6" Pipe. Infiltration weeper at 19' US, infiltration stain at 36' US. Deformed vertically at 203.3' US. Survey abandoned due to large amounts of debris in pipe and vertical deformation (no reversal attempted)	T&S, CIPP	5	144	0	144	\$19,108	\$0	\$19,108	\$132.69
CONTRACT 2	HS11	Islington St	3243	EOP	1439	8	VCP	149	Clear water coming from lateral at 135.9' US. Clear water running from laterals at 63.2' and 122.8' US (unknown source). Hinge fracture 3 at 144' US.	Grout Lateral, Inspect Lateral, Short Liner	5	0	576	576	\$4,470	\$0	\$4,470	\$0.00



Contract Number	Metering Basin	Street	Sewer ID	US MH	DS MH	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab Cost	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 2	HS11	Islington St	3525	605	5400	8	VCP	217	Includes Pipe SewerID 3850, 3851 and 6429. Fractures and voids throughout pipe, intruding laterals at 103.2' DS, 115.5' DS, and 216.8' DS. Clear water coming from laterals at 20', 133.9', and 161.3' DS. Clear water coming from lateral at 115.5' DS (unknown source)	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service	5	0	432	432	\$21,837	\$0	\$21,837	\$0.00
CONTRACT 2	HS11	Lovell St	237	1361	1360	8	AC	183	Infiltration weeper at 46.1' DS. Intruding lateral with clear water running at 53.1' DS (Unknown Source). Broken pipe void visible 1' US. Clear water running from laterals at 10 and 94' US. Broken pipe void visible at 123.1' US	T&S, Inspect Lateral, CIPP	5	576	2,880	3,456	\$13,077	\$0	\$13,077	\$22.70
CONTRACT 2	HS11	Melbourne St	201	589	590	10	VCP	456	Fracture multiple at 217' US. Roots and infiltration stains throughout pipe. Survey abandoned at 218' US due to sharp uphill bend (Reversal Complete)	CIPP, Spot Repair	5	0	0	0	\$0	\$33,377	\$33,377	\$0.00
CONTRACT 2	HS11	Melbourne St	5006	End of Pipe	589	10	VCP	242	Roots fine and ball throughout pipe, Intruding tap at 169.5' US causing abandoned survey.	Cut Service, Complete CCTV, Root Treatment	4	0	0	0	\$0	\$3,209	\$3,209	\$0.00
CONTRACT 2	HS11	Rutland St	204	590	End Of Pipe	8	VCP	240	Clear water dripping from laterals at 9.1' and 31' DS, intruding lateral at 10' DS. roots fine joint throughout pipe. Survey abandoned at 152' DS due to debris in pipe (reversal incomplete)	T&S, Grout Lateral, Cut Service, Complete CCTV, Root Treatment	5	0	1,584	1,584	\$10,076	\$0	\$10,076	\$0.00
CONTRACT 2	HS11	Sheffield Rd	200	583	589	8	VCP	240	Hole soil visible at 15.4' US from separated joint. Fracture longitudinal at 22' US. Hole soil visible at 49' US (Bell completely separated from pipe). Infiltration stain at 107' US. Hole soil visible at 132.7' US. Survey abandoned at 132.7' US due to separated joint (no reversal attempted)	T&S, CIPP, Complete CCTV, Spot Repair	5	0	0	0	\$0	\$26,689	\$26,689	\$0.00
CONTRACT 2	HS11	US 1B Off Ramp	329	1414	1415	8	VCP	258	Infiltration runner at 6' DS due to fracture. Infiltration stains and debris throughout pipe. Protruding lateral at 76' DS causing abandoned survey (reversal incomplete). Protruding lateral at 185.8' DS (found on reversal inspection)	T&S, Cut Service, Complete CCTV, Spot Repair	4	1,440	0	1,440	\$11,226	\$0	\$11,226	\$7.80
CONTRACT 2	HS11	US Rt 1 Bypass	195	1384	1383	12	VCP	358	Infiltration stains and drippers throughout. Roots fine joint at 22' US. Settled gravel at 187' US causing abandoned survey (no reversal attempted)	T&S, Complete CCTV	3	288	0	288	\$11,108	\$0	\$11,108	\$38.57
CONTRACT 2	LR5	Broad Street	3832	1092	1091	8	VCP	528	Solids deposit at joint 0', roots medium joint @ 3' (2), root ball @ 17'. Large object protruding from lateral at 42'. Fracture at 42' broken pipe around lateral. Infiltration stains at 53.5' originating from service. Patch repair at 59'. Broken pipe @ 63' hole with soil visible. Hole soil visible @ 74' from faulty lateral. Crack Longitudinal at 106'. Faulty lateral @ 143' void w/void visible. Diameter change 8-10" @ 180' (EOS)	Root Treatment, CIPP	5	0	0	0	\$0	\$36,200	\$36,200	\$0.00
CONTRACT 2	LR5	Lafayette Rd XC	1916	1046	1069	10	AC	135	Infiltration runner at 30.3' DS, MH 1069 has infiltration at walls (1.5 gpm)	Clean, T&S	4	432	0	432	\$1,751	\$0	\$1,751	\$4.05
CONTRACT 2	LR5	Ledgewood Dr	1915	1045	1046	10	AC	167	Broken pipe at 17.4' US. Hole soil visible at 40' US. Infiltration stains throughout pipe, infiltration runner joint at 224' US. Survey abandoned due to high water level in pipe at 226' US (no reversal attempted)	T&S, Complete CCTV, Spot Repair	5	288	0	288	\$5,168	\$0	\$5,168	\$17.94
CONTRACT 2	LR5	Ledgewood Dr	1908	1040	1062	8	VCP	134	Deposits attached grease throughout pipe. Survey abandoned at 86.5' DS due to grease blockage (no reversal attempted)	Complete CCTV	5	0	0	0	\$0	\$735	\$735	\$0.00
CONTRACT 3	B1	Colonial Dr	173	468	467	8	VCP	318	Infiltration stains throughout pipe. Intruding laterals at 81.7, 110.2, 138.8, 202.2, 243.9', 252.6', 301.2', and 309' DS. Fracture spiral at 21' DS, Fracture multiple at 24.2 and 27.3' DS. Clear water running from lateral at 64.4' DS (Unknown Source).	Inspect Lateral, CIPP, Cut Service	4	0	144	144	\$23,266	\$0	\$23,266	\$0.00
CONTRACT 3	B1	Georges Ter	688	471	470	8	VCP	111	Roots ball and joint throughout. Infiltration dripper at 18.4' DS from intruding lateral. Intruding lateral with clear water running at 49' DS	Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	432	432	\$9,099	\$0	\$9,099	\$0.00
CONTRACT 3	LD1	Blue Heron dr	2982	926	925	8	VCP	228	Roots throughout pipe. Infiltration weeper at joint 117' DS. Clear Water coming from laterals at 145' and 148' DS (Unknown source). Fracture spiral with infiltration runner at 147' DS.	T&S, Inspect Lateral, Spot Repair, Root Treatment	5	1,152	1,008	2,160	\$11,064	\$0	\$11,064	\$9.60

Contract Number	Metering Basin	Street	Sewer ID	US MH	DS MH	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab Cost	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 3	LD1	Blue Heron Dr	3102	828	829	8	VCP	242	Infiltration, fractures, and roots throughout pipe. Clear water coming from laterals at 88', 172', and 198' US (Unknown Source).	T&S, Inspect Lateral, CIPP, Complete CCTV, Root Treatment	4	288	1,152	1,440	\$25,631	\$0	\$25,631	\$89.00
CONTRACT 3	LD1	Blue Heron Dr	2981	927	926	8	VCP	195	Survey abandoned at 7' US due to roots (no reversal attempted)	Root Treatment	5	0	0	0	\$0	\$1,170	\$1,170	\$0.00
CONTRACT 3	LD1	Blue Heron Dr	2977	928	926	8	VCP	154	Roots throughout pipe. Broken pipe void visible at 146.2' DS. Fracture spiral at 0' US.	Short Liner, Root Treatment	5	0	0	0	\$0	\$3,442	\$3,442	\$0.00
CONTRACT 3	LD1	Blue Heron Dr	2976	930	928	6	PVC	243	Roots ball joint at 3' US. Clear Water running from lateral at 81' US (Unknown Source). Fracture spiral at 239.8' US (material changed to VCP at 232' US)	Inspect Lateral, Root Treatment	4	0	1,440	1,440	\$2,206	\$0	\$2,206	\$0.00
CONTRACT 3	LD1	Dunlin Way	2966	924	923	8	VCP	242	Fractures throughout pipe. Sag in pipe at 41' DS. Broken pipe no void visible at 95' DS. Pipe sag at 110' DS. Hinge fracture 3 from 135'-170' DS. Broken pipe with Hole soil visible at 160' DS (continuation of fracture).	CIPP, Spot Repair	5	0	0	0	\$0	\$21,995	\$21,995	\$0.00
CONTRACT 3	LD1	Market St	842	5565	2369	8	PVC	207	Light debris throughout pipe. Infiltration weeper and stain at 192' DS.	Clean, T&S	2	144	0	144	\$2,329	\$0	\$2,329	\$16.17
CONTRACT 3	LD1	Michael Succi Dr	3048	1015	1016	14	AC	200	Roots medium joint @ 79', hole with soil visible @ 79', difficult to determine where survey begins	Short Liner	5	0	0	0	\$0	\$3,000	\$3,000	\$0.00
CONTRACT 3	LD1	Michael Succi Dr	3049	1016	1017	14	AC	209	Offset joint small with void visible @ 36', infiltration stains at lateral 89' and 143', roots fine joint @ 207' (Manhole)	T&S	4	0	0	0	\$0	\$600	\$600	\$0.00
CONTRACT 3	LD1	Osprey Dr	2988	841	840	8	VCP	146	Fractures and infiltration stains throughout pipe. Roots ball joint at 111' DS	CIPP, Root Treatment	5	0	288	288	\$9,605	\$0	\$9,605	\$0.00
CONTRACT 3	LD1	Osprey Dr	2989	840	839	8	VCP	326	Roots and fractures throughout pipe. Hinge fracture 3 at 120.2' DS.	CIPP	4	0	0	0	\$0	\$19,533	\$19,533	\$0.00
CONTRACT 3	LD1	Spinnaker Way	2957	941	942	8	VCP	225	Surface spalling at 14' US. Clear water coming from laterals at 69', 106', 166', and 204' US. Clear water from lateral at 21' US (unknown source). Crack longitudinal at 22' US. Broken pipe at 30' (no void visible). Fracture spiral at 44' US. Roots in lateral at 69' US. Roots fine barrel at 100' US. Infiltration stains at 126' US. Fracture spiral at 217' US with infiltration runner	Grout Lateral, Inspect Lateral, Short Liner, Spot Repair	5	288	3,312	3,600	\$7,570	\$0	\$7,570	\$26.28
CONTRACT 3	LD1	Spinnaker Way	2955	939	940	8	VCP	246	Roots throughout pipe. Infiltration runner at 92' DS coming from crack longitudinal. Infiltration runner at 114' DS. Deposits attached grease and encrustation throughout pipe. Clear water running from lateral at 146' DS (Unknown source). Infiltration dripper joint at 174' DS. Infiltration runner joint at 180' DS. Infiltration dripper at 206' DS.	Clean, T&S, Inspect Lateral, Spot Repair	5	2,160	432	2,592	\$10,769	\$0	\$10,769	\$4.99
CONTRACT 3	LD1	Spinnaker Way	2963	935	934	8	VCP	206	Roots and debris throughout pipe. Broken pipe void visible at 62' US. Infiltration weeper joint at 98' US and 102' US. Collapsed pipe at 106' US. Hinge fracture 3 from 130' and 155' US.	T&S, Spot Repair, Root Treatment	5	720	0	720	\$22,653	\$0	\$22,653	\$31.46
CONTRACT 3	LD1	Spinnaker Way	2958	942	932	8	VCP	219	Crack longitudinal at 10' US With infiltration weeper. Crack circumferential and infiltration stains at 14' US. Pipe half full of debris at 28' (grass and toilet paper). Settled gravel deposits at 36' US. Infiltration stain joint at 40' US. Clear water leaking from lateral at 62' US. Roots joint fine and roots barrel fine at 100' US with Clear water running from lateral 100' US. Infiltration dripper at joint 112' US. Heavy debris and gravel blocking remaining survey. (Reversal complete)	T&S, Grout Lateral, CIPP, Short Liner	4	288	432	720	\$23,750	\$0	\$23,750	\$82.47
CONTRACT 3	LD1	Spinnaker Way	2961	937	936	8	VCP	212	Infiltration dripper at 55' US. Broken pipe soil visible at 55' US. PVC Spot Repair at 79' US with Joint Offset Severe (sinking into ground)	Complete CCTV, Spot Repair	5	144	0	144	\$13,667	\$0	\$13,667	\$94.91
CONTRACT 3	LD1	Spinnaker Way	3027	943	2361	8	VCP	279	Infiltration runner in lateral at 207.6' DS. Infiltration stains and roots throughout pipe	T&S, Grout Lateral, Root Treatment	4	0	1,440	1,440	\$8,646	\$0	\$8,646	\$0.00
CONTRACT 3	LD1	Spinnaker Way	2956	940	941	8	VCP	186	Fractures, roots, and infiltration stains throughout pipe. Clear water running from lateral at 114.8' DS (Unknown Source)	T&S, Inspect Lateral, CIPP, Root Treatment	4	0	432	432	\$17,682	\$0	\$17,682	\$0.00

Contract Number	Metering Basin	Street	Sewer ID	US MH	DS MH	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab Cost	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 4	HS14	Coakley Rd	321	533	534	8	VCP	315	Fractures throughout pipe. Hole and broken pipe soil visible at 143' DS. Survey abandoned at 143' DS due to broken pipe (reversal incomplete)	CIPP, Spot Repair	5	0	0	0	\$0	\$21,381	\$21,381	\$0.00
CONTRACT 4	HS14	Coakley Rd	1334	541	5341	8	VCP	88	Roots, fractures, and infiltration throughout pipe. Hinge fracture 3 at 47' DS	T&S, CIPP, Spot Repair, Root Treatment	5	1,728	0	1,728	\$10,527	\$0	\$10,527	\$6.09
CONTRACT 4	HS14	Coakley Rd	187	538	540	8	VCP	560	Includes Pipe SewerID 1335. Roots throughout pipe. Broken pipe at 17.9' US. Fracture longitudinal at 61' US. Clear water running from laterals at 173' and 389' US (Unknown Source). Protruding lateral at 247' US. Fracture spiral at 288' US. Hole soil visible at 481' US.	Inspect Lateral, CIPP, Root Treatment	5	0	720	720	\$37,710	\$0	\$37,710	\$0.00
CONTRACT 4	HS14	Coakley Rd	320	532	533	8	VCP	178	Hinge fracture 4 at 34' DS, Clear water dripping from lateral at 48' DS, Hinge fracture 3 at 48-52' DS. Hinge fracture 3 from 149'-160' DS. Fractures throughout pipe. Candidate for Dig & Replace.	CIPP	4	0	144	144	\$10,685	\$0	\$10,685	\$0.00
CONTRACT 4	HS14	Coakley St	323	540	541	8	VCP	121	Fractures throughout pipe. Hinge fracture 3 at 35' DS. Hinge fracture 4 at 38' DS. Broken pipe void visible at 39' DS. Fracture spiral at 48' DS. Survey abandoned at large offset joint (52.4' DS) (no reversal attempted)	CIPP, Spot Repair	5	0	0	0	\$0	\$12,288	\$12,288	\$0.00
CONTRACT 4	HS15	Essex Ave	1389	596	598	8	VCP	390	Fractures and roots throughout pipe, clear water dripping from lateral at 165.8' US (Unknown Source). Collapsed pipe at 150.6 DS.	Inspect Lateral, CIPP, Spot Repair, Root Treatment	5	0	432	432	\$29,017	\$0	\$29,017	\$0.00
CONTRACT 4	HS15	Essex Ave	4156	593	580	8	VCP	318	Infiltration stains and roots throughout pipe. Fracture at 47.4.	T&S, Short Liner, Root Treatment	4	0	0	0	\$0	\$12,389	\$12,389	\$0.00
CONTRACT 4	HS15	Hampshire Rd	4172	587	1381	10	VCP	153	Infiltration and fractures throughout, broken pipe void visible at 35.2'.	T&S, CIPP	5	288	0	288	\$13,009	\$0	\$13,009	\$45.17
CONTRACT 4	HS15	Hampshire Rd	4165	2211	587	10	VCP	89	Infiltration stains at 11.1' US. Survey abandoned at 68.8' US due to high grease and water level (reversal incomplete)	T&S, Complete CCTV	4	0	0	0	\$0	\$2,717	\$2,717	\$0.00
CONTRACT 4	HS15	Melbourne St	5008	5401	2728	8	VCP	480	Fractures, holes, and roots throughout pipe. Intruding laterals at 21.6', 261', 301.4', 322.3', and 429.6' DS. Clear water running from laterals at 70.8', 261.7', 301.4, 350.7, and 364' DS.	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	2,592	2,592	\$48,069	\$0	\$48,069	\$0.00
CONTRACT 4	HS15	Melbourne St	202	2728	596	8	VCP	248	Roots and fractures throughout pipe, hole with soil visible at 210' DS, chipped bell at 233' DS.	CIPP, Root Treatment	5	0	0	0	\$0	\$16,377	\$16,377	\$0.00
CONTRACT 4	HS15	Sheffield Rd	4163	581	580	8	VCP	242	Hinge fracture 3 with broken pipe at 2' DS. Fractures throughout remainder of pipe. Intruding laterals at 58.6', 136', 145.4', and 167.5' DS. Clear water running from lateral at 167.5' DS (Unknown Source). Hole soil visible at 57.5' DS. Infiltration stains and mineral deposits throughout pipe with infiltration runner from joint at 156.1' DS.	T&S, Inspect Lateral, CIPP, Cut Service, Spot Repair	5	1,440	288	1,728	\$25,556	\$0	\$25,556	\$17.75
CONTRACT 4	HS15	Sheffield Rd	6468	597	5685	8	VCP	173	Fractures throughout pipe. Intruding laterals at 124.8' and 151.7' DS. Clear water dripping from lateral at 124.8' DS	T&S, Grout Lateral, CIPP, Cut Service	4	0	288	288	\$16,030	\$0	\$16,030	\$0.00
CONTRACT 4	HS15	Sims Ave	4153	599	600	8	VCP	80	Infiltration Runner at DS MH Connection	Clean, T&S	4	720	0	720	\$2,440	\$0	\$2,440	\$3.39
CONTRACT 4	HS15	Sims Ave	4188	2728	598	8	VCP	238	Broken pipe at 69' DS. Infiltration Stains throughout pipe. Clear Water coming from lateral at 131.4 DS. Protruding lateral at 135.6' DS causing abandoned survey (reversal incomplete)	T&S, Grout Lateral, CIPP, Short Liner	4	0	288	288	\$23,222	\$0	\$23,222	\$0.00
CONTRACT 4	HS15	US Rt 1 Bypass	547	1423	1382	8	VCP	83	Infiltration stains throughout pipe. Crack longitudinal at 21' US, Broken pipe void visible at 56.8' US, Large rock intruding into broken pipe at 79.9' US with infiltration runner around rock. Roots medium joint at 82.1' US. Candidate for Dig & Replace.	CIPP	5	720	0	720	\$4,956	\$0	\$4,956	\$6.88
CONTRACT 4	HS15	US Rt 1 Bypass	4554	1382	1383	12	VCP	290	Includes Pipe Sewer ID 4555. Infiltration stains and drippers throughout pipe. Clear water running from laterals at 190.7 and 191.3' DS. lateral intruding at 190.7' DS. Survey abandoned at 290' DS due to high water level (no reversal attempted)	T&S, Grout Lateral, Complete CCTV	4	432	720	1,152	\$9,893	\$0	\$9,893	\$22.90
CONTRACT 4	HS15	US Rt 1 Bypass N	194	1383	1384	10	VCP	399	Fracture spiral at 22' US. Infiltration drippers throughout pipe	Clean, T&S, Short Liner	3	1,728	0	1,728	\$14,747	\$0	\$14,747	\$8.53
CONTRACT 4	M1	Fairview Ave	834	111	110	8	PVC	28	Separated joint 1.5', lateral at 4.5' potential inflow source (steady clear water),	Grout Lateral	2	432	0	432	\$300	\$0	\$300	\$0.69

Contract Number	Metering Basin	Street	Sewer ID	US MH	DS MH	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab Cost	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 4	M1	Maplewood Ave	830	2129	2132	8	PVC	223	Light infiltration observed at lateral 160'	T&S	2	144	0	144	\$1,800	\$0	\$1,800	\$12.50
CONTRACT 4	M1	Maplewood Ave	841	105	104	8	PVC	261	Infiltration observed @ lateral (192'), grease deposits @ 250', lateral 1/2 full of grease @ 255'	Clean, Grout Lateral	3	432	0	432	\$1,800	\$0	\$1,800	\$4.17
CONTRACT 4	M1	Maplewood Ave	840	2359	105	8	PVC	169	Potential inflow observed @ 33' from lateral (steady clear water)	Grout Lateral	4	432	0	432	\$300	\$0	\$300	\$0.69
CONTRACT 4	M1	Maplewood St	837	767	769	8	VCP	213	Clear water running from lateral at 45.5' DS. Cracks and fractures throughout pipe. Survey abandoned at 110' DS due to turn in pipe (reversal incomplete) - City Currently Digging, Removed from Recommendation.	Monitor	4	0	0	0	\$0	\$0	\$0	\$0.00
CONTRACT 4	M1	Oleary Pl	833	759	111	6	AC	100	Rag wedged in joint at 29' DS. Survey abandoned at 33' DS due to offset joint (no reversal attempted)	Complete CCTV	5	0	0	0	\$0	\$553	\$553	\$0.00
CONTRACT 1 TOTALS												51,264	4,032	55,296	\$178,085	\$12,045	\$190,130	-
CONTRACT 2 TOTALS												3,744	9,360	13,104	\$170,480	\$122,406	\$292,885	-
CONTRACT 3 TOTALS												5,184	10,512	15,696	\$187,938	\$49,739	\$237,677	-
CONTRACT 4 TOTALS												8,496	5,472	13,968	\$250,062	\$65,705	\$315,767	-

Table 4-15: Manhole Rehabilitation Recommendations

Contract	Metering Basin	Street	MH Number	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 1	GR1	Blue Heron Dr Easement	916	8	BRICK	Roots and infiltration staining at wall	Root Treatment, Grout Manhole, Cementitious Liner	2	360	\$2,960	\$2,200	\$5,160	\$8.22
CONTRACT 1	GR1	Commerce Way	638	16	PRECAST	Infiltration staining	Grout Manhole	2	720	\$3,400	\$0	\$3,400	\$4.72
CONTRACT 1	GR1	Commerce Way	5332	13	PRECAST	Active infiltration at walls, cracked frame with broken pieces	New Frame and Cover, Grout Manhole, Cementitious Liner	3	720	\$4,810	\$820	\$5,630	\$6.68
CONTRACT 1	GR1	Commerce Way Easement	632	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
CONTRACT 1	GR1	Commerce Way Easement	2385	8	BRICK	Severe infiltration from corbel, surcharging (no bench or invert visible), ponding around frame causing inflow. Located on Pease effluent line.	Corbel Repair, Rebuild Bench, Grout Manhole, Raise to Surface	4	2880	\$1,600	\$4,300	\$5,900	\$0.56
CONTRACT 1	GR1	Commerce Way Easement	2386	9	BRICK	Roots in corbel, Active infiltration with mineral deposits at wall, heavy debris in invert. Located on Pease effluent line.	Root Treatment, Grout Manhole, Cementitious Liner	3	1440	\$3,330	\$2,200	\$5,530	\$2.31
CONTRACT 1	GR1	Granite St R.O.W.	5729	6	PRECAST	Evidence of surcharge, bench and invert not visible due to high water.	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 1	GR1	Oriental Gardens R.O.W.	629	11	PRECAST	Heavy mineral deposits, aggregate visible at wall due to H2S	Grout Manhole, Epoxy Liner	3	1440	\$2,200	\$5,500	\$7,700	\$1.53
CONTRACT 1	GR1	Oriental Gardens R.O.W.	631	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
CONTRACT 1	GR1	Osprey Dr	821	9	BRICK	Manhole walls leaking at 11.6 gpm per flow isolation, no picture taken of infiltration. Also, possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	16704	\$3,700	\$0	\$3,700	\$0.22
CONTRACT 1	GR1	Osprey Dr Easement	5495	8	UNKNOWN	Cover broken	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
CONTRACT 1	GR1	Portsmouth Boulevard	816	8	BRICK	Mineral deposits at wall. Pipe connection leak.	Grout Manhole, Cementitious Liner	3	7200	\$3,330	\$0	\$3,330	\$0.46
CONTRACT 1	GR1	Portsmouth Boulevard	818	10	BLOCK	Active infiltration and mineral deposits at wall, roots	Root Treatment, Grout Manhole, Cementitious Liner	4	7200	\$4,070	\$2,200	\$6,270	\$0.57
CONTRACT 1	GR1	Portsmouth Boulevard Easement	5852	11	PRECAST	Mineral deposits at bench, broken bricks and missing mortar from corbel	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$4,070	\$1,000	\$5,070	\$5.65
CONTRACT 1	GR1	Portsmouth Boulevard near Market St	813	11	BRICK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	432	\$4,070	\$0	\$4,070	\$9.42
CONTRACT 1	GR1	Shearwater Dr	920	9	BRICK	Pipe connection leak from north and west pipes. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	10080	\$3,330	\$0	\$3,330	\$0.33
CONTRACT 1	GR1	Woodbury Ave	642	11	PRECAST	Missing bricks and mortar from corbel, Mineral deposits at wall, debris buildup in bench.	Corbel Repair, Grout Manhole, Cementitious Liner	3	1440	\$4,070	\$1,000	\$5,070	\$2.83
CONTRACT 1	GR1	Woodbury Ave	2387	12	PRECAST	Infiltration staining at wall, aggregate visible at wall due to H2S. Located on Pease effluent line.	Grout Manhole, Epoxy Liner	2	360	\$2,400	\$6,000	\$8,400	\$6.67
CONTRACT 1	GR1	Woodbury Ave	2388	13	PRECAST	Mineral deposits, debris buildup in bench and channel. Bricks missing from bench.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	360	\$4,810	\$2,200	\$7,010	\$13.36
CONTRACT 1	GR1	Woodbury Ave	5334	12	PRECAST	Missing bricks in bench and invert. Light debris buildup in bench and channel. Infiltration staining at wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole	4	720	\$2,400	\$2,200	\$4,600	\$3.33
CONTRACT 1	LR3	Nathaniel Dr R.O.W.	1646	5	PRECAST	Wall leaks, hole in wall at connection to bench	Grout Manhole, Cementitious Liner	3	2880	\$1,850	\$0	\$1,850	\$0.64
CONTRACT 1	LR3	Nathaniel Dr R.O.W.	2445	8	PRECAST	Light infiltration stains at walls, cracked cover	New Frame and Cover, Grout Manhole, Cementitious Liner	3	2880	\$2,960	\$820	\$3,780	\$1.03
CONTRACT 1	LR3	Nathaniel Dr R.O.W.	2455	7	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	288	\$2,590	\$0	\$2,590	\$8.99
CONTRACT 1	LR3	Nathaniel Dr R.O.W.	2458	9	PRECAST	Rocks on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
CONTRACT 1	LR4	Greenleaf Ave	395	8	PRECAST	Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	3	720	\$2,960	\$0	\$2,960	\$4.11
CONTRACT 1	LR4	Greenleaf Ave	397	8	PRECAST	Corbel missing bricks and mortar, light debris on bench. 6 gpm leak observed during flow isolation.	Corbel Repair, Grout Manhole, Cementitious Liner	3	8640	\$2,960	\$1,000	\$3,960	\$0.34
CONTRACT 1	LR4	Greenleaf Ave	1047	8	PRECAST	Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	3	1080	\$2,960	\$0	\$2,960	\$2.74
CONTRACT 1	LR4	Greenleaf Woods Dr	376	8	UNKNOWN	Incoming pipe connection leak	Grout Manhole, Cementitious Liner	3	288	\$2,960	\$0	\$2,960	\$10.28
CONTRACT 1	LR4	Greenleaf Woods Dr	377	14	PRECAST	Mineral deposits at pipe connections (primary in/out) with active infiltration	Grout Manhole, Cementitious Liner	4	17280	\$5,180	\$0	\$5,180	\$0.30
CONTRACT 1	LR4	Greenleaf Woods Dr	378	15	PRECAST	Active infiltration from wall	Grout Manhole, Cementitious Liner	4	1440	\$5,920	\$0	\$5,920	\$4.11
CONTRACT 1	LR4	Greenleaf Woods Dr	380	14	PRECAST	Chipped frame, Active infiltration with mineral deposits at wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$5,180	\$820	\$6,000	\$17.99
CONTRACT 1	LR4	Greenleaf Woods Dr	396	7	PRECAST	Incoming pipe connection leak, voids visible around inlet and outlet pipe connections.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	9360	\$2,590	\$2,200	\$4,790	\$0.28
CONTRACT 1	LR4	Greenleaf Woods Dr	5872	8	UNKNOWN	Incoming pipe connection leak	Grout Manhole, Cementitious Liner	3	1080	\$2,960	\$0	\$2,960	\$2.74
CONTRACT 1	LR4	McClintock Ave	544	8	PRECAST	Active Infiltration at walls	Grout Manhole, Cementitious Liner	3	1080	\$2,960	\$0	\$2,960	\$2.74
CONTRACT 1	LR4	McClintock Ave	545	8	PRECAST	Infiltration Gusher at Effluent Pipe Connection (to MH 420)	Grout Manhole, Cementitious Liner	3	2880	\$2,960	\$0	\$2,960	\$1.03
CONTRACT 1	LR4	McClintock Ave	2726	8	UNKNOWN	Incoming pipe connection leak	Grout Manhole, Cementitious Liner	3	72	\$2,960	\$0	\$2,960	\$41.11
CONTRACT 1	LR4	Middle Rd	961	6	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 1	LR4	Middle Rd at Leavitt Ave	554	5	BLOCK	No bench and invert, heavy debris buildup, corbel blocks missing/deteriorating	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
CONTRACT 1	LR4	Peverly Hill Rd	406	7	PRECAST	Incoming and outgoing pipe connection leaks.	Grout Manhole, Cementitious Liner	3	2232	\$2,960	\$0	\$2,960	\$1.33
CONTRACT 1	LR4	Peverly Hill Rd at McClintock Ave	407	8	PRECAST	Outgoing pipe connection leak.	Grout Manhole, Cementitious Liner	3	1440	\$3,330	\$0	\$3,330	\$2.31
CONTRACT 1	LR4	Swealt Ave	551	8	PRECAST	Pipe connection and invert leaking	Rebuild Bench, Grout Manhole, Cementitious Liner	3	360	\$2,960	\$2,200	\$5,160	\$8.22
CONTRACT 1	LR4	Woodworth Ave	546	8	UNKNOWN	Infiltration at pipe connection and invert	Grout Manhole	2	288	\$1,600	\$0	\$1,600	\$5.56
CONTRACT 1	LR6	Heritage Ave	2635	12	PRECAST	Active infiltration at wall	Grout Manhole, Cementitious Liner	3	288	\$4,440	\$0	\$4,440	\$15.42
CONTRACT 1	LR6	Heritage Ave	2642	9	PRECAST	Light Infiltration observed at walls, mineral deposits	Grout Manhole, Cementitious Liner	3	1440	\$3,700	\$0	\$3,700	\$2.57

Contract	Metering Basin	Street	MH Number	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 1	LR6	Lafayette Rd	2471	6	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	720	\$2,590	\$0	\$2,590	\$3.60
CONTRACT 1	LR6	Lafayette Rd	2507	6	PRECAST	Infiltration at bench/wall connection	Grout Manhole, Cementitious Liner	2	432	\$2,590	\$0	\$2,590	\$6.00
CONTRACT 1	LR6	Lafayette Rd at Blue Fish Boulevard	2501	6	PRECAST	Moderate debris on bench, broken cover	New Frame and Cover, Rebuild Bench	4	0	\$0	\$3,020	\$3,020	\$0.00
CONTRACT 1	LR6	Lafayette Rd at Coach Rd	2483	8	PRECAST	Light infiltration at manhole wall	Grout Manhole	2	288	\$1,800	\$0	\$1,800	\$6.25
CONTRACT 1	LR6	Lafayette Rd at Coach Rd	2487	8	PRECAST	Light debris on bench and invert. Infiltration at bench/wall connection. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	2	2520	\$3,330	\$0	\$3,330	\$1.32
CONTRACT 1	LR6	Lafayette Rd at Constitution Ave	2631	8	PRECAST	Broken frame, light debris on bench, bench missing bricks, corbel missing mortar	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
CONTRACT 1	LR6	Lafayette Rd at Constitution Ave	2632	9	PRECAST	Broken frame, light debris on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
CONTRACT 1	LR6	Robert Ave	2646	6	PRECAST	Mineral deposits at wall and void visible at outgoing pipe connection	Grout Manhole, Cementitious Liner	3	5040	\$2,220	\$0	\$2,220	\$0.44
CONTRACT 1	LR6	White Cedar Boulevard R.O.W.	2657	8	PRECAST	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	360	\$3,330	\$0	\$3,330	\$9.25
CONTRACT 2	HS11	Aldrich Rd at Aldrich Court	5819	8	PRECAST	Incoming pipe connection leak (estimated at 2 gpm)	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1800	\$2,960	\$2,200	\$5,160	\$1.64
CONTRACT 2	HS11	Bartlett St	1397	7	BRICK	Broken and loose bricks on corbel, missing mortar from corbel. No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,390	\$3,390	\$0.00
CONTRACT 2	HS11	Brewery Lane	1329	14	PRECAST	No bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 2	HS11	Brewery Lane	1330	11	PRECAST	Bench and invert gone/broken/sinking, infiltration staining at walls, piece of frame missing	New Frame and Cover, Rebuild Bench, Grout Manhole, Epoxy Liner	5	720	\$2,400	\$9,020	\$11,420	\$3.33
CONTRACT 2	HS11	Brewery Lane	1331	14	BRICK AND STONE	No bench and invert, roots at wall. Large gaps in wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1440	\$5,550	\$2,200	\$7,750	\$3.85
CONTRACT 2	HS11	Cate St	1390	9	BLOCK	Active infiltration and mineral deposits at wall, corbel missing mortar	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
CONTRACT 2	HS11	Cate St	1392	5	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$1,200	\$0	\$1,200	\$3.33
CONTRACT 2	HS11	Fells Rd	1300	8	BRICK	Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	3	720	\$2,960	\$0	\$2,960	\$4.11
CONTRACT 2	HS11	Fields Rd and Sewall Rd	1311	7	BLOCK	Moderate debris in bench and invert, active infiltration from wall	Grout Manhole, Cementitious Liner	3	1440	\$2,960	\$0	\$2,960	\$2.06
CONTRACT 2	HS11	Hampshire Rd	1381	8	BLOCK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$2,960	\$0	\$2,960	\$10.28
CONTRACT 2	HS11	Islington St	2221	11	BRICK	Active infiltration at wall, bench and invert not visible, corbel missing mortar and cracked	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	1080	\$4,440	\$3,200	\$7,640	\$4.11
CONTRACT 2	HS11	Islington St	2248	8	PRECAST	No bench and invert. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	2880	\$2,960	\$2,200	\$5,160	\$1.03
CONTRACT 2	HS11	Lovell St R.O.W.	2741	10	BLOCK	Walls missing mortar, no bench and invert, mineral deposits in incoming line	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,070	\$2,200	\$6,270	\$5.65
CONTRACT 2	HS11	Madison St at Lovell St	1344	6	PRECAST	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 2	HS11	Sewall Rd	1307	6	PRECAST	Active infiltration at walls, hole in bench, corbel missing mortar, chipped frame	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	3	288	\$2,590	\$3,020	\$5,610	\$8.99
CONTRACT 2	HS11	Sewall Rd	1314	8	PRECAST	Chipped cover, active infiltration coming from wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$2,960	\$820	\$3,780	\$10.28
CONTRACT 2	HS11	Sewall Rd at Spinney Rd	1315	9	PRECAST	Faulty drop connection in manhole, light debris on bench and invert, walls weeping at joints	Grout Manhole, Cementitious Liner	3	1728	\$3,330	\$0	\$3,330	\$1.93
CONTRACT 2	HS11	Sheffield Rd	583	8	BRICK	Incoming pipe connection leak, broken and loose bricks in manhole. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	3	720	\$2,960	\$0	\$2,960	\$4.11
CONTRACT 2	HS11	Thaxter Rd at Fells Rd	1303	11	BLOCK	Loose bricks in wall, no bench and invert, active infiltration at wall	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1080	\$4,070	\$2,200	\$6,270	\$3.77
CONTRACT 2	HS11	US Bypass 1	1387	12	BLOCK	Roots, Active infiltration and mineral deposits at wall	Root Treatment, Grout Manhole, Cementitious Liner	3	144	\$4,440	\$2,200	\$6,640	\$30.83
CONTRACT 2	HS11	US Bypass 1 at rear	1388	11	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$2,400	\$0	\$2,400	\$6.67
CONTRACT 2	LR5	Lafayette Rd	1064	11	PRECAST	Active infiltration with mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$4,070	\$0	\$4,070	\$14.13
CONTRACT 2	LR5	Ledgewood Dr	1069	8	UNKNOWN	Incoming pipe connection leak	Grout Manhole, Cementitious Liner	3	1080	\$2,960	\$0	\$2,960	\$2.74
CONTRACT 2	LR5	Ledgewood Dr R.O.W.	1044	5	PRECAST	No bench and invert, heavy debris buildup, active infiltration at wall, frame chipped	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,220	\$3,020	\$5,240	\$7.71
CONTRACT 2	LR5	Ledgewood Dr R.O.W.	1045	8	PRECAST	Infiltration staining and mineral deposits at wall. Active infiltration from wall joints	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
CONTRACT 3	B1	Victory Rd	460	8	BRICK	Roots at wall, corbel has broken bricks and missing mortar	Corbel Repair, Root Treatment, Grout Manhole	2	720	\$1,800	\$3,200	\$5,000	\$2.50
CONTRACT 3	LD1	Albacore Museum Access Pump Station	2368	18	PRECAST	Light infiltration stains at walls	Grout Manhole, Cementitious Liner	3	720	\$6,660	\$0	\$6,660	\$9.25
CONTRACT 3	LD1	Dunlin Way	2454	14	PRECAST	No bench and invert, debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 3	LD1	Kearsarge Rd at Market St	2362	10	PRECAST	Invert leak. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1440	\$3,700	\$2,200	\$5,900	\$2.57
CONTRACT 3	LD1	Kearsarge Way	946	8	PRECAST	Roots and Wall Leak	Root Treatment, Grout Manhole, Cementitious Liner	3	720	\$2,960	\$2,200	\$5,160	\$4.11
CONTRACT 3	LD1	Market St	5563	8	PRECAST	Wall leaks and the manhole does not have a bench/invert. Significant debris build up. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1080	\$2,960	\$2,200	\$5,160	\$2.74
CONTRACT 3	LD1	Osprey Dr	838	8	BRICK	Active Infiltration at walls. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	3	1440	\$2,960	\$0	\$2,960	\$2.06
CONTRACT 3	LD1	Portsmouth Boulevard R.O.W.	17	7	PRECAST	Missing mortar from corbel with roots in corbel. Infiltration at pipe connection.	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$2,960	\$1,000	\$3,960	\$4.11

Contract	Metering Basin	Street	MH Number	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
CONTRACT 3	LD1	Spinnaker Way	939	8	UNKNOWN	Infiltration at manhole walls	Grout Manhole, Cementitious Liner	3	720	\$2,960	\$0	\$2,960	\$4.11
CONTRACT 3	LD1	Spinnaker Way	940	8	UNKNOWN	Infiltration at manhole walls. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	1440	\$2,960	\$0	\$2,960	\$2.06
CONTRACT 3	LD1	Spinnaker Way	942	9	BRICK	Mineral deposits at bench and invert, roots in corbel. Walls weeping during MH Inspection. Active infiltration during flow isolation.	Grout Manhole, Cementitious Liner	3	2880	\$3,330	\$0	\$3,330	\$1.16
CONTRACT 3	LD1	Spinnaker Way	943	8	UNKNOWN	Wall leaks. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	2	720	\$2,960	\$0	\$2,960	\$4.11
CONTRACT 4	HS14	Barberry Lane Easement	5316	7	PRECAST	Active infiltration and mineral deposits at wall, corbel missing mortar	Corbel Repair, Grout Manhole, Cementitious Liner	3	2160	\$2,590	\$1,000	\$3,590	\$1.20
CONTRACT 4	HS14	Barberry Lane Easement	5412	17	PRECAST	Infiltration staining at wall	Grout Manhole, Cementitious Liner	3	360	\$6,660	\$0	\$6,660	\$18.50
CONTRACT 4	HS14	Borthwick Ave at Marriot Hotel	2219	6	PRECAST	Mineral deposits at outlet pipe with active infiltration	Grout Manhole, Cementitious Liner	3	288	\$2,220	\$0	\$2,220	\$7.71
CONTRACT 4	HS14	Coakley Rd	534	10	PARGED	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS14	Coakley Rd	540	8	BLOCK	Moderate debris on bench, broken frame, loose and broken bricks from corbel, missing mortar from walls	New Frame and Cover, Corbel Repair, Grout Manhole, Cementitious Liner	3	720	\$2,960	\$1,820	\$4,780	\$4.11
CONTRACT 4	HS14	Coakley Rd	541	7	BLOCK	Missing mortar in walls, No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,560	\$3,560	\$0.00
CONTRACT 4	HS14	Coakley Rd	2727	8	BLOCK	Missing mortar in wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$3,330	\$2,200	\$5,530	\$4.63
CONTRACT 4	HS15	Essex Ave	593	12	BLOCK	Broken and missing bricks from wall, loose bricks in corbel, no bench or invert, heavy debris buildup	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,810	\$3,200	\$8,010	\$6.68
CONTRACT 4	HS15	Essex Ave and Middle Rd	591	6	BLOCK	No bench and invert, active infiltration at wall, missing mortar from wall, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,590	\$2,200	\$4,790	\$8.99
CONTRACT 4	HS15	Hampshire Rd	584	7	BLOCK	No bench and invert, heavy debris buildup, corbel missing mortar	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS15	Hampshire Rd	586	7	BLOCK	No bench and invert, heavy debris	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS15	Hampshire Rd	587	10	BLOCK	Mineral deposits at wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole	4	720	\$2,000	\$2,200	\$4,200	\$2.78
CONTRACT 4	HS15	Marjorie St at Middle Rd	563	7	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS15	Middle Rd	577	8	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS15	Middle Rd	578	10	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS15	Sheffield Rd	5685	7	BLOCK	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	144	\$2,590	\$0	\$2,590	\$17.99
CONTRACT 4	HS15	Sims Ave	598	9	BRICK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
CONTRACT 4	HS15	Sims Ave	600	8	PRECAST	Infiltration Gusher at Influent Pipe Connection (from MH 599)	Grout Manhole, Cementitious Liner	3	2880	\$2,960	\$0	\$2,960	\$1.03
CONTRACT 4	HS15	Sims Ave at Benson St	599	8	PRECAST	Infiltration at manhole wall	Grout Manhole	2	720	\$1,800	\$0	\$1,800	\$2.50
CONTRACT 4	HS15	US Rt 1 Bypass North	1382	11	BLOCK	Active infiltration at wall, roots in corbel, loose bricks and debris on bench. Collapsed pipe connection found during flow isolation. Possible industrial connection/service infiltration.	Remove and Replace Manhole	4	1728	\$13,100	\$0	\$13,100	\$7.58
CONTRACT 4	M1	860 Maplewood Ave	2129	8	UNKNOWN	MH Leaking via CCTV Inspection	Grout Manhole	3	1152	\$1,600	\$0	\$1,600	\$1.39
CONTRACT 4	M1	Cutts St at Rt 1 Bypass	93	7	PRECAST	Evidence of surcharge, heavy debris blocking flow, cracked cover	Clean, New Frame and Cover	4	0	\$0	\$1,370	\$1,370	\$0.00
CONTRACT 4	M1	Edmund Ave near Fairview Ave	108	8	PRECAST	Cracked cover	New Frame and Cover, Grout Manhole	2	360	\$1,800	\$820	\$2,620	\$5.00
CONTRACT 4	M1	Fairview Ave	111	4	PRECAST	Cracked cover	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
CONTRACT 4	M1	Maplewood Ave	767	6	BRICK	No bench and invert, corbel breaking	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
CONTRACT 4	M1	US Rt 1 Bypass	116	9	PRECAST	Light infiltration at walls and light debris in invert	Grout Manhole	2	288	\$2,000	\$0	\$2,000	\$6.94
CONTRACT 4	M1	US Rt 1 Bypass at Cutts Ave	92	8	PRECAST	Broken bricks in corbel, Light infiltration at walls	Corbel Repair, Grout Manhole, Cementitious Liner	3	360	\$2,960	\$1,000	\$3,960	\$8.22
CONTRACT 1 TOTALS									119,160	\$144,550	\$50,560	\$195,110	-
CONTRACT 2 TOTALS									18,288	\$71,120	\$40,070	\$111,190	-
CONTRACT 3 TOTALS									12,600	\$36,210	\$13,000	\$49,210	-
CONTRACT 4 TOTALS									13,608	\$55,970	\$38,790	\$94,760	-

Table 4-16: Smoke Testing Rehabilitation Recommendations

Area	Re-direct Catch Basin	Re-direct Roof Leader	Re-direct Driveway/ Yard Drain	Repair Cleanout Cap	Replace Frame & Cover	Monitor (indirect source)	Repair Manhole
Subarea B1	1	0	0	2	0	0	0
Subarea HS11	9	1	2	0	1	10	0
Subarea HS15	1	0	0	0	0	0	0
Subarea LD1	0	0	0	3	3	2	0
Subarea LR1	1	0	1	1	4	2	0
Subarea LR2	0	0	0	1	0	1	0
Subarea LR4	1	0	0	1	0	1	1
Subarea LR6	0	0	1	3	1	0	0
Subarea P1	0	0	0	0	0	0	0
Total	13	1	4	11	9	16	1



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## 5. REFERENCES

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Ted Berry Company, Inc., 2017. *Portsmouth, NH CCTV Inspection Report April – July 2017*; July 26.

Massachusetts Department of Environmental Protection, 2017. *Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Survey*; May 30.

## 6. LIST OF ABBREVIATIONS

AC	Asbestos Cement
CCTV	Closed Circuit Television
CI	Cast Iron
CIPP	Cured-in-Place-Pipe
CITS	Clean, Inspect, Test and Seal
City	City of Portsmouth, New Hampshire
CMOM	Capacity, Management, Operations and Maintenance
DI	Ductile Iron
DPW	Department of Public Works
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
Flow Assessment	Flow Assessment Services, LLC
FOG	Fats, Oils and Grease
GIS	Geographic Information System
GPD	Gallons per Day
GPM	Gallons per Minute
HDPE	High-Density Polyethylene
IDDE	Illicit Discharge Detection and Elimination
IDM	Inch Diameter Mile
I/I	Infiltration/Inflow
LF	Linear Feet
MACP	Manhole Assessment and Certification Program
MassDEP	Massachusetts Department of Environmental Protection
MGD	Million Gallons per Day
MH	Manhole
NASSCO	National Association of Sewer Service Companies
NPDES	National Pollutant Discharge Elimination System
NHDES	New Hampshire Department of Environmental Services
O&M	Operational and Maintenance
PACP	Pipeline Assessment and Certification Program
PVC	Polyvinyl Chloride

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QMR	Quick Maintenance Pipe Rating
QOR	Quick Overall Pipe Rating
QSR	Quick Structural Pipe Rating
SRF	State Revolving Fund
SSES	Sewer System Evaluation Survey
SSOs	Sanitary Sewer Overflows
T&T	Transport and Treatment
Ted Berry	Ted Berry Company, Inc.
VC	Vitrified Clay
VCP	Vitrified Clay Pipe
WWTF	Wastewater Treatment Facility

## APPENDIX A: CCTV FINDINGS AND RECOMMENDATIONS

Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
3016	912	913	GR1	Blue Heron Dr	6	PolyVinyl Chloride	300	Clear water running from laterals at 174.6 and 289.1' US (Unknown Source).	Inspect Lateral	2	0	2,880	2,880	\$1,500	\$0	\$1,500	\$0.52	
1640	237	236	LR6	Constitution Ave	8	Asbestos Cement	230	Clear water coming from lateral at 97.1' US (Unknown Source). Roots medium barrel at 104' US. Infiltration gusher at 107' US. Roots fine joint at 118' US.	T&S, Inspect Lateral, Root Treatment	4	4,320	0	4,320	\$3,853	\$0	\$3,853	\$0.89	
2000	2484	2479	LR6	Lafayette Rd	8	Asbestos Cement	284	Clear water running from lateral at 96.3' DS (Unknown Source), Infiltration runner from broken pipe/fracture spiral at 265' DS.	Inspect Lateral, Spot Repair	5	2,880	720	3,600	\$3,250	\$0	\$3,250	\$0.90	
1587	2641	136	LR6	Heritage Rd	8	Asbestos Cement	285	Heavy grease and debris buildup in pipe. Infiltration gusher at 9.6' DS from defective wye. Infiltration stains at 127' DS	Clean, T&S, Spot Repair	5	4,320	0	4,320	\$3,961	\$0	\$3,961	\$0.92	
3210	5852	818	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	103	Infiltration throughout with runners and gushers. Survey abandoned due to debris (no reversal attempted)	T&S, CIPP	5	9,072	0	9,072	\$8,720	\$0	\$8,720	\$0.96	
6610	5819	5818	HS11	Aldrich Rd	8	PolyVinyl Chloride	274	Clear water running from lateral at 189.8' DS (Unknown Source).	Inspect Lateral	2	0	720	720	\$750	\$0	\$750	\$1.04	
556	1055	1056	LR4	Hillside Dr	8	PolyVinyl Chloride	397	Clear water running from laterals at 187.9' and 315.2' DS (Unknown Source)	Inspect Lateral	2	0	1,440	1,440	\$1,500	\$0	\$1,500	\$1.04	
3408	5096	1340	HS11	Lovell St	12	PolyVinyl Chloride	76	Clear water running from lateral at 3' DS (Unknown Source).	Inspect Lateral	0	0	720	720	\$750	\$0	\$750	\$1.04	
1513	2595	2593	LR3	Suzanne Dr	8	Asbestos Cement	78	Infiltration gusher from hole at 15' US	Clean, T&S, Spot Repair	5	5,760	0	5,760	\$6,011	\$0	\$6,011	\$1.04	
563	1047	1631	LR4	Greenleaf Ave	8	Vitrified Clay Pipe	89	Clear water running from lateral at 80.5' DS (Unknown Source)	Inspect Lateral	2	0	576	576	\$750	\$0	\$750	\$1.30	
5121	5422	5394	LR4	Parking lot	8	Asbestos Cement	180	Clear water coming from laterals at 44.4' and 86.2' DS (Unknown Source)	Inspect Lateral	1	0	1,152	1,152	\$1,500	\$0	\$1,500	\$1.30	
2979	932	920	LD1	Blue Heron Dr	6	PolyVinyl Chloride	208	Clear water running from lateral at 133' DS (Unknown Source). Survey abandoned at 160' DS due to hard left turn (no reversal attempted)	Inspect Lateral, Complete CCTV	2	0	1,440	1,440	\$1,894	\$0	\$1,894	\$1.32	
5408	5494	817	GR1	Sanderling Way	6	PolyVinyl Chloride	115	Clear water running from lateral at 90.7' US (Unknown source). Heavy infiltration during flow isolation.	Clean, T&S, Inspect Lateral	2	0	1,440	1,440	\$2,050	\$0	\$2,050	\$1.42	
1881	394	392	LR4	Greenleaf Ave	10	Asbestos Cement	321	Infiltration stains throughout pipe with gusher and runner at 238 and 248' DS, respectively. Protruding lateral at 256.8' DS	Clean, T&S, Cut Service, Spot Repair	5	5,040	0	5,040	\$7,599	\$0	\$7,599	\$1.51	
220	1312	1311	HS11	Fields Rd	8	Unknown	264	Lining slightly detached at 27' US, clear water running from lateral at 81' US (Unknown Source), roots in lateral at 99' US. Survey abandoned at 170' US due to debris in pipe (no reversal attempted)	Inspect Lateral, Complete CCTV	3	0	1,440	1,440	\$2,199	\$0	\$2,199	\$1.53	
2976	930	928	LD1	Blue Heron Dr	6	PolyVinyl Chloride	243	Roots ball joint at 3' US. Clear Water running from lateral at 81' US (Unknown Source). Fracture spiral at 239.8' US (material changed to VCP at 232' US)	Inspect Lateral, Root Treatment	4	0	1,440	1,440	\$2,206	\$0	\$2,206	\$1.53	
2978	EOP	932	LD1	Blue Heron Dr	6	PolyVinyl Chloride	211	Clear water running from laterals at 32.7 and 61.1' US. Clear water running from laterals at 37' and 58.4' US (unknown source)	Clean, T&S, Grout Lateral, Inspect Lateral	0	0	3,024	3,024	\$4,774	\$0	\$4,774	\$1.58	
1333	1402	1401	HS11	Bartlett St	8	Vitrified Clay Pipe	249	Infiltration stain joint at 11.5' DS. Protruding lateral at 42.1' DS with clear water running (Unknown Source)	Inspect Lateral, Cut Service	2	0	720	720	\$1,180	\$0	\$1,180	\$1.64	
3511	1344	5844	HS11	Lovell St	10	PolyVinyl Chloride	312	Clear water running from laterals at 3', 126.6', 161.5', and 282.3' DS (Unknown Source). Intruding laterals at 157.6, 161.5, 168.2, and 170.1' DS.	Inspect Lateral, Cut Service	2	0	2,880	2,880	\$4,720	\$0	\$4,720	\$1.64	
1834	372	5872	LR4	Greenleaf Ave XC	10	Asbestos Cement	184	Clear water dripping from lateral at 22.2' DS, Infiltration runner at DS MH connection	Clean, T&S, Grout Lateral	4	1,440	288	1,728	\$2,842	\$0	\$2,842	\$1.64	
640	562	565	LR4	Sylvester St	8	Asbestos Cement	199	Clear water coming from lateral at 160.3' DS. Infiltration gusher from hole in pipe at 190' DS	Clean, T&S, Grout Lateral, Spot Repair	5	2,880	144	3,024	\$5,533	\$0	\$5,533	\$1.83	
1892	374	375	LR4	X-Country Greenleaf woods Dr	10	Asbestos Cement	231	Infiltration runner joint at 116' US. Roots at US MH Connection	Clean, T&S	4	1,440	0	1,440	\$3,000	\$0	\$3,000	\$2.08	
2957	941	942	LD1	Spinnaker Way	8	Vitrified Clay Pipe	225	Surface spalling at 14' US. Clear water coming from laterals at 69', 106', 166', and 204' US. Clear water from lateral at 21' US (unknown source). Crack longitudinal at 22' US. Broken pipe at 30' (no void visible). Fracture spiral at 44' US. Roots in lateral at 69' US. Roots fine barrel at 100' US. Infiltration stains at 126' US. Fracture spiral at 217' US with infiltration runner	Grout Lateral, Inspect Lateral, Short Liner, Spot Repair	5	288	3,312	3,600	\$7,570	\$0	\$7,570	\$2.10	
1845	545	420	LR4	X-Country	8	Asbestos Cement	195	Infiltration gusher at US MH Connection, roots at DS MH Connection	Clean, T&S	5	1,152	0	1,152	\$2,537	\$0	\$2,537	\$2.20	

Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
5095	524	5411	HS14	X-Country	18	PolyVinyl Chloride	412	Clear Water Gushing from around lateral at 388.2' DS.	Clean, T&S, Grout Lateral	3	0	2,880	2,880	\$6,882	\$0	\$6,882	\$2.39	
4753	392	391	LR4	Greenleaf Ave	8	Asbestos Cement	274	Clear water running from lateral at 13.4' US (Unknown Source). Debris buildup at MH 392	Inspect Lateral	4	0	288	288	\$750	\$0	\$750	\$2.60	
3496	5109	5109A	HS11	Manor Dr	8	PolyVinyl Chloride	33	Clear water running from lateral at 24' DS (Unknown Source)	Inspect Lateral	0	0	288	288	\$750	\$0	\$750	\$2.60	
236	1362	1361	HS11	Yoga Parking Lot	8	Asbestos Cement	109	Clear water running from lateral at 105.3' DS. Clear water dripping from lateral at 53.8' DS (Unknown Source). Protruding lateral at 53.8' DS	Clean, T&S, Grout Lateral, Inspect Lateral, Cut Service	2	0	1,152	1,152	\$3,051	\$0	\$3,051	\$2.65	
4153	599	600	HS15	Sims Ave	8	Vitrified Clay Pipe	80	Infiltration Runner at DS MH Connection	Clean, T&S	4	720	0	720	\$2,440	\$0	\$2,440	\$3.39	
2975	931	5496	LD1	Blue Heron Dr	6	PolyVinyl Chloride	216	Clear water running from laterals at 56' DS and 187.6' DS (Unknown Source)	Inspect Lateral	2	0	432	432	\$1,500	\$0	\$1,500	\$3.47	
237	1361	1360	HS11	Lovell St	8	Asbestos Cement	183	Infiltration weeper at 46.1' DS. Intruding lateral with clear water running at 53.1' DS (Unknown Source). Broken pipe void visible 1' US. Clear water running from laterals at 10 and 94' US. Broken pipe void visible at 123.1' US	T&S, Inspect Lateral, CIPP	5	576	2,880	3,456	\$13,077	\$0	\$13,077	\$3.78	
1916	1046	1069	LR5	Lafayette Rd XC	10	Asbestos Cement	135	Infiltration runner at 30.3' DS, MH 1069 has infiltration at walls (1.5 gpm)	Clean, T&S	4	432	0	432	\$1,751	\$0	\$1,751	\$4.05	
2955	939	940	LD1	Spinnaker Way	8	Vitrified Clay Pipe	246	Roots throughout pipe. Infiltration runner at 92' DS coming from crack longitudinal. Infiltration runner at 114' DS. Deposits attached grease and encrustation throughout pipe. Clear water running from lateral at 146' DS (Unknown source). Infiltration dripper joint at 174' DS. Infiltration runner joint at 180' DS. Infiltration dripper at 206' DS.	Clean, T&S, Inspect Lateral, Spot Repair	5	2,160	432	2,592	\$10,769	\$0	\$10,769	\$4.15	
210	1310	1311	HS11	Fields Rd	12	Fiberglass Reinforced Pipe	176	Infiltration drippers and runners throughout pipe. Broken pipe with infiltration weeper at 51.2' DS. Clear water running from laterals at 32.2' DS, 81.7' DS, and 156.8' DS. Candidate for Dig & Replace.	CIPP	5	432	2,016	2,448	\$10,553	\$0	\$10,553	\$4.31	
3017	913	914	GR1	Blue heron Dr	6	PolyVinyl Chloride	231	Clear water running from lateral at 131' DS. Roots ball joint and fine joint throughout pipe.	T&S, Grout Lateral, Root Treatment	4	720	0	720	\$3,167	\$0	\$3,167	\$4.40	
1883	390	389	LR4	Greenleaf Ave	8	Asbestos Cement	209	Clear water running from lateral at 94.4' DS	Clean, T&S, Grout Lateral	0	0	720	720	\$3,170	\$0	\$3,170	\$4.40	
338	1401	1400	HS11	Bartlett St	8	Vitrified Clay Pipe	259	Intruding laterals at 53.4, 197.4, 225, 273, and 309' US. Clear water running from lateral at 152.2' US (Unknown Source). Hole soil visible at lateral break @ 24.9 US	Inspect Lateral, Cut Service, Complete CCTV, Short Liner	2	0	1,440	1,440	\$6,844	\$0	\$6,844	\$4.75	
2982	926	925	LD1	Blue Heron dr	8	Vitrified Clay Pipe	228	Roots throughout pipe. Infiltration weeper at joint 117' DS. Clear Water coming from laterals at 145' and 148' DS (Unknown source). Fracture spiral with infiltration runner at 147' DS.	T&S, Inspect Lateral, Spot Repair, Root Treatment	5	1,152	1,008	2,160	\$11,064	\$0	\$11,064	\$5.12	
1844	544	545	LR4	X-Country	8	Asbestos Cement	206	Clear water weeping from lateral at 91.4' DS (Unknown Source)	Inspect Lateral	2	0	144	144	\$750	\$0	\$750	\$5.21	
5120	5421	5422	LR4	Parking lot	8	Asbestos Cement	237	Clear water coming from laterals at 59', 75', and 154.9' US (Unknown Source). Broken pipe void visible with infiltration dripper at 65' US. Infiltration drippers and stains throughout pipe	Clean, T&S, Inspect Lateral, Spot Repair	5	144	1,296	1,440	\$7,837	\$0	\$7,837	\$5.44	
3416	1344A	1344	HS11	Madison St	12	PolyVinyl Chloride	180	Intruding laterals 49.7' and 122.7' US. Clear water running from laterals at 49.7', 122.7', 137.3', and 142.7' US (Unknown Source). Survey abandoned at 146.1' US due to size change (no reversal attempted)	Inspect Lateral, Cut Service, Complete CCTV	2	0	864	864	\$4,941	\$0	\$4,941	\$5.72	
3027	943	2361	LD1	Spinnaker Way	8	Vitrified Clay Pipe	279	Infiltration runner in lateral at 207.6' DS. Infiltration stains and roots throughout pipe	T&S, Grout Lateral, Root Treatment	4	0	1,440	1,440	\$8,646	\$0	\$8,646	\$6.00	
1334	541	5341	HS14	Coakley Rd	8	Vitrified Clay Pipe	88	Roots, fractures, and infiltration throughout pipe. Hinge fracture 3 at 47' DS	T&S, CIPP, Spot Repair, Root Treatment	5	1,728	0	1,728	\$10,527	\$0	\$10,527	\$6.09	
3209	816	5852	GR1	Portsmouth Blvd	10	Vitrified Clay Pipe	182	Fractures and infiltration throughout pipe	T&S, CIPP	4	2,448	0	2,448	\$15,462	\$0	\$15,462	\$6.32	
204	590	End Of Pipe	HS11	Rutland St	8	Vitrified Clay Pipe	240	Clear water dripping from laterals at 9.1' and 31' DS, intruding lateral at 10' DS. roots fine joint throughout pipe. Survey abandoned at 152' DS due to debris in pipe (reversal incomplete)	T&S, Grout Lateral, Cut Service, Complete CCTV, Root Treatment	5	0	1,584	1,584	\$10,076	\$0	\$10,076	\$6.36	

Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
547	1423	1382	HS15	US Rt 1 Bypass	8	Vitrified Clay Pipe	83	Infiltration stains throughout pipe. Crack longitudinal at 21' US, Broken pipe void visible at 56.8' US, Large rock intruding into broken pipe at 79.9' US with infiltration runner around rock. Roots medium joint at 82.1' US. Candidate for Dig & Replace.	CIPP	5	720	0	720	\$4,956	\$0	\$4,956	\$6.88	
1988	2652	143	LR6	Ricci Ave	8	Asbestos Cement	314	Infiltration runner at intruding lateral 26.6' DS. Intruding lateral at 106' DS. Debris buildup at 307' DS	Clean, T&S, Grout Lateral, Cut Service	4	720	0	720	\$5,396	\$0	\$5,396	\$7.49	
3243	EOP	1439	HS11	Islington St	8	Vitrified Clay Pipe	149	Clear water coming from lateral at 135.9' US. Clear water running from laterals at 63.2' and 122.8' US (unknown source). Hinge fracture 3 at 144' US.	Grout Lateral, Inspect Lateral, Short Liner	5	0	576	576	\$4,470	\$0	\$4,470	\$7.76	
329	1414	1415	HS11	US 1B Off Ramp	8	Vitrified Clay Pipe	258	Infiltration runner at 6' DS due to fracture. Infiltration stains and debris throughout pipe. Protruding lateral at 76' DS causing abandoned survey (reversal incomplete). Protruding lateral at 185.8' DS (found on reversal inspection)	T&S, Cut Service, Complete CCTV, Spot Repair	4	1,440	0	1,440	\$11,226	\$0	\$11,226	\$7.80	
2986	911	842	LD1	Osprey Dr	6	Vitrified Clay Pipe	270	Roots throughout pipe, clear water running from laterals at 84 and 87.4' US (Unknown Source). Survey abandoned at 91.5' US due to large offset joint (no reversal attempted)	Inspect Lateral, Complete CCTV, Root Treatment	3	0	576	576	\$4,601	\$0	\$4,601	\$7.99	
194	1383	1384	HS15	US Rt 1 Bypass N	10	Vitrified Clay Pipe	399	Fracture spiral at 22' US. Infiltration drippers throughout pipe	Clean, T&S, Short Liner	3	1,728	0	1,728	\$14,747	\$0	\$14,747	\$8.53	
4554	1382	1383	HS15	US Rt 1 Bypass	12	Vitrified Clay Pipe	290	Includes Pipe Sewer ID 4555. Infiltration stains and drippers throughout pipe. Clear water running from laterals at 190.7 and 191.3' DS. lateral intruding at 190.7' DS. Survey abandoned at 290' DS due to high water level (no reversal attempted)	T&S, Grout Lateral, Complete CCTV	4	432	720	1,152	\$9,893	\$0	\$9,893	\$8.59	
1327	2239A	2239	HS11	Cottage St	8	Vitrified Clay Pipe	339	Roots medium and ball throughout pipe, clear water running from lateral at 125.5' US (Unknown Source).	Inspect Lateral, Root Treatment	4	0	288	288	\$2,783	\$0	\$2,783	\$9.66	
3001	819	639	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	335	Fractures and infiltration throughout pipe, survey abandoned at 211' DS due to settled debris	T&S, CIPP	4	2,880	0	2,880	\$28,479	\$0	\$28,479	\$9.89	
1833	395	372	LR4	Greenleaf Ave XC	10	Asbestos Cement	216	Survey abandoned at 214' DS due to severe root ball. Infiltration dripper at MH372.	T&S, Root Treatment	5	288	0	288	\$2,921	\$0	\$2,921	\$10.14	
894	2133	78	LD1	Leslie Dr	8	PolyVinyl Chloride	78	Clear Water Weeping from laterals at 39.1' US and 42.4' US (Unknown Source)	Inspect Lateral	0	0	144	144	\$1,500	\$0	\$1,500	\$10.42	
322	534	5342	HS14	Coakley St	8	PolyVinyl Chloride	230	Clear water running from lateral at 93.6' DS.	Clean, T&S, Grout Lateral	2	0	288	288	\$3,042	\$0	\$3,042	\$10.56	
4163	581	580	HS15	Sheffield Rd	8	Vitrified Clay Pipe	242	Hinge fracture 3 with broken pipe at 2' DS. Fractures throughout remainder of pipe. Intruding laterals at 58.6', 136', 145.4', and 167.5' DS. Clear water running from lateral at 167.5' DS (Unknown Source). Hole soil visible at 57.5' DS. Infiltration stains and mineral deposits throughout pipe with infiltration runner from joint at 156.1' DS.	T&S, Inspect Lateral, CIPP, Cut Service, Spot Repair	5	1,440	288	1,728	\$25,556	\$0	\$25,556	\$14.79	
896	78	73	LD1	Leslie Dr	8	PolyVinyl Chloride	154	Clear Water Weeping from lateral at 102' DS	Clean, T&S, Grout Lateral	2	0	144	144	\$2,186	\$0	\$2,186	\$15.18	
212	1309	1308	HS11	Fields Rd	12	PolyVinyl Chloride	92	Intruding lateral at 47.5' DS with clear water weeping. Clear water running from lateral at 62.1' DS (Unknown Source)	Clean, T&S, Grout Lateral, Inspect Lateral	2	0	144	144	\$2,278	\$0	\$2,278	\$15.82	
842	5565	2369	LD1	Market St	8	PolyVinyl Chloride	207	Light debris throughout pipe. Infiltration weeper and stain at 192' DS.	Clean, T&S	2	144	0	144	\$2,329	\$0	\$2,329	\$16.17	
3102	828	829	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	242	Infiltration, fractures, and roots throughout pipe. Clear water coming from laterals at 88', 172', and 198' US (Unknown Source).	T&S, Inspect Lateral, CIPP, Complete CCTV, Root Treatment	4	288	1,152	1,440	\$25,631	\$0	\$25,631	\$17.80	
689	470	469	B1	Odin St	8	Vitrified Clay Pipe	252	Clear water running from lateral at 70.9' US. Clear water running from laterals at 35.7' and 102.5' US (unknown source). Lateral at 70.9' US is intruding. Survey abandoned at 112.1' US due to offset joint and water level (reversal incomplete).	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service, Complete CCTV	2	0	1,440	1,440	\$25,681	\$0	\$25,681	\$17.83	
1915	1045	1046	LR5	Ledgewood Dr	10	Asbestos Cement	167	Broken pipe at 17.4' US. Hole soil visible at 40' US. Infiltration stains throughout pipe, infiltration runner joint at 224' US. Survey abandoned due to high water level in pipe at 226' US (no reversal attempted)	T&S, Complete CCTV, Spot Repair	5	288	0	288	\$5,168	\$0	\$5,168	\$17.94	

Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
5008	5401	2728	HS15	Melbourne St	8	Vitrified Clay Pipe	480	Fractures, holes, and roots throughout pipe. Intruding laterals at 21.6', 261', 301.4', 322.3', and 429.6' DS. Clear water running from laterals at 70.8', 261.7', 301.4, 350.7, and 364' DS.	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	2,592	2,592	\$48,069	\$0	\$48,069	\$18.55	
326	1630	1402	HS11	Bartlett St	8	Vitrified Clay Pipe	91	Infiltration weeper at 52.9' US. Clear water running from lateral at 52.9' US. Defective short liner at 75' US	Clean, T&S, Grout Lateral, Spot Repair	3	0	288	288	\$5,713	\$0	\$5,713	\$19.84	
688	471	470	B1	Georges Ter	8	Vitrified Clay Pipe	111	Roots ball and joint throughout. Infiltration dripper at 18.4' DS from intruding lateral. Intruding lateral with clear water running at 49' DS	Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	432	432	\$9,099	\$0	\$9,099	\$21.06	
555	1056	1047	LR4	Greenleaf Ave	8	Asbestos Cement	305	Fractures and infiltration stains throughout pipe. Clear water running from laterals at 24.5' and 138.5' US. Clear water coming from lateral at 217.2' US (unknown source).	T&S, Grout Lateral, Inspect Lateral, CIPP	5	144	864	1,008	\$22,229	\$0	\$22,229	\$22.05	
328	1413	1414	HS11	Boyd Rd	8	Vitrified Clay Pipe	271	Intruding taps at 59' and 90' DS. Clear water coming from tap break-ins at 59' and 90' DS. Roots and infiltration stains throughout pipe with infiltration runner at 192.3' DS. Fractures at 157.1' and 189.2' DS. Broken pipe void visible at 133.2' and 258' DS.	T&S, Grout Lateral, CIPP, Cut Service, Spot Repair, Root Treatment	5	144	864	1,008	\$28,968	\$0	\$28,968	\$28.74	
2963	935	934	LD1	Spinnaker Way	8	Vitrified Clay Pipe	206	Roots and debris throughout pipe. Broken pipe void visible at 62' US. Infiltration weeper joint at 98' US and 102' US. Collapsed pipe at 106' US. Hinge fracture 3 from 130' and 155' US.	T&S, Spot Repair, Root Treatment	5	720	0	720	\$22,653	\$0	\$22,653	\$31.46	
2958	942	932	LD1	Spinnaker Way	8	Vitrified Clay Pipe	219	Crack longitudinal at 10' US With infiltration weeper. Crack circumferential and infiltration stains at 14' US. Pipe half full of debris at 28' (grass and toilet paper). Settled gravel deposits at 36' US. Infiltration stain joint at 40' US. Clear water leaking from lateral at 62' US. Roots joint fine and roots barrel fine at 100' US with Clear water running from lateral 100' US. Infiltration dripper at joint 112' US. Heavy debris and gravel blocking remaining survey. (Reversal complete)	T&S, Grout Lateral, CIPP, Short Liner	4	288	432	720	\$23,750	\$0	\$23,750	\$32.99	
2988	841	840	LD1	Osprey Dr	8	Vitrified Clay Pipe	146	Fractures and infiltration stains throughout pipe. Roots ball joint at 111' DS	CIPP, Root Treatment	5	0	288	288	\$9,605	\$0	\$9,605	\$33.35	
4142	554	555	LR4	Middle Rd	8	Vitrified Clay Pipe	161	Infiltration stains, roots, and fractures throughout pipe. Clear water coming from protruding lateral at 96' DS. reversal complete	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	4	0	432	432	\$15,537	\$0	\$15,537	\$35.97	
195	1384	1383	HS11	US Rt 1 Bypass	12	Vitrified Clay Pipe	358	Infiltration stains and drippers throughout. Roots fine joint at 22' US. Settled gravel at 187' US causing abandoned survey (no reversal attempted)	T&S, Complete CCTV	3	288	0	288	\$11,108	\$0	\$11,108	\$38.57	
2956	940	941	LD1	Spinnaker Way	8	Vitrified Clay Pipe	186	Fractures, roots, and infiltration stains throughout pipe. Clear water running from lateral at 114.8' DS (Unknown Source)	T&S, Inspect Lateral, CIPP, Root Treatment	4	0	432	432	\$17,682	\$0	\$17,682	\$40.93	
334	1419	1418	HS11	Cottage St	8	Vitrified Clay Pipe	298	Roots and infiltration throughout pipe, Fracture spiral at 32.8' US. Broken lateral at 38' US (Fernco disconnected). Protruding lateral at 228.4' US. Clear water running from lateral at 228.4' US (Unknown Source)	T&S, Inspect Lateral, CIPP, Spot Repair, Root Treatment	4	0	720	720	\$30,355	\$0	\$30,355	\$42.16	
4172	587	1381	HS15	Hampshire Rd	10	Vitrified Clay Pipe	153	Infiltration and fractures throughout, broken pipe void visible at 35.2'.	T&S, CIPP	5	288	0	288	\$13,009	\$0	\$13,009	\$45.17	
3525	605	5400	HS11	Islington St	8	Vitrified Clay Pipe	217	Includes Pipe SewerID 3850, 3851 and 6429. Fractures and voids throughout pipe, intruding laterals at 103.2' DS, 115.5' DS, and 216.8' DS. Clear water coming from laterals at 20', 133.9', and 161.3' DS. Clear water coming from lateral at 115.5' DS (unknown source)	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service	5	0	432	432	\$21,837	\$0	\$21,837	\$50.55	
187	538	540	HS14	Coakley Rd	8	Vitrified Clay Pipe	560	Includes Pipe SewerID 1335. Roots throughout pipe. Broken pipe at 17.9' US. Fracture longitudinal at 61' US. Clear water running from laterals at 173' and 389' US (Unknown Source). Protruding lateral at 247' US. Fracture spiral at 288' US. Hole soil visible at 481' US.	Inspect Lateral, CIPP, Root Treatment	5	0	720	720	\$37,710	\$0	\$37,710	\$52.38	
3241	2239	2242	HS11	Cate St	8	Vitrified Clay Pipe	498	Roots throughout pipe. Intruding laterals at 13.2', 28.1' and 66.1' DS. Clear water dripping from lateral at 66.1' DS (Unknown Source). Survey abandoned at 66.1' DS (reversal incomplete)	Inspect Lateral, Cut Service, Complete CCTV, Root Treatment	3	0	144	144	\$7,767	\$0	\$7,767	\$53.94	
6468	597	5685	HS15	Sheffield Rd	8	Vitrified Clay Pipe	173	Fractures throughout pipe. Intruding laterals at 124.8' and 151.7' DS. Clear water dripping from lateral at 124.8' DS	T&S, Grout Lateral, CIPP, Cut Service	4	0	288	288	\$16,030	\$0	\$16,030	\$55.66	
1389	596	598	HS15	Essex Ave	8	Vitrified Clay Pipe	390	Fractures and roots throughout pipe, clear water dripping from lateral at 165.8' US (Unknown Source). Collapsed pipe at 150.6 DS.	Inspect Lateral, CIPP, Spot Repair, Root Treatment	5	0	432	432	\$29,017	\$0	\$29,017	\$67.17	



Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
2983	925	924	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	165	Fracture spiral at 1.6' DS. Clear water dripping from lateral at 42.3' DS (Unknown Source). Crack longitudinal at 105' DS. Broken pipe no void visible at 131' DS.	CIPP	3	0	144	144	\$9,899	\$0	\$9,899	\$68.74	
1453	EOP	2140	LD1	Leslie Dr	8	Vitrified Clay Pipe	304	Clear water running from lateral at 24.3' US. Survey abandoned at 46.6' US due to offset joint (could not inspect by reversal)	T&S, Grout Lateral, Cut Service, Complete CCTV	1	0	144	144	\$10,156	\$0	\$10,156	\$70.53	
320	532	533	HS14	Coakley Rd	8	Vitrified Clay Pipe	178	Hinge fracture 4 at 34' DS, Clear water dripping from lateral at 48' DS, Hinge fracture 3 at 48-52' DS. Hinge fracture 3 from 149'-160' DS. Fractures throughout pipe. Candidate for Dig & Replace.	CIPP	4	0	144	144	\$10,685	\$0	\$10,685	\$74.20	
4188	2728	598	HS15	Sims Ave	8	Vitrified Clay Pipe	238	Broken pipe at 69' DS. Infiltration Stains throughout pipe. Clear Water coming from lateral at 131.4 DS. Protruding lateral at 135.6' DS causing abandoned survey (reversal incomplete)	T&S, Grout Lateral, CIPP, Short Liner	4	0	288	288	\$23,222	\$0	\$23,222	\$80.63	
2961	937	936	LD1	Spinnaker Way	8	Vitrified Clay Pipe	212	Infiltration dripper at 55' US. Broken pipe soil visible at 55' US. PVC Spot Repair at 79' US with Joint Offset Severe (sinking into ground)	Complete CCTV, Spot Repair	5	144	0	144	\$13,667	\$0	\$13,667	\$94.91	
239	1364	1363	HS11	Hannaford	6	Asbestos Cement	218	This is a 6" Pipe. Infiltration weeper at 19' US, infiltration stain at 36' US. Deformed vertically at 203.3' US. Survey abandoned due to large amounts of debris in pipe and vertical deformation (no reversal attempted)	T&S, CIPP	5	144	0	144	\$19,108	\$0	\$19,108	\$132.69	
173	468	467	B1	Colonial Dr	8	Vitrified Clay Pipe	318	Infiltration stains throughout pipe. Intruding laterals at 81.7, 110.2, 138.8, 202.2, 243.9', 252.6', 301.2', and 309' DS. Fracture spiral at 21' DS, Fracture multiple at 24.2 and 27.3' DS. Clear water running from lateral at 64.4' DS (Unknown Source).	Inspect Lateral, CIPP, Cut Service	4	0	144	144	\$23,266	\$0	\$23,266	\$161.57	
837	767	769	M1	Maplewood St	8	Vitrified Clay Pipe	213	Clear water running from lateral at 45.5' DS. Cracks and fractures throughout pipe. Survey abandoned at 110' DS due to turn in pipe (reversal incomplete) - City Currently Digging, Removed from Recommendation.	Monitor	4	0	0	0	\$0	\$0	\$0	\$0.00	
833	759	111	M1	Oleary Pl	6	Asbestos Cement	100	Rag wedged in joint at 29' DS. Survey abandoned at 33' DS due to offset joint (no reversal attempted)	Complete CCTV	5	0	0	0	\$0	\$553	\$553	\$0.00	
1908	1040	1062	LR5	Ledgewood Dr	8	Vitrified Clay Pipe	134	Deposits attached grease throughout pipe. Survey abandoned at 86.5' DS due to grease blockage (no reversal attempted)	Complete CCTV	5	0	0	0	\$0	\$735	\$735	\$0.00	
2981	927	926	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	195	Survey abandoned at 7' US due to roots (no reversal attempted)	Root Treatment	5	0	0	0	\$0	\$1,170	\$1,170	\$0.00	
1329	1400	1399	HS11	Bartlett St	8	Vitrified Clay Pipe	20	Broken pipe soil visible at 13.2' US.	CIPP	5	0	0	0	\$0	\$1,216	\$1,216	\$0.00	
1893	375	376	LR4	X-Country Greenleaf Woods Dr	10	Asbestos Cement	214	Broken pipe at 34.8' US	Short Liner	5	0	0	0	\$0	\$2,580	\$2,580	\$0.00	
2977	928	926	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	154	Roots throughout pipe. Broken pipe void visible at 146.2' DS. Fracture spiral at 0' US.	Short Liner, Root Treatment	5	0	0	0	\$0	\$3,442	\$3,442	\$0.00	
3023	916	919	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	238	Fracture multiple and broken pipe with soil visible at 150.2' US. Hole void visible at 152.2' US causing abandoned survey (no reversal attempted)	Complete CCTV, Spot Repair	5	0	0	0	\$0	\$3,809	\$3,809	\$0.00	
327	1412	1413	HS11	Boyd Rd	8	Vitrified Clay Pipe	260	Hinge fracture 3 with void visible at 108' DS. Roots fine joint throughout. Intruding laterals at 123.7, 154.6, 199.6', and 233.2' DS.	Cut Service, Spot Repair, Root Treatment	5	0	0	0	\$0	\$5,781	\$5,781	\$0.00	
323	540	541	HS14	Coakley St	8	Vitrified Clay Pipe	121	Fractures throughout pipe. Hinge fracture 3 at 35' DS. Hinge fracture 4 at 38' DS. Broken pipe void visible at 39' DS. Fracture spiral at 48' DS. Survey abandoned at large offset joint (52.4' DS) (no reversal attempted)	CIPP, Spot Repair	5	0	0	0	\$0	\$12,288	\$12,288	\$0.00	
343	1399	1398	HS11	Bartlett St	8	Vitrified Clay Pipe	219	Hole void visible at 4' DS. Hole void visible in lateral at 25.4' DS. Hole soil visible at 26.2' DS. Protruding laterals at 48.4' DS and 215.9' DS blocking complete survey (reversal unsuccessful)	CIPP, Cut Service, Complete CCTV	5	0	0	0	\$0	\$15,199	\$15,199	\$0.00	
202	2728	596	HS15	Melbourne St	8	Vitrified Clay Pipe	248	Roots and fractures throughout pipe, hole with soil visible at 210' DS, chipped bell at 233' DS.	CIPP, Root Treatment	5	0	0	0	\$0	\$16,377	\$16,377	\$0.00	
321	533	534	HS14	Coakley Rd	8	Vitrified Clay Pipe	315	Fractures throughout pipe. Hole and broken pipe soil visible at 143' DS. Survey abandoned at 143' DS due to broken pipe (reversal incomplete)	CIPP, Spot Repair	5	0	0	0	\$0	\$21,381	\$21,381	\$0.00	

Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
2966	924	923	LD1	Dunlin Way	8	Vitrified Clay Pipe	242	Fractures throughout pipe. Sag in pipe at 41' DS. Broken pipe no void visible at 95' DS. Pipe sag at 110' DS. Hinge fracture 3 from 135'-170' DS. Broken pipe with Hole soil visible at 160' DS (continuation of fracture).	CIPP, Spot Repair	5	0	0	0	\$0	\$21,995	\$21,995	\$0.00	
200	583	589	HS11	Sheffield Rd	8	Vitrified Clay Pipe	240	Hole soil visible at 15.4' US from separated joint. Fracture longitudinal at 22' US. Hole soil visible at 49' US (Bell completely separated from pipe). Infiltration stain at 107' US. Hole soil visible at 132.7' US. Survey abandoned at 132.7' US due to separated joint (no reversal attempted)	T&S, CIPP, Complete CCTV, Spot Repair	5	0	0	0	\$0	\$26,689	\$26,689	\$0.00	
201	589	590	HS11	Melbourne St	10	Vitrified Clay Pipe	456	Fracture multiple at 217' US. Roots and infiltration stains throughout pipe. Survey abandoned at 218' US due to sharp uphill bend (Reversal Complete)	CIPP, Spot Repair	5	0	0	0	\$0	\$33,377	\$33,377	\$0.00	
3021	921	920	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	139	Roots fine joint at 26' US. Roots fine joint at 63' US. Crack spiral at 75' US. Roots ball joint at 120' US. Roots ball barrel at 125' US. Rag in joint at 135' US.	Root Treatment	4	0	0	0	\$0	\$836	\$836	\$0.00	
4165	2211	587	HS15	Hampshire Rd	10	Vitrified Clay Pipe	89	Infiltration stains at 11.1' US. Survey abandoned at 68.8' US due to high grease and water level (reversal incomplete)	T&S, Complete CCTV	4	0	0	0	\$0	\$2,717	\$2,717	\$0.00	
5006	End of Pipe	589	HS11	Melbourne St	10	Vitrified Clay Pipe	242	Roots fine and ball throughout pipe, Intruding tap at 169.5' US causing abandoned survey.	Cut Service, Complete CCTV, Root Treatment	4	0	0	0	\$0	\$3,209	\$3,209	\$0.00	
5122	5423	5421	LR4	Parking lot	8	Asbestos Cement	325	Infiltration stains throughout pipe, Fractures at 120.5' DS.	Clean, T&S	4	0	0	0	\$0	\$4,220	\$4,220	\$0.00	
4156	593	580	HS15	Essex Ave	8	Vitrified Clay Pipe	318	Infiltration stains and roots throughout pipe. Fracture at 47.4.	T&S, Short Liner, Root Treatment	4	0	0	0	\$0	\$12,389	\$12,389	\$0.00	
2989	840	839	LD1	Osprey Dr	8	Vitrified Clay Pipe	326	Roots and fractures throughout pipe. Hinge fracture 3 at 120.2' DS.	CIPP	4	0	0	0	\$0	\$19,533	\$19,533	\$0.00	
2994	820	819	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	55	Chipped bell at 42.3' DS, light debris throughout pipe	Clean	3	0	0	0	\$0	\$300	\$300	\$0.00	
2964	934	933	LD1	Dunlin Way	8	Vitrified Clay Pipe	99	Debris and roots throughout pipe	Root Treatment	3	0	0	0	\$0	\$595	\$595	\$0.00	
2965	933	924	LD1	Dunlin Way	8	Vitrified Clay Pipe	126	Roots throughout pipe	Root Treatment	3	0	0	0	\$0	\$755	\$755	\$0.00	
1919	1043	1044	LR5	Portsmouth High School Fields	10	Asbestos Cement	165	Survey abandoned at 75' DS due to debris (no reversal attempted)	Complete CCTV	3	0	0	0	\$0	\$909	\$909	\$0.00	
1888	389	388	LR4	Holiday Dr	8	Asbestos Cement	256	Grease and debris throughout pipe, survey abandoned at 250' DS due to grease	Complete CCTV	3	0	0	0	\$0	\$1,408	\$1,408	\$0.00	
331	1415	1416	HS11	US 1B Off Ramp	8	Vitrified Clay Pipe	296	Debris buildup throughout pipe, survey abandoned at 37.8' DS due to debris (no reversal attempted)	Complete CCTV	3	0	0	0	\$0	\$1,625	\$1,625	\$0.00	
1343	469	468	B1	Odin St	8	Vitrified Clay Pipe	270	Roots medium and fine joint throughout pipe, intruding laterals at 9.5', 67.3', and 195.1' DS.	CIPP, Cut Service, Root Treatment	3	0	0	0	\$0	\$19,088	\$19,088	\$0.00	
1483	2455	2452	LR3	Nathaniel Dr XC	10	Asbestos Cement	249	Fracture spiral at 76' DS. Heavy infiltration during flow isolation.	Clean, T&S	3	0	0	0	\$0	\$3,241	\$3,241	\$0.00	
6438	5398	916	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	53	Fractures and Roots throughout pipe	CIPP, Root Treatment	3	0	0	0	\$0	\$3,511	\$3,511	\$0.00	
2967	923	837	LD1	Dunlin Way	8	Vitrified Clay Pipe	258	Water level 2/3 at beginning of survey. Fracture longitudinal at 142' US, Roots fine joint throughout pipe. Large offset joint with fernco visible at 206' US	Spot Repair, Root Treatment	3	0	0	0	\$0	\$4,046	\$4,046	\$0.00	
3000	817	5852	GR1	Portsmouth Blvd	8	PolyVinyl Chloride	191	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
3089	5307	634	GR1	Commerce Way	10	Asbestos Cement	106	Light debris throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
6453	5505	5307	GR1	Commerce Way	10	Asbestos Cement	183	Infiltration stain at 66.3' DS	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
238	1360	2741	HS11	Lovell St	8	Asbestos Cement	220	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
1328	5110	1420	HS11	Cottage St	8	Asbestos Cement	128	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
193	5316	527	HS14	X-Country	12	PolyVinyl Chloride	170	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
5092	527	5410	HS14	Barberry Ln XC	12	PolyVinyl Chloride	136	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
6377	530	5316	HS14	X-Country Brothwick Ave	12	PolyVinyl Chloride	289	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
2972	2457	2454	LD1	Dunlin Way	10	PolyVinyl Chloride	194	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
6451	5496	930	LD1	Blue Heron Dr	6	PolyVinyl Chloride	131	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
564	1631	394	LR4	Greenleaf Ave	8	Asbestos Cement	172	Deposits settled gravel with broken pipe debris at 149.3' DS (unknown origin)	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
1843	419	418	LR4	Moffat St	8	PolyVinyl Chloride	169	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
1848	2726	544	LR4	McClintock Ave	8	PolyVinyl Chloride	200	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	

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SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
569	1042A	1042	LR5	X-Country Highschool	10	Asbestos Cement	360	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
570	1042	1043	LR5	Portsmouth High School Fields	10	Asbestos Cement	167	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
1909	1038	1040	LR5	Ledgewood Dr	8	Vitrified Clay Pipe	98	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
1925	1066	1065	LR5	Tuscan Market Parking lot	8	Asbestos Cement	173	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
826	102	101	M1	Maplewood Ave	8	PolyVinyl Chloride	138	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
831	2132	103	M1	Maplewood Ave	8	PolyVinyl Chloride	137	Moderate grease and debris buildup throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
832	103	102	M1	Maplewood Ave	8	PolyVinyl Chloride	89	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
1448	100	99	M1	Maplewood Ave	10	PolyVinyl Chloride	274	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
3348	2794	95	M1	Cutts St	10	Vitrified Clay Pipe	37	Deposits settled gravel at 0' DS	Monitor	2	0	0	0	\$0	\$0	\$0	\$0.00	
560	1050	1049	LR4	Hillside Dr	8	Vitrified Clay Pipe	29	Roots fine barrel at 16' US	Root Treatment	2	0	0	0	\$0	\$176	\$176	\$0.00	
1372	End of Pipe	1303	HS11	Thaxter Rd	8	Vitrified Clay Pipe	44	Deposits settled gravel at 2.5' US. Pipe changes to 6" VCP at 9' US causing abandoned survey.	Complete CCTV	2	0	0	0	\$0	\$243	\$243	\$0.00	
6391	5504	1302	HS11	Fells Rd	8	PolyVinyl Chloride	77	Protruding laterals at 6.9' and 16.1' DS	Cut Service	2	0	0	0	\$0	\$430	\$430	\$0.00	
5419	End of Pipe	842	LD1	Osprey Dr	8	PolyVinyl Chloride	157	Light Grease throughout pipe. Survey abandoned at 98.5' US due to left turn (could not inspect by reversal)	Complete CCTV	2	0	0	0	\$0	\$865	\$865	\$0.00	
1917	1069	1068	LR5	Lafayette Rd	10	Asbestos Cement	158	Surface spalling at 4' DS, debris at 79' US causing abandoned survey (no reversal attempted)	Complete CCTV	2	0	0	0	\$0	\$868	\$868	\$0.00	
2974	EOP	931	LD1	Blue Heron Dr	6	PolyVinyl Chloride	174	Survey abandoned at 41.4' US due to hard left turn (could not inspect by reversal)	Complete CCTV	2	0	0	0	\$0	\$956	\$956	\$0.00	
838	769	106	M1	Maplewood Ave	8	PolyVinyl Chloride	141	Intruding lateral at 24' US causing abandoned survey (no reversal attempted)	Cut Service, Complete CCTV	2	0	0	0	\$0	\$1,206	\$1,206	\$0.00	
1911	1039	1038	LR5	Ledgewood Dr	8	Asbestos Cement	329	Survey abandoned due to hard right turn at 131.5' DS	Complete CCTV	2	0	0	0	\$0	\$1,808	\$1,808	\$0.00	
5407	5493	817	GR1	Sanderling Way	6	PolyVinyl Chloride	177	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$0	\$1,999	\$1,999	\$0.00	
1994	2462	2460	LR3	Nathaniel Dr XC	10	PolyVinyl Chloride	182	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$0	\$2,052	\$2,052	\$0.00	
3352	1646	2464	LR3	Nathaniel Dr XC	10	Asbestos Cement	211	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$0	\$2,745	\$2,745	\$0.00	
2962	936	935	LD1	Spinnaker Way	8	Vitrified Clay Pipe	206	Joint offset large at 60' DS change from VCP to PVC. Survey abandoned at 60' DS (no reversal attempted)	Complete CCTV, Spot Repair	2	0	0	0	\$0	\$3,634	\$3,634	\$0.00	
1481	2460	2458	LR3	Nathaniel Dr	10	Asbestos Cement	285	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$0	\$3,706	\$3,706	\$0.00	
834	111	110	M1	Fairview Ave	8	PolyVinyl Chloride	28	Joint separated medium at 22.2' DS	Monitor	1	0	0	0	\$0	\$0	\$0	\$0.00	
1552	2593	2591	LR3	Suzanne Dr	8	PolyVinyl Chloride	160	Roots fine joint at 82.2' US. Heavy infiltration during flow isolation.	Clean, T&S	1	0	0	0	\$0	\$1,799	\$1,799	\$0.00	
2999	818	639	GR1	Portsmouth Blvd	8	Asbestos Cement	62	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
211	1310	1309	HS11	Fields Rd	12	PolyVinyl Chloride	133	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
3443	1298	5916	HS11	Boss Ave	8	PolyVinyl Chloride	114	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
3495	5109A	5110	HS11	Manor Dr	8	Asbestos Cement	206	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
3497	1420	1419	HS11	Cottage St	8	Vitrified Clay Pipe	31	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
5763	5550	5551	HS11	Lovell St	12	PolyVinyl Chloride	208	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
192	2219	530	HS14	Borthwick Ave	10	PolyVinyl Chloride	341	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
4802	5342	541	HS14	Coakley St	8	PolyVinyl Chloride	111	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
548	1381	1382	HS15	US Rt 1 Bypass N	8	Vitrified Clay Pipe	71	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
4154	600	594	HS15	Essex Ave	8	Vitrified Clay Pipe	235	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
893	79	2133	LD1	Leslie Dr	8	PolyVinyl Chloride	125	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
895	2140	78	LD1	Leslie Dr	8	PolyVinyl Chloride	11	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
916	984	985	LD1	Market St	8	Vitrified Clay Pipe	301	Infiltration stains throughout pipe	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
918	981	982	LD1	Market St	10	Asbestos Cement	248	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
919	982	983	LD1	Market St	10	Asbestos Cement	196	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
2980	929	927	LD1	Blue Heron Dr	6	PolyVinyl Chloride	198	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
3035	2444	2440	LD1	Spinnaker Way XC	10	PolyVinyl Chloride	200	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
3108	830	17	LD1	Portsmouth Blvd	10	PolyVinyl Chloride	46	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
6464	2361	5564	LD1	Market St	8	PolyVinyl Chloride	272	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
6465	5564	5565	LD1	Market St	8	PolyVinyl Chloride	71	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
637	2208	2209	LR4	Middle Rd	8	Asbestos Cement	250	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
642	564	565	LR4	Marjorie St	8	Asbestos Cement	199	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	

Appendix A.1 - Pipeline Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization																		
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Infiltration Removal Cost	Estimated Structural/ O&M Rehab	Estimated Total Rehabilitation Cost	Cost Effectiveness (\$ Spent per Gallon Per Day Removed)	
1830	396	395	LR4	Greenleaf Ave	10	Asbestos Cement	162	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1842	420	419	LR4	Moffat St	8	Asbestos Cement	39	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1850	551	2726	LR4	McClintock Ave	8	PolyVinyl Chloride	207	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1884	391	390	LR4	Greenleaf Ave	8	Asbestos Cement	222	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1488	2489	2487	LR6	Lafayette Rd	8	Asbestos Cement	43	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1573	2651	2652	LR6	Ricci Ave	8	Asbestos Cement	110	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1579	2646	2647	LR6	Robert Ave	8	Asbestos Cement	119	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
1858	2479	2477	LR6	Lafayette Rd	8	Asbestos Cement	30	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
827	101	100	M1	Maplewood Ave	10	PolyVinyl Chloride	36	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
872	99	98	M1	Maplewood Ave	10	PolyVinyl Chloride	19	No defects observed	Monitor	0	0	0	0	\$0	\$0	\$0	\$0.00	
6514	EOP	5736	HS11	US Route 1 Bypass	6	Vitrified Clay Pipe	43	Too small to navigate with 8" CCTV camera	Complete CCTV	0	0	0	0	\$0	\$235	\$235	\$0.00	
4164	580	2211	HS15	X-Country	8	PolyVinyl Chloride	105	No report or video provided	Complete CCTV	0	0	0	0	\$0	\$577	\$577	\$0.00	
337	1421	1422	HS11	US Rt 1 Bypass	8	Vitrified Clay Pipe	110	Survey abandoned at 11' DS due to turn in pipe (reversal incomplete)	Complete CCTV	0	0	0	0	\$0	\$606	\$606	\$0.00	
4161	5685	580	HS15	Sheffield Rd	8	PolyVinyl Chloride	160	Infiltration stains throughout pipe. Survey abandoned at 11' DS due to turns (reversal incomplete)	Complete CCTV	0	0	0	0	\$0	\$881	\$881	\$0.00	
1876	373	374	LR4	Greenleaf Ave X-Country	10	Asbestos Cement	208	Could not find MH's	Complete CCTV	0	0	0	0	\$0	\$1,141	\$1,141	\$0.00	
5409	5495	817	GR1	Sanderling Way	6	PolyVinyl Chloride	105	No defects observed. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$0	\$1,183	\$1,183	\$0.00	
1918	1068	1067	LR5	Lafayette Rd	10	Asbestos Cement	114	Could not locate line	Clean, Complete CCTV	0	0	0	0	\$0	\$1,254	\$1,254	\$0.00	
370	1330	1331	HS11	Bartlett St	36	Brick	203	Could not enter pipe- Full	Clean	0	0	0	0	\$0	\$1,423	\$1,423	\$0.00	
2960	938	937	LD1	Spinnaker Way	8	Vitrified Clay Pipe	277	Buried/Could not locate	Complete CCTV	0	0	0	0	\$0	\$1,524	\$1,524	\$0.00	
5405	EOP	5493	GR1	Sanderling Way	6	PolyVinyl Chloride	225	Survey abandoned at 157.6' US due to hard left turn (could not inspect by reversal). Heavy infiltration during flow isolation.	T&S, Complete CCTV	0	0	0	0	\$0	\$2,540	\$2,540	\$0.00	
1914	1044	1045	LR5	Ledgewood Dr	10	Asbestos Cement	233	MH 1044 is buried, line is full of debris	Clean, Complete CCTV	0	0	0	0	\$0	\$2,565	\$2,565	\$0.00	
1907	1062	1063	LR5	Lafayette Rd	8	Asbestos Cement	245	50% Full of Debris, could not attempt survey	Clean, Complete CCTV	0	0	0	0	\$0	\$2,699	\$2,699	\$0.00	
1506	2464	2462	LR3	Nathaniel Dr XC	10	Asbestos Cement	219	No defects observed. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$0	\$2,849	\$2,849	\$0.00	
1482	2458	2455	LR3	Nathaniel Dr XC	10	Asbestos Cement	243	Infiltration stain at 159.4' US. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$0	\$3,154	\$3,154	\$0.00	

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
833	759	111	M1	Oleary Pl	6	Asbestos Cement	100	Rag wedged in joint at 29' DS. Survey abandoned at 33' DS due to offset joint (no reversal attempted)	Complete CCTV	5	0	0	0	\$553	\$0.00
1908	1040	1062	LR5	Ledgewood Dr	8	Vitrified Clay Pipe	134	Deposits attached grease throughout pipe. Survey abandoned at 86.5' DS due to grease blockage (no reversal attempted)	Complete CCTV	5	0	0	0	\$735	\$0.00
2981	927	926	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	195	Survey abandoned at 7' US due to roots (no reversal attempted)	Root Treatment	5	0	0	0	\$1,170	\$0.00
1329	1400	1399	HS11	Bartlett St	8	Vitrified Clay Pipe	20	Broken pipe soil visible at 13.2' US.	CIPP	5	0	0	0	\$1,216	\$0.00
1893	375	376	LR4	X-Country Greenleaf Woods Dr	10	Asbestos Cement	214	Broken pipe at 34.8' US	Short Liner	5	0	0	0	\$2,580	\$0.00
2977	928	926	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	154	Roots throughout pipe. Broken pipe void visible at 146.2' DS. Fracture spiral at 0' US.	Short Liner, Root Treatment	5	0	0	0	\$3,442	\$0.00
3023	916	919	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	238	Fracture multiple and broken pipe with soil visible at 150.2' US. Hole void visible at 152.2' US causing abandoned survey (no reversal attempted)	Complete CCTV, Spot Repair	5	0	0	0	\$3,809	\$0.00
327	1412	1413	HS11	Boyd Rd	8	Vitrified Clay Pipe	260	Hinge fracture 3 with void visible at 108' DS. Roots fine joint throughout. Intruding laterals at 123.7, 154.6, 199.6', and 233.2' DS.	Cut Service, Spot Repair, Root Treatment	5	0	0	0	\$5,781	\$0.00
323	540	541	HS14	Coakley St	8	Vitrified Clay Pipe	121	Fractures throughout pipe. Hinge fracture 3 at 35' DS. Hinge fracture 4 at 38' DS. Broken pipe void visible at 39' DS. Fracture spiral at 48' DS. Survey abandoned at large offset joint (52.4' DS) (no reversal attempted)	CIPP, Spot Repair	5	0	0	0	\$12,288	\$0.00
343	1399	1398	HS11	Bartlett St	8	Vitrified Clay Pipe	219	Hole void visible at 4' DS. Hole void visible in lateral at 25.4' DS. Hole soil visible at 26.2' DS. Protruding laterals at 48.4' DS and 215.9' DS blocking complete survey (reversal unsuccessful)	CIPP, Cut Service, Complete CCTV	5	0	0	0	\$15,199	\$0.00
202	2728	596	HS15	Melbourne St	8	Vitrified Clay Pipe	248	Roots and fractures throughout pipe, hole with soil visible at 210' DS, chipped bell at 233' DS.	CIPP, Root Treatment	5	0	0	0	\$16,377	\$0.00
321	533	534	HS14	Coakley Rd	8	Vitrified Clay Pipe	315	Fractures throughout pipe. Hole and broken pipe soil visible at 143' DS. Survey abandoned at 143' DS due to broken pipe (reversal incomplete)	CIPP, Spot Repair	5	0	0	0	\$21,381	\$0.00
2966	924	923	LD1	Dunlin Way	8	Vitrified Clay Pipe	242	Fractures throughout pipe. Sag in pipe at 41' DS. Broken pipe no void visible at 95' DS. Pipe sag at 110' DS. Hinge fracture 3 from 135'-170' DS. Broken pipe with Hole soil visible at 160' DS (continuation of fracture).	CIPP, Spot Repair	5	0	0	0	\$21,995	\$0.00
200	583	589	HS11	Sheffield Rd	8	Vitrified Clay Pipe	240	Hole soil visible at 15.4' US from separated joint. Fracture longitudinal at 22' US. Hole soil visible at 49' US (Bell completely separated from pipe). Infiltration stain at 107' US. Hole soil visible at 132.7' US. Survey abandoned at 132.7' US due to separated joint (no reversal attempted)	T&S, CIPP, Complete CCTV, Spot Repair	5	0	0	0	\$26,689	\$0.00
201	589	590	HS11	Melbourne St	10	Vitrified Clay Pipe	456	Fracture multiple at 217' US. Roots and infiltration stains throughout pipe. Survey abandoned at 218' US due to sharp uphill bend (Reversal Complete)	CIPP, Spot Repair	5	0	0	0	\$33,377	\$0.00
2961	937	936	LD1	Spinnaker Way	8	Vitrified Clay Pipe	212	Infiltration dripper at 55' US. Broken pipe soil visible at 55' US. PVC Spot Repair at 79' US with Joint Offset Severe (sinking into ground)	Complete CCTV, Spot Repair	5	144	0	144	\$13,667	\$94.91
239	1364	1363	HS11	Hannaford	6	Asbestos Cement	218	This is a 6" Pipe. Infiltration weeper at 19' US, infiltration stain at 36' US. Deformed vertically at 203.3' US. Survey abandoned due to large amounts of debris in pipe and vertical deformation (no reversal attempted)	T&S, CIPP	5	144	0	144	\$19,108	\$132.69
1833	395	372	LR4	Greenleaf Ave XC	10	Asbestos Cement	216	Survey abandoned at 214' DS due to severe root ball. Infiltration dripper at MH372.	T&S, Root Treatment	5	288	0	288	\$2,921	\$10.14
1915	1045	1046	LR5	Ledgewood Dr	10	Asbestos Cement	167	Broken pipe at 17.4' US. Hole soil visible at 40' US. Infiltration stains throughout pipe, infiltration runner joint at 224' US. Survey abandoned due to high water level in pipe at 226' US (no reversal attempted)	T&S, Complete CCTV, Spot Repair	5	288	0	288	\$5,168	\$17.94
2988	841	840	LD1	Osprey Dr	8	Vitrified Clay Pipe	146	Fractures and infiltration stains throughout pipe. Roots ball joint at 111' DS	CIPP, Root Treatment	5	0	288	288	\$9,605	\$33.35
4172	587	1381	HS15	Hampshire Rd	10	Vitrified Clay Pipe	153	Infiltration and fractures throughout, broken pipe void visible at 35.2'.	T&S, CIPP	5	288	0	288	\$13,009	\$45.17

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
688	471	470	B1	Georges Ter	8	Vitrified Clay Pipe	111	Roots ball and joint throughout. Infiltration dripper at 18.4' DS from intruding lateral. Intruding lateral with clear water running at 49' DS	Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	432	432	\$9,099	\$21.06
3525	605	5400	HS11	Islington St	8	Vitrified Clay Pipe	217	Includes Pipe SewerID 3850, 3851 and 6429. Fractures and voids throughout pipe, intruding laterals at 103.2' DS, 115.5' DS, and 216.8' DS. Clear water coming from laterals at 20', 133.9', and 161.3' DS. Clear water coming from lateral at 115.5' DS (unknown source)	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service	5	0	432	432	\$21,837	\$50.55
1389	596	598	HS15	Essex Ave	8	Vitrified Clay Pipe	390	Fractures and roots throughout pipe, clear water dripping from lateral at 165.8' US (Unknown Source). Collapsed pipe at 150.6 DS.	Inspect Lateral, CIPP, Spot Repair, Root Treatment	5	0	432	432	\$29,017	\$67.17
3243	EOP	1439	HS11	Islington St	8	Vitrified Clay Pipe	149	Clear water coming from lateral at 135.9' US. Clear water running from laterals at 63.2' and 122.8' US (unknown source). Hinge fracture 3 at 144' US.	Grout Lateral, Inspect Lateral, Short Liner	5	0	576	576	\$4,470	\$7.76
547	1423	1382	HS15	US Rt 1 Bypass	8	Vitrified Clay Pipe	83	Infiltration stains throughout pipe. Crack longitudinal at 21' US, Broken pipe void visible at 56.8' US, Large rock intruding into broken pipe at 79.9' US with infiltration runner around rock. Roots medium joint at 82.1' US. Candidate for Dig & Replace.	CIPP	5	720	0	720	\$4,956	\$6.88
2963	935	934	LD1	Spinnaker Way	8	Vitrified Clay Pipe	206	Roots and debris throughout pipe. Broken pipe void visible at 62' US. Infiltration weeper joint at 98' US and 102' US. Collapsed pipe at 106' US. Hinge fracture 3 from 130' and 155' US.	T&S, Spot Repair, Root Treatment	5	720	0	720	\$22,653	\$31.46
187	538	540	HS14	Coakley Rd	8	Vitrified Clay Pipe	560	Includes Pipe SewerID 1335. Roots throughout pipe. Broken pipe at 17.9' US. Fracture longitudinal at 61' US. Clear water running from laterals at 173' and 389' US (Unknown Source). Protruding lateral at 247' US. Fracture spiral at 288' US. Hole soil visible at 481' US.	Inspect Lateral, CIPP, Root Treatment	5	0	720	720	\$37,710	\$52.38
555	1056	1047	LR4	Greenleaf Ave	8	Asbestos Cement	305	Fractures and infiltration stains throughout pipe. Clear water running from laterals at 24.5' and 138.5' US. Clear water coming from lateral at 217.2' US (unknown source).	T&S, Grout Lateral, Inspect Lateral, CIPP	5	144	864	1,008	\$22,229	\$22.05
328	1413	1414	HS11	Boyd Rd	8	Vitrified Clay Pipe	271	Intruding taps at 59' and 90' DS. Clear water coming from tap break-ins at 59' and 90' DS. Roots and infiltration stains throughout pipe with infiltration runner at 192.3' DS. Fractures at 157.1' and 189.2' DS. Broken pipe void visible at 133.2' and 258' DS.	T&S, Grout Lateral, CIPP, Cut Service, Spot Repair, Root Treatment	5	144	864	1,008	\$28,968	\$28.74
1845	545	420	LR4	X-Country	8	Asbestos Cement	195	Infiltration gusher at US MH Connection, roots at DS MH Connection	Clean, T&S	5	1,152	0	1,152	\$2,537	\$2.20
5120	5421	5422	LR4	Parking lot	8	Asbestos Cement	237	Clear water coming from laterals at 59', 75', and 154.9' US (Unknown Source). Broken pipe void visible with infiltration dripper at 65' US. Infiltration drippers and stains throughout pipe	Clean, T&S, Inspect Lateral, Spot Repair	5	144	1,296	1,440	\$7,837	\$5.44
204	590	End Of Pipe	HS11	Rutland St	8	Vitrified Clay Pipe	240	Clear water dripping from laterals at 9.1' and 31' DS, intruding lateral at 10' DS. roots fine joint throughout pipe. Survey abandoned at 152' DS due to debris in pipe (reversal incomplete)	T&S, Grout Lateral, Cut Service, Complete CCTV, Root Treatment	5	0	1,584	1,584	\$10,076	\$6.36
1334	541	5341	HS14	Coakley Rd	8	Vitrified Clay Pipe	88	Roots, fractures, and infiltration throughout pipe. Hinge fracture 3 at 47' DS	T&S, CIPP, Spot Repair, Root Treatment	5	1,728	0	1,728	\$10,527	\$6.09
4163	581	580	HS15	Sheffield Rd	8	Vitrified Clay Pipe	242	Hinge fracture 3 with broken pipe at 2' DS. Fractures throughout remainder of pipe. Intruding laterals at 58.6', 136', 145.4', and 167.5' DS. Clear water running from lateral at 167.5' DS (Unknown Source). Hole soil visible at 57.5' DS. Infiltration stains and mineral deposits throughout pipe with infiltration runner from joint at 156.1' DS.	T&S, Inspect Lateral, CIPP, Cut Service, Spot Repair	5	1,440	288	1,728	\$25,556	\$14.79
2982	926	925	LD1	Blue Heron dr	8	Vitrified Clay Pipe	228	Roots throughout pipe. Infiltration weeper at joint 117' DS. Clear Water coming from laterals at 145' and 148' DS (Unknown source). Fracture spiral with infiltration runner at 147' DS.	T&S, Inspect Lateral, Spot Repair, Root Treatment	5	1,152	1,008	2,160	\$11,064	\$5.12

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
210	1310	1311	HS11	Fields Rd	12	Fiberglass Reinforced Pipe	176	Infiltration drippers and runners throughout pipe. Broken pipe with infiltration weeper at 51.2' DS. Clear water running from laterals at 32.2' DS, 81.7' DS, and 156.8' DS. Candidate for Dig & Replace.	CIPP	5	432	2,016	2,448	\$10,553	\$4.31
2955	939	940	LD1	Spinnaker Way	8	Vitrified Clay Pipe	246	Roots throughout pipe. Infiltration runner at 92' DS coming from crack longitudinal. Infiltration runner at 114' DS. Deposits attached grease and encrustation throughout pipe. Clear water running from lateral at 146' DS (Unknown source). Infiltration dripper joint at 174' DS. Infiltration runner joint at 180' DS. Infiltration dripper at 206' DS.	Clean, T&S, Inspect Lateral, Spot Repair	5	2,160	432	2,592	\$10,769	\$4.15
5008	5401	2728	HS15	Melbourne St	8	Vitrified Clay Pipe	480	Fractures, holes, and roots throughout pipe. Intruding laterals at 21.6', 261', 301.4', 322.3', and 429.6' DS. Clear water running from laterals at 70.8', 261.7', 301.4', 350.7, and 364' DS.	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	2,592	2,592	\$48,069	\$18.55
640	562	565	LR4	Sylvester St	8	Asbestos Cement	199	Clear water coming from lateral at 160.3' DS. Infiltration gusher from hole in pipe at 190' DS	Clean, T&S, Grout Lateral, Spot Repair	5	2,880	144	3,024	\$5,533	\$1.83
237	1361	1360	HS11	Lovell St	8	Asbestos Cement	183	Infiltration weeper at 46.1' DS. Intruding lateral with clear water running at 53.1' DS (Unknown Source). Broken pipe void visible 1' US. Clear water running from laterals at 10 and 94' US. Broken pipe void visible at 123.1' US	T&S, Inspect Lateral, CIPP	5	576	2,880	3,456	\$13,077	\$3.78
2000	2484	2479	LR6	Lafayette Rd	8	Asbestos Cement	284	Clear water running from lateral at 96.3' DS (Unknown Source), Infiltration runner from broken pipe/fracture spiral at 265' DS.	Inspect Lateral, Spot Repair	5	2,880	720	3,600	\$3,250	\$0.90
2957	941	942	LD1	Spinnaker Way	8	Vitrified Clay Pipe	225	Surface spalling at 14' US. Clear water coming from laterals at 69', 106', 166', and 204' US. Clear water from lateral at 21' US (unknown source). Crack longitudinal at 22' US. Broken pipe at 30' (no void visible). Fracture spiral at 44' US. Roots in lateral at 69' US. Roots fine barrel at 100' US. Infiltration stains at 126' US. Fracture spiral at 217' US with infiltration runner	Grout Lateral, Inspect Lateral, Short Liner, Spot Repair	5	288	3,312	3,600	\$7,570	\$2.10
1587	2641	136	LR6	Heritage Rd	8	Asbestos Cement	285	Heavy grease and debris buildup in pipe. Infiltration gusher at 9.6' DS from defective wye. Infiltration stains at 127' DS	Clean, T&S, Spot Repair	5	4,320	0	4,320	\$3,961	\$0.92
1881	394	392	LR4	Greenleaf Ave	10	Asbestos Cement	321	Infiltration stains throughout pipe with gusher and runner at 238 and 248' DS, respectively. Protruding lateral at 256.8' DS	Clean, T&S, Cut Service, Spot Repair	5	5,040	0	5,040	\$7,599	\$1.51
1513	2595	2593	LR3	Suzanne Dr	8	Asbestos Cement	78	Infiltration gusher from hole at 15' US	Clean, T&S, Spot Repair	5	5,760	0	5,760	\$6,011	\$1.04
3210	5852	818	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	103	Infiltration throughout with runners and gushers. Survey abandoned due to debris (no reversal attempted)	T&S, CIPP	5	9,072	0	9,072	\$8,720	\$0.96
3021	921	920	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	139	Roots fine joint at 26' US. Roots fine joint at 63' US. Crack spiral at 75' US. Roots ball joint at 120' US. Roots ball barrel at 125' US. Rag in joint at 135' US.	Root Treatment	4	0	0	0	\$836	\$0.00
4165	2211	587	HS15	Hampshire Rd	10	Vitrified Clay Pipe	89	Infiltration stains at 11.1' US. Survey abandoned at 68.8' US due to high grease and water level (reversal incomplete)	T&S, Complete CCTV	4	0	0	0	\$2,717	\$0.00
5006	End of Pipe	589	HS11	Melbourne St	10	Vitrified Clay Pipe	242	Roots fine and ball throughout pipe, Intruding tap at 169.5' US causing abandoned survey.	Cut Service, Complete CCTV, Root Treatment	4	0	0	0	\$3,209	\$0.00
5122	5423	5421	LR4	Parking lot	8	Asbestos Cement	325	Infiltration stains throughout pipe, Fractures at 120.5' DS.	Clean, T&S	4	0	0	0	\$4,220	\$0.00
4156	593	580	HS15	Essex Ave	8	Vitrified Clay Pipe	318	Infiltration stains and roots throughout pipe. Fracture at 47.4.	T&S, Short Liner, Root Treatment	4	0	0	0	\$12,389	\$0.00
2989	840	839	LD1	Osprey Dr	8	Vitrified Clay Pipe	326	Roots and fractures throughout pipe. Hinge fracture 3 at 120.2' DS.	CIPP	4	0	0	0	\$19,533	\$0.00
173	468	467	B1	Colonial Dr	8	Vitrified Clay Pipe	318	Infiltration stains throughout pipe. Intruding laterals at 81.7, 110.2, 138.8, 202.2, 243.9', 252.6', 301.2', and 309' DS. Fracture spiral at 21' DS, Fracture multiple at 24.2 and 27.3' DS. Clear water running from lateral at 64.4' DS (Unknown Source).	Inspect Lateral, CIPP, Cut Service	4	0	144	144	\$23,266	\$161.57

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
320	532	533	HS14	Coakley Rd	8	Vitrified Clay Pipe	178	Hinge fracture 4 at 34' DS, Clear water dripping from lateral at 48' DS, Hinge fracture 3 at 48-52' DS. Hinge fracture 3 from 149'-160' DS. Fractures throughout pipe. Candidate for Dig & Replace.	CIPP	4	0	144	144	\$10,685	\$74.20
4753	392	391	LR4	Greenleaf Ave	8	Asbestos Cement	274	Clear water running from lateral at 13.4' US (Unknown Source). Debris buildup at MH 392	Inspect Lateral	4	0	288	288	\$750	\$2.60
1327	2239A	2239	HS11	Cottage St	8	Vitrified Clay Pipe	339	Roots medium and ball throughout pipe, clear water running from lateral at 125.5' US (Unknown Source).	Inspect Lateral, Root Treatment	4	0	288	288	\$2,783	\$9.66
6468	597	5685	HS15	Sheffield Rd	8	Vitrified Clay Pipe	173	Fractures throughout pipe. Intruding laterals at 124.8' and 151.7' DS. Clear water dripping from lateral at 124.8' DS	T&S, Grout Lateral, CIPP, Cut Service	4	0	288	288	\$16,030	\$55.66
837	767	769	M1	Maplewood St	8	Vitrified Clay Pipe	213	Clear water running from lateral at 45.5' DS. Cracks and fractures throughout pipe. Survey abandoned at 110' DS due to turn in pipe (reversal incomplete) - City Currently Digging, Removed from Recommendation.	Monitor	4	0	0	0	\$0	\$0.00
4188	2728	598	HS15	Sims Ave	8	Vitrified Clay Pipe	238	Broken pipe at 69' DS. Infiltration Stains throughout pipe. Clear Water coming from lateral at 131.4 DS. Protruding lateral at 135.6' DS causing abandoned survey (reversal incomplete)	T&S, Grout Lateral, CIPP, Short Liner	4	0	288	288	\$23,222	\$80.63
1916	1046	1069	LR5	Lafayette Rd XC	10	Asbestos Cement	135	Infiltration runner at 30.3' DS, MH 1069 has infiltration at walls (1.5 gpm)	Clean, T&S	4	432	0	432	\$1,751	\$4.05
4142	554	555	LR4	Middle Rd	8	Vitrified Clay Pipe	161	Infiltration stains, roots, and fractures throughout pipe. Clear water coming from protruding lateral at 96' DS. reversal complete	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	4	0	432	432	\$15,537	\$35.97
2956	940	941	LD1	Spinnaker Way	8	Vitrified Clay Pipe	186	Fractures, roots, and infiltration stains throughout pipe. Clear water running from lateral at 114.8' DS (Unknown Source)	T&S, Inspect Lateral, CIPP, Root Treatment	4	0	432	432	\$17,682	\$40.93
4153	599	600	HS15	Sims Ave	8	Vitrified Clay Pipe	80	Infiltration Runner at DS MH Connection	Clean, T&S	4	720	0	720	\$2,440	\$3.39
3017	913	914	GR1	Blue heron Dr	6	PolyVinyl Chloride	231	Clear water running from lateral at 131' DS. Roots ball joint and fine joint throughout pipe.	T&S, Grout Lateral, Root Treatment	4	720	0	720	\$3,167	\$4.40
1988	2652	143	LR6	Ricci Ave	8	Asbestos Cement	314	Infiltration runner at intruding lateral 26.6' DS. Intruding lateral at 106' DS. Debris buildup at 307' DS	Clean, T&S, Grout Lateral, Cut Service	4	720	0	720	\$5,396	\$7.49
2958	942	932	LD1	Spinnaker Way	8	Vitrified Clay Pipe	219	Crack longitudinal at 10' US With infiltration weeper. Crack circumferential and infiltration stains at 14' US. Pipe half full of debris at 28' (grass and toilet paper). Settled gravel deposits at 36' US. Infiltration stain joint at 40' US. Clear water leaking from lateral at 62' US. Roots joint fine and roots barrel fine at 100' US with Clear water running from lateral 100' US. Infiltration dripper at joint 112' US. Heavy debris and gravel blocking remaining survey. (Reversal complete)	T&S, Grout Lateral, CIPP, Short Liner	4	288	432	720	\$23,750	\$32.99
334	1419	1418	HS11	Cottage St	8	Vitrified Clay Pipe	298	Roots and infiltration throughout pipe, Fracture spiral at 32.8' US. Broken lateral at 38' US (Fernco disconnected). Protruding lateral at 228.4' US. Clear water running from lateral at 228.4' US (Unknown Source)	T&S, Inspect Lateral, CIPP, Spot Repair, Root Treatment	4	0	720	720	\$30,355	\$42.16
4554	1382	1383	HS15	US Rt 1 Bypass	12	Vitrified Clay Pipe	290	Includes Pipe Sewer ID 4555. Infiltration stains and drippers throughout pipe. Clear water running from laterals at 190.7 and 191.3' DS. lateral intruding at 190.7' DS. Survey abandoned at 290' DS due to high water level (no reversal attempted)	T&S, Grout Lateral, Complete CCTV	4	432	720	1,152	\$9,893	\$8.59
2976	930	928	LD1	Blue Heron Dr	6	PolyVinyl Chloride	243	Roots ball joint at 3' US. Clear Water running from lateral at 81' US (Unknown Source). Fracture spiral at 239.8' US (material changed to VCP at 232' US)	Inspect Lateral, Root Treatment	4	0	1,440	1,440	\$2,206	\$1.53
1892	374	375	LR4	X-Country Greenleaf woods Dr	10	Asbestos Cement	231	Infiltration runner joint at 116' US. Roots at US MH Connection	Clean, T&S	4	1,440	0	1,440	\$3,000	\$2.08
3027	943	2361	LD1	Spinnaker Way	8	Vitrified Clay Pipe	279	Infiltration runner in lateral at 207.6' DS. Infiltration stains and roots throughout pipe	T&S, Grout Lateral, Root Treatment	4	0	1,440	1,440	\$8,646	\$6.00



Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
329	1414	1415	HS11	US 1B Off Ramp	8	Vitrified Clay Pipe	258	Infiltration runner at 6' DS due to fracture. Infiltration stains and debris throughout pipe. Protruding lateral at 76' DS causing abandoned survey (reversal incomplete). Protruding lateral at 185.8' DS (found on reversal inspection)	T&S, Cut Service, Complete CCTV, Spot Repair	4	1,440	0	1,440	\$11,226	\$7.80
3102	828	829	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	242	Infiltration, fractures, and roots throughout pipe. Clear water coming from laterals at 88', 172', and 198' US (Unknown Source).	T&S, Inspect Lateral, CIPP, Complete CCTV, Root Treatment	4	288	1,152	1,440	\$25,631	\$17.80
1834	372	5872	LR4	Greenleaf Ave XC	10	Asbestos Cement	184	Clear water dripping from lateral at 22.2' DS, Infiltration runner at DS MH connection	Clean, T&S, Grout Lateral	4	1,440	288	1,728	\$2,842	\$1.64
3209	816	5852	GR1	Portsmouth Blvd	10	Vitrified Clay Pipe	182	Fractures and infiltration throughout pipe	T&S, CIPP	4	2,448	0	2,448	\$15,462	\$6.32
3001	819	639	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	335	Fractures and infiltration throughout pipe, survey abandoned at 211' DS due to settled debris	T&S, CIPP	4	2,880	0	2,880	\$28,479	\$9.89
1640	237	236	LR6	Constitution Ave	8	Asbestos Cement	230	Clear water coming from lateral at 97.1' US (Unknown Source). Roots medium barrel at 104' US. Infiltration gusher at 107' US. Roots fine joint at 118' US.	T&S, Inspect Lateral, Root Treatment	4	4,320	0	4,320	\$3,853	\$0.89
2994	820	819	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	55	Chipped bell at 42.3' DS, light debris throughout pipe	Clean	3	0	0	0	\$300	\$0.00
2964	934	933	LD1	Dunlin Way	8	Vitrified Clay Pipe	99	Debris and roots throughout pipe	Root Treatment	3	0	0	0	\$595	\$0.00
2965	933	924	LD1	Dunlin Way	8	Vitrified Clay Pipe	126	Roots throughout pipe	Root Treatment	3	0	0	0	\$755	\$0.00
1919	1043	1044	LR5	Portsmouth High School Fields	10	Asbestos Cement	165	Survey abandoned at 75' DS due to debris (no reversal attempted)	Complete CCTV	3	0	0	0	\$909	\$0.00
1888	389	388	LR4	Holiday Dr	8	Asbestos Cement	256	Grease and debris throughout pipe, survey abandoned at 250' DS due to grease	Complete CCTV	3	0	0	0	\$1,408	\$0.00
331	1415	1416	HS11	US 1B Off Ramp	8	Vitrified Clay Pipe	296	Debris buildup throughout pipe, survey abandoned at 37.8' DS due to debris (no reversal attempted)	Complete CCTV	3	0	0	0	\$1,625	\$0.00
1343	469	468	B1	Odin St	8	Vitrified Clay Pipe	270	Roots medium and fine joint throughout pipe, intruding laterals at 9.5', 67.3', and 195.1' DS.	CIPP, Cut Service, Root Treatment	3	0	0	0	\$19,088	\$0.00
1483	2455	2452	LR3	Nathaniel Dr XC	10	Asbestos Cement	249	Fracture spiral at 76' DS. Heavy infiltration during flow isolation.	Clean, T&S	3	0	0	0	\$3,241	\$0.00
6438	5398	916	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	53	Fractures and Roots throughout pipe	CIPP, Root Treatment	3	0	0	0	\$3,511	\$0.00
2967	923	837	LD1	Dunlin Way	8	Vitrified Clay Pipe	258	Water level 2/3 at beginning of survey. Fracture longitudinal at 142' US, Roots fine joint throughout pipe. Large offset joint with fernco visible at 206' US	Spot Repair, Root Treatment	3	0	0	0	\$4,046	\$0.00
3241	2239	2242	HS11	Cate St	8	Vitrified Clay Pipe	498	Roots throughout pipe. Intruding laterals at 13.2', 28.1' and 66.1' DS. Clear water dripping from lateral at 66.1' DS (Unknown Source). Survey abandoned at 66.1' DS (reversal incomplete)	Inspect Lateral, Cut Service, Complete CCTV, Root Treatment	3	0	144	144	\$7,767	\$53.94
2983	925	924	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	165	Fracture spiral at 1.6' DS. Clear water dripping from lateral at 42.3' DS (Unknown Source). Crack longitudinal at 105' DS. Broken pipe no void visible at 131' DS.	CIPP	3	0	144	144	\$9,899	\$68.74
326	1630	1402	HS11	Bartlett St	8	Vitrified Clay Pipe	91	Infiltration weeper at 52.9' US. Clear water running from lateral at 52.9' US. Defective short liner at 75' US	Clean, T&S, Grout Lateral, Spot Repair	3	0	288	288	\$5,713	\$19.84
195	1384	1383	HS11	US Rt 1 Bypass	12	Vitrified Clay Pipe	358	Infiltration stains and drippers throughout. Roots fine joint at 22' US. Settled gravel at 187' US causing abandoned survey (no reversal attempted)	T&S, Complete CCTV	3	288	0	288	\$11,108	\$38.57
2986	911	842	LD1	Osprey Dr	6	Vitrified Clay Pipe	270	Roots throughout pipe, clear water running from laterals at 84 and 87.4' US (Unknown Source). Survey abandoned at 91.5' US due to large offset joint (no reversal attempted)	Inspect Lateral, Complete CCTV, Root Treatment	3	0	576	576	\$4,601	\$7.99
220	1312	1311	HS11	Fields Rd	8	Unknown	264	Lining slightly detached at 27' US, clear water running from lateral at 81' US (Unknown Source), roots in lateral at 99' US. Survey abandoned at 170' US due to debris in pipe (no reversal attempted)	Inspect Lateral, Complete CCTV	3	0	1,440	1,440	\$2,199	\$1.53
194	1383	1384	HS15	US Rt 1 Bypass N	10	Vitrified Clay Pipe	399	Fracture spiral at 22' US. Infiltration drippers throughout pipe	Clean, T&S, Short Liner	3	1,728	0	1,728	\$14,747	\$8.53

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
5095	524	5411	HS14	X-Country	18	PolyVinyl Chloride	412	Clear Water Gushing from around lateral at 388.2' DS.	Clean, T&S, Grout Lateral	3	0	2,880	2,880	\$6,882	\$2.39
3000	817	5852	GR1	Portsmouth Blvd	8	PolyVinyl Chloride	191	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
3089	5307	634	GR1	Commerce Way	10	Asbestos Cement	106	Light debris throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
6453	5505	5307	GR1	Commerce Way	10	Asbestos Cement	183	Infiltration stain at 66.3' DS	Monitor	2	0	0	0	\$0	\$0.00
238	1360	2741	HS11	Lovell St	8	Asbestos Cement	220	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1328	5110	1420	HS11	Cottage St	8	Asbestos Cement	128	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
193	5316	527	HS14	X-Country	12	PolyVinyl Chloride	170	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
5092	527	5410	HS14	Barberry Ln XC	12	PolyVinyl Chloride	136	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
6377	530	5316	HS14	X-Country Brothwick Ave	12	PolyVinyl Chloride	289	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
2972	2457	2454	LD1	Dunlin Way	10	PolyVinyl Chloride	194	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
6451	5496	930	LD1	Blue Heron Dr	6	PolyVinyl Chloride	131	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
564	1631	394	LR4	Greenleaf Ave	8	Asbestos Cement	172	Deposits settled gravel with broken pipe debris at 149.3' DS (unknown origin)	Monitor	2	0	0	0	\$0	\$0.00
1843	419	418	LR4	Moffat St	8	PolyVinyl Chloride	169	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1848	2726	544	LR4	McClintock Ave	8	PolyVinyl Chloride	200	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
569	1042A	1042	LR5	X-Country Highschool	10	Asbestos Cement	360	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
570	1042	1043	LR5	Portsmouth High School Fields	10	Asbestos Cement	167	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1909	1038	1040	LR5	Ledgewood Dr	8	Vitrified Clay Pipe	98	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1925	1066	1065	LR5	Tuscan Market Parking lot	8	Asbestos Cement	173	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
826	102	101	M1	Maplewood Ave	8	PolyVinyl Chloride	138	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
831	2132	103	M1	Maplewood Ave	8	PolyVinyl Chloride	137	Moderate grease and debris buildup throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
832	103	102	M1	Maplewood Ave	8	PolyVinyl Chloride	89	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1448	100	99	M1	Maplewood Ave	10	PolyVinyl Chloride	274	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
3348	2794	95	M1	Cutts St	10	Vitrified Clay Pipe	37	Deposits settled gravel at 0' DS	Monitor	2	0	0	0	\$0	\$0.00
560	1050	1049	LR4	Hillside Dr	8	Vitrified Clay Pipe	29	Roots fine barrel at 16' US	Root Treatment	2	0	0	0	\$176	\$0.00
1372	End of Pipe	1303	HS11	Thaxter Rd	8	Vitrified Clay Pipe	44	Deposits settled gravel at 2.5' US. Pipe changes to 6" VCP at 9' US causing abandoned survey.	Complete CCTV	2	0	0	0	\$243	\$0.00
6391	5504	1302	HS11	Fells Rd	8	PolyVinyl Chloride	77	Protruding laterals at 6.9' and 16.1' DS	Cut Service	2	0	0	0	\$430	\$0.00
5419	End of Pipe	842	LD1	Osprey Dr	8	PolyVinyl Chloride	157	Light Grease throughout pipe. Survey abandoned at 98.5' US due to left turn (could not inspect by reversal)	Complete CCTV	2	0	0	0	\$865	\$0.00
1917	1069	1068	LR5	Lafayette Rd	10	Asbestos Cement	158	Surface spalling at 4' DS, debris at 79' US causing abandoned survey (no reversal attempted)	Complete CCTV	2	0	0	0	\$868	\$0.00
2974	EOP	931	LD1	Blue Heron Dr	6	PolyVinyl Chloride	174	Survey abandoned at 41.4' US due to hard left turn (could not inspect by reversal)	Complete CCTV	2	0	0	0	\$956	\$0.00
838	769	106	M1	Maplewood Ave	8	PolyVinyl Chloride	141	Intruding lateral at 24' US causing abandoned survey (no reversal attempted)	Cut Service, Complete CCTV	2	0	0	0	\$1,206	\$0.00
1911	1039	1038	LR5	Ledgewood Dr	8	Asbestos Cement	329	Survey abandoned due to hard right turn at 131.5' DS	Complete CCTV	2	0	0	0	\$1,808	\$0.00
5407	5493	817	GR1	Sanderling Way	6	PolyVinyl Chloride	177	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$1,999	\$0.00
1994	2462	2460	LR3	Nathaniel Dr XC	10	PolyVinyl Chloride	182	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$2,052	\$0.00
3352	1646	2464	LR3	Nathaniel Dr XC	10	Asbestos Cement	211	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$2,745	\$0.00
2962	936	935	LD1	Spinnaker Way	8	Vitrified Clay Pipe	206	Joint offset large at 60' DS change from VCP to PVC. Survey abandoned at 60' DS (no reversal attempted)	Complete CCTV, Spot Repair	2	0	0	0	\$3,634	\$0.00
1481	2460	2458	LR3	Nathaniel Dr	10	Asbestos Cement	285	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$3,706	\$0.00
1844	544	545	LR4	X-Country	8	Asbestos Cement	206	Clear water weeping from lateral at 91.4' DS (Unknown Source)	Inspect Lateral	2	0	144	144	\$750	\$5.21
896	78	73	LD1	Leslie Dr	8	PolyVinyl Chloride	154	Clear Water Weeping from lateral at 102' DS	Clean, T&S, Grout Lateral	2	0	144	144	\$2,186	\$15.18

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
212	1309	1308	HS11	Fields Rd	12	PolyVinyl Chloride	92	Intruding lateral at 47.5' DS with clear water weeping. Clear water running from lateral at 62.1' DS (Unknown Source)	Clean, T&S, Grout Lateral, Inspect Lateral	2	0	144	144	\$2,278	\$15.82
842	5565	2369	LD1	Market St	8	PolyVinyl Chloride	207	Light debris throughout pipe. Infiltration weeper and stain at 192' DS.	Clean, T&S	2	144	0	144	\$2,329	\$16.17
322	534	5342	HS14	Coakley St	8	PolyVinyl Chloride	230	Clear water running from lateral at 93.6' DS.	Clean, T&S, Grout Lateral	2	0	288	288	\$3,042	\$10.56
2975	931	5496	LD1	Blue Heron Dr	6	PolyVinyl Chloride	216	Clear water running from laterals at 56' DS and 187.6' DS (Unknown Source)	Inspect Lateral	2	0	432	432	\$1,500	\$3.47
563	1047	1631	LR4	Greenleaf Ave	8	Vitrified Clay Pipe	89	Clear water running from lateral at 80.5' DS (Unknown Source)	Inspect Lateral	2	0	576	576	\$750	\$1.30
6610	5819	5818	HS11	Aldrich Rd	8	PolyVinyl Chloride	274	Clear water running from lateral at 189.8' DS (Unknown Source).	Inspect Lateral	2	0	720	720	\$750	\$1.04
1333	1402	1401	HS11	Bartlett St	8	Vitrified Clay Pipe	249	Infiltration stain joint at 11.5' DS. Protruding lateral at 42.1' DS with clear water running (Unknown Source)	Inspect Lateral, Cut Service	2	0	720	720	\$1,180	\$1.64
3416	1344A	1344	HS11	Madison St	12	PolyVinyl Chloride	180	Intruding laterals 49.7' and 122.7' US. Clear water running from laterals at 49.7', 122.7', 137.3', and 142.7' US (Unknown Source). Survey abandoned at 146.1' US due to size change (no reversal attempted)	Inspect Lateral, Cut Service, Complete CCTV	2	0	864	864	\$4,941	\$5.72
236	1362	1361	HS11	Yoga Parking Lot	8	Asbestos Cement	109	Clear water running from lateral at 105.3' DS. Clear water dripping from lateral at 53.8' DS (Unknown Source). Protruding lateral at 53.8' DS	Clean, T&S, Grout Lateral, Inspect Lateral, Cut Service	2	0	1,152	1,152	\$3,051	\$2.65
556	1055	1056	LR4	Hillside Dr	8	PolyVinyl Chloride	397	Clear water running from laterals at 187.9' and 315.2' DS (Unknown Source)	Inspect Lateral	2	0	1,440	1,440	\$1,500	\$1.04
2979	932	920	LD1	Blue Heron Dr	6	PolyVinyl Chloride	208	Clear water running from lateral at 133' DS (Unknown Source). Survey abandoned at 160' DS due to hard left turn (no reversal attempted)	Inspect Lateral, Complete CCTV	2	0	1,440	1,440	\$1,894	\$1.32
5408	5494	817	GR1	Sanderling Way	6	PolyVinyl Chloride	115	Clear water running from lateral at 90.7' US (Unknown source). Heavy infiltration during flow isolation.	Clean, T&S, Inspect Lateral	2	0	1,440	1,440	\$2,050	\$1.42
338	1401	1400	HS11	Bartlett St	8	Vitrified Clay Pipe	259	Intruding laterals at 53.4, 197.4, 225, 273, and 309' US. Clear water running from lateral at 152.2' US (Unknown Source). Hole soil visible at lateral break @ 24.9 US	Inspect Lateral, Cut Service, Complete CCTV, Short Liner	2	0	1,440	1,440	\$6,844	\$4.75
689	470	469	B1	Odin St	8	Vitrified Clay Pipe	252	Clear water running from lateral at 70.9' US. Clear water running from laterals at 35.7' and 102.5' US (unknown source). Lateral at 70.9' US is intruding. Survey abandoned at 112.1' US due to offset joint and water level (reversal incomplete).	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service, Complete CCTV	2	0	1,440	1,440	\$25,681	\$17.83
3016	912	913	GR1	Blue Heron Dr	6	PolyVinyl Chloride	300	Clear water running from laterals at 174.6 and 289.1' US (Unknown Source).	Inspect Lateral	2	0	2,880	2,880	\$1,500	\$0.52
3511	1344	5844	HS11	Lovell St	10	PolyVinyl Chloride	312	Clear water running from laterals at 3', 126.6', 161.5', and 282.3' DS (Unknown Source). Intruding laterals at 157.6, 161.5, 168.2, and 170.1' DS.	Inspect Lateral, Cut Service	2	0	2,880	2,880	\$4,720	\$1.64
834	111	110	M1	Fairview Ave	8	PolyVinyl Chloride	28	Joint separated medium at 22.2' DS	Monitor	1	0	0	0	\$0	\$0.00
1552	2593	2591	LR3	Suzanne Dr	8	PolyVinyl Chloride	160	Roots fine joint at 82.2' US. Heavy infiltration during flow isolation.	Clean, T&S	1	0	0	0	\$1,799	\$0.00
1453	EOP	2140	LD1	Leslie Dr	8	Vitrified Clay Pipe	304	Clear water running from lateral at 24.3' US. Survey abandoned at 46.6' US due to offset joint (could not inspect by reversal)	T&S, Grout Lateral, Cut Service, Complete CCTV	1	0	144	144	\$10,156	\$70.53
5121	5422	5394	LR4	Parking lot	8	Asbestos Cement	180	Clear water coming from laterals at 44.4' and 86.2' DS (Unknown Source)	Inspect Lateral	1	0	1,152	1,152	\$1,500	\$1.30
2999	818	639	GR1	Portsmouth Blvd	8	Asbestos Cement	62	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
211	1310	1309	HS11	Fields Rd	12	PolyVinyl Chloride	133	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3443	1298	5916	HS11	Boss Ave	8	PolyVinyl Chloride	114	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3495	5109A	5110	HS11	Manor Dr	8	Asbestos Cement	206	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3497	1420	1419	HS11	Cottage St	8	Vitrified Clay Pipe	31	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
5763	5550	5551	HS11	Lovell St	12	PolyVinyl Chloride	208	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
192	2219	530	HS14	Borthwick Ave	10	PolyVinyl Chloride	341	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
4802	5342	541	HS14	Coakley St	8	PolyVinyl Chloride	111	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
548	1381	1382	HS15	US Rt 1 Bypass N	8	Vitrified Clay Pipe	71	No defects observed	Monitor	0	0	0	0	\$0	\$0.00

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
4154	600	594	HS15	Essex Ave	8	Vitrified Clay Pipe	235	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
893	79	2133	LD1	Leslie Dr	8	PolyVinyl Chloride	125	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
895	2140	78	LD1	Leslie Dr	8	PolyVinyl Chloride	11	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
916	984	985	LD1	Market St	8	Vitrified Clay Pipe	301	Infiltration stains throughout pipe	Monitor	0	0	0	0	\$0	\$0.00
918	981	982	LD1	Market St	10	Asbestos Cement	248	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
919	982	983	LD1	Market St	10	Asbestos Cement	196	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
2980	929	927	LD1	Blue Heron Dr	6	PolyVinyl Chloride	198	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3035	2444	2440	LD1	Spinnaker Way XC	10	PolyVinyl Chloride	200	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3108	830	17	LD1	Portsmouth Blvd	10	PolyVinyl Chloride	46	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
6464	2361	5564	LD1	Market St	8	PolyVinyl Chloride	272	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
6465	5564	5565	LD1	Market St	8	PolyVinyl Chloride	71	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
637	2208	2209	LR4	Middle Rd	8	Asbestos Cement	250	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
642	564	565	LR4	Marjorie St	8	Asbestos Cement	199	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1830	396	395	LR4	Greenleaf Ave	10	Asbestos Cement	162	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1842	420	419	LR4	Moffat St	8	Asbestos Cement	39	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1850	551	2726	LR4	McClintock Ave	8	PolyVinyl Chloride	207	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1884	391	390	LR4	Greenleaf Ave	8	Asbestos Cement	222	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1488	2489	2487	LR6	Lafayette Rd	8	Asbestos Cement	43	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1573	2651	2652	LR6	Ricci Ave	8	Asbestos Cement	110	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1579	2646	2647	LR6	Robert Ave	8	Asbestos Cement	119	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1858	2479	2477	LR6	Lafayette Rd	8	Asbestos Cement	30	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
827	101	100	M1	Maplewood Ave	10	PolyVinyl Chloride	36	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
872	99	98	M1	Maplewood Ave	10	PolyVinyl Chloride	19	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
6514	EOP	5736	HS11	US Route 1 Bypass	6	Vitrified Clay Pipe	43	Too small to navigate with 8" CCTV camera	Complete CCTV	0	0	0	0	\$235	\$0.00
4164	580	2211	HS15	X-Country	8	PolyVinyl Chloride	105	No report or video provided	Complete CCTV	0	0	0	0	\$577	\$0.00
337	1421	1422	HS11	US Rt 1 Bypass	8	Vitrified Clay Pipe	110	Survey abandoned at 11' DS due to turn in pipe (reversal incomplete)	Complete CCTV	0	0	0	0	\$606	\$0.00
4161	5685	580	HS15	Sheffield Rd	8	PolyVinyl Chloride	160	Infiltration stains throughout pipe. Survey abandoned at 11' DS due to turns (reversal incomplete)	Complete CCTV	0	0	0	0	\$881	\$0.00
1876	373	374	LR4	Greenleaf Ave X-Country	10	Asbestos Cement	208	Could not find MH's	Complete CCTV	0	0	0	0	\$1,141	\$0.00
5409	5495	817	GR1	Sanderling Way	6	PolyVinyl Chloride	105	No defects observed. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$1,183	\$0.00
1918	1068	1067	LR5	Lafayette Rd	10	Asbestos Cement	114	Could not locate line	Clean, Complete CCTV	0	0	0	0	\$1,254	\$0.00
370	1330	1331	HS11	Bartlett St	36	Brick	203	Could not enter pipe- Full	Clean	0	0	0	0	\$1,423	\$0.00
2960	938	937	LD1	Spinnaker Way	8	Vitrified Clay Pipe	277	Buried/Could not locate	Complete CCTV	0	0	0	0	\$1,524	\$0.00
5405	EOP	5493	GR1	Sanderling Way	6	PolyVinyl Chloride	225	Survey abandoned at 157.6' US due to hard left turn (could not inspect by reversal). Heavy infiltration during flow isolation.	T&S, Complete CCTV	0	0	0	0	\$2,540	\$0.00
1914	1044	1045	LR5	Ledgewood Dr	10	Asbestos Cement	233	MH 1044 is buried, line is full of debris	Clean, Complete CCTV	0	0	0	0	\$2,565	\$0.00
1907	1062	1063	LR5	Lafayette Rd	8	Asbestos Cement	245	50% Full of Debris, could not attempt survey	Clean, Complete CCTV	0	0	0	0	\$2,699	\$0.00
1506	2464	2462	LR3	Nathaniel Dr XC	10	Asbestos Cement	219	No defects observed. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$2,849	\$0.00
1482	2458	2455	LR3	Nathaniel Dr XC	10	Asbestos Cement	243	Infiltration stain at 159.4' US. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$3,154	\$0.00
894	2133	78	LD1	Leslie Dr	8	PolyVinyl Chloride	78	Clear Water Weeping from laterals at 39.1' US and 42.4' US (Unknown Source)	Inspect Lateral	0	0	144	144	\$1,500	\$10.42
3496	5109	5109A	HS11	Manor Dr	8	PolyVinyl Chloride	33	Clear water running from lateral at 24' DS (Unknown Source)	Inspect Lateral	0	0	288	288	\$750	\$2.60
3408	5096	1340	HS11	Lovell St	12	PolyVinyl Chloride	76	Clear water running from lateral at 3' DS (Unknown Source).	Inspect Lateral	0	0	720	720	\$750	\$1.04
1883	390	389	LR4	Greenleaf Ave	8	Asbestos Cement	209	Clear water running from lateral at 94.4' DS	Clean, T&S, Grout Lateral	0	0	720	720	\$3,170	\$4.40

Appendix A.2 - Pipeline Rehabilitation Recommendations - Max Defect Score Prioritization															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
2978	EOP	932	LD1	Blue Heron Dr	6	PolyVinyl Chloride	211	Clear water running from laterals at 32.7 and 61.1' US. Clear water running from laterals at 37' and 58.4' US (unknown source)	Clean, T&S, Grout Lateral, Inspect Lateral	0	0	3,024	3,024	\$4,774	\$1.58

Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
173	468	467	B1	Colonial Dr	8	Vitrified Clay Pipe	318	Infiltration stains throughout pipe. Intruding laterals at 81.7, 110.2, 138.8, 202.2, 243.9', 252.6', 301.2', and 309' DS. Fracture spiral at 21' DS, Fracture multiple at 24.2 and 27.3' DS. Clear water running from lateral at 64.4' DS (Unknown Source).	Inspect Lateral, CIPP, Cut Service	4	0	144	144	\$23,266	\$161.57
688	471	470	B1	Georges Ter	8	Vitrified Clay Pipe	111	Roots ball and joint throughout. Infiltration dripper at 18.4' DS from intruding lateral. Intruding lateral with clear water running at 49' DS	Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	432	432	\$9,099	\$21.06
1343	469	468	B1	Odin St	8	Vitrified Clay Pipe	270	Roots medium and fine joint throughout pipe, intruding laterals at 9.5', 67.3', and 195.1' DS.	CIPP, Cut Service, Root Treatment	3	0	0	0	\$19,088	\$0.00
689	470	469	B1	Odin St	8	Vitrified Clay Pipe	252	Clear water running from lateral at 70.9' US. Clear water running from laterals at 35.7' and 102.5' US (unknown source). Lateral at 70.9' US is intruding. Survey abandoned at 112.1' US due to offset joint and water level (reversal incomplete).	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service, Complete CCTV	2	0	1,440	1,440	\$25,681	\$17.83
3021	921	920	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	139	Roots fine joint at 26' US. Roots fine joint at 63' US. Crack spiral at 75' US. Roots ball joint at 120' US. Roots ball barrel at 125' US. Rag in joint at 135' US.	Root Treatment	4	0	0	0	\$836	\$0.00
3016	912	913	GR1	Blue Heron Dr	6	PolyVinyl Chloride	300	Clear water running from laterals at 174.6 and 289.1' US (Unknown Source).	Inspect Lateral	2	0	2,880	2,880	\$1,500	\$0.52
3017	913	914	GR1	Blue heron Dr	6	PolyVinyl Chloride	231	Clear water running from lateral at 131' DS. Roots ball joint and fine joint throughout pipe.	T&S, Grout Lateral, Root Treatment	4	720	0	720	\$3,167	\$4.40
6438	5398	916	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	53	Fractures and Roots throughout pipe	CIPP, Root Treatment	3	0	0	0	\$3,511	\$0.00
3023	916	919	GR1	Blue Heron Dr	8	Vitrified Clay Pipe	238	Fracture multiple and broken pipe with soil visible at 150.2' US. Hole void visible at 152.2' US causing abandoned survey (no reversal attempted)	Complete CCTV, Spot Repair	5	0	0	0	\$3,809	\$0.00
3089	5307	634	GR1	Commerce Way	10	Asbestos Cement	106	Light debris throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
6453	5505	5307	GR1	Commerce Way	10	Asbestos Cement	183	Infiltration stain at 66.3' DS	Monitor	2	0	0	0	\$0	\$0.00
2999	818	639	GR1	Portsmouth Blvd	8	Asbestos Cement	62	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3001	819	639	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	335	Fractures and infiltration throughout pipe, survey abandoned at 211' DS due to settled debris	T&S, CIPP	4	2,880	0	2,880	\$28,479	\$9.89
3210	5852	818	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	103	Infiltration throughout with runners and gushers. Survey abandoned due to debris (no reversal attempted)	T&S, CIPP	5	9,072	0	9,072	\$8,720	\$0.96
2994	820	819	GR1	Portsmouth Blvd	8	Vitrified Clay Pipe	55	Chipped bell at 42.3' DS, light debris throughout pipe	Clean	3	0	0	0	\$300	\$0.00
3209	816	5852	GR1	Portsmouth Blvd	10	Vitrified Clay Pipe	182	Fractures and infiltration throughout pipe	T&S, CIPP	4	2,448	0	2,448	\$15,462	\$6.32
3000	817	5852	GR1	Portsmouth Blvd	8	PolyVinyl Chloride	191	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
5409	5495	817	GR1	Sanderling Way	6	PolyVinyl Chloride	105	No defects observed. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$1,183	\$0.00
5407	5493	817	GR1	Sanderling Way	6	PolyVinyl Chloride	177	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$1,999	\$0.00
5408	5494	817	GR1	Sanderling Way	6	PolyVinyl Chloride	115	Clear water running from lateral at 90.7' US (Unknown source). Heavy infiltration during flow isolation.	Clean, T&S, Inspect Lateral	2	0	1,440	1,440	\$2,050	\$1.42
5405	EOP	5493	GR1	Sanderling Way	6	PolyVinyl Chloride	225	Survey abandoned at 157.6' US due to hard left turn (could not inspect by reversal). Heavy infiltration during flow isolation.	T&S, Complete CCTV	0	0	0	0	\$2,540	\$0.00
6610	5819	5818	HS11	Aldrich Rd	8	PolyVinyl Chloride	274	Clear water running from lateral at 189.8' DS (Unknown Source).	Inspect Lateral	2	0	720	720	\$750	\$1.04
370	1330	1331	HS11	Bartlett St	36	Brick	203	Could not enter pipe- Full	Clean	0	0	0	0	\$1,423	\$0.00
1333	1402	1401	HS11	Bartlett St	8	Vitrified Clay Pipe	249	Infiltration stain joint at 11.5' DS. Protruding lateral at 42.1' DS with clear water running (Unknown Source)	Inspect Lateral, Cut Service	2	0	720	720	\$1,180	\$1.64
343	1399	1398	HS11	Bartlett St	8	Vitrified Clay Pipe	219	Hole void visible at 4' DS. Hole void visible in lateral at 25.4' DS. Hole soil visible at 26.2' DS. Protruding laterals at 48.4' DS and 215.9' DS blocking complete survey (reversal unsuccessful)	CIPP, Cut Service, Complete CCTV	5	0	0	0	\$15,199	\$0.00
1329	1400	1399	HS11	Bartlett St	8	Vitrified Clay Pipe	20	Broken pipe soil visible at 13.2' US.	CIPP	5	0	0	0	\$1,216	\$0.00

Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
338	1401	1400	HS11	Bartlett St	8	Vitrified Clay Pipe	259	Intruding laterals at 53.4, 197.4, 225, 273, and 309' US. Clear water running from lateral at 152.2' US (Unknown Source). Hole soil visible at lateral break @ 24.9 US	Inspect Lateral, Cut Service, Complete CCTV, Short Liner	2	0	1,440	1,440	\$6,844	\$4.75
326	1630	1402	HS11	Bartlett St	8	Vitrified Clay Pipe	91	Infiltration weeper at 52.9' US. Clear water running from lateral at 52.9' US. Defective short liner at 75' US	Clean, T&S, Grout Lateral, Spot Repair	3	0	288	288	\$5,713	\$19.84
3443	1298	5916	HS11	Boss Ave	8	PolyVinyl Chloride	114	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
327	1412	1413	HS11	Boyd Rd	8	Vitrified Clay Pipe	260	Hinge fracture 3 with void visible at 108' DS. Roots fine joint throughout. Intruding laterals at 123.7, 154.6, 199.6', and 233.2' DS.	Cut Service, Spot Repair, Root Treatment	5	0	0	0	\$5,781	\$0.00
328	1413	1414	HS11	Boyd Rd	8	Vitrified Clay Pipe	271	Intruding taps at 59' and 90' DS. Clear water coming from tap break-ins at 59' and 90' DS. Roots and infiltration stains throughout pipe with infiltration runner at 192.3' DS. Fractures at 157.1' and 189.2' DS. Broken pipe void visible at 133.2' and 258' DS.	T&S, Grout Lateral, CIPP, Cut Service, Spot Repair, Root Treatment	5	144	864	1,008	\$28,968	\$28.74
3241	2239	2242	HS11	Cate St	8	Vitrified Clay Pipe	498	Roots throughout pipe. Intruding laterals at 13.2', 28.1' and 66.1' DS. Clear water dripping from lateral at 66.1' DS (Unknown Source). Survey abandoned at 66.1' DS (reversal incomplete)	Inspect Lateral, Cut Service, Complete CCTV, Root Treatment	3	0	144	144	\$7,767	\$53.94
334	1419	1418	HS11	Cottage St	8	Vitrified Clay Pipe	298	Roots and infiltration throughout pipe, Fracture spiral at 32.8' US. Broken lateral at 38' US (Ferenco disconnected). Protruding lateral at 228.4' US. Clear water running from lateral at 228.4' US (Unknown Source)	T&S, Inspect Lateral, CIPP, Spot Repair, Root Treatment	4	0	720	720	\$30,355	\$42.16
3497	1420	1419	HS11	Cottage St	8	Vitrified Clay Pipe	31	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1328	5110	1420	HS11	Cottage St	8	Asbestos Cement	128	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1327	2239A	2239	HS11	Cottage St	8	Vitrified Clay Pipe	339	Roots medium and bail throughout pipe, clear water running from lateral at 125.5' US (Unknown Source).	Inspect Lateral, Root Treatment	4	0	288	288	\$2,783	\$9.66
6391	5504	1302	HS11	Fells Rd	8	PolyVinyl Chloride	77	Protruding laterals at 6.9' and 16.1' DS	Cut Service	2	0	0	0	\$430	\$0.00
212	1309	1308	HS11	Fields Rd	12	PolyVinyl Chloride	92	Intruding lateral at 47.5' DS with clear water weeping. Clear water running from lateral at 62.1' DS (Unknown Source)	Clean, T&S, Grout Lateral, Inspect Lateral	2	0	144	144	\$2,278	\$15.82
211	1310	1309	HS11	Fields Rd	12	PolyVinyl Chloride	133	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
210	1310	1311	HS11	Fields Rd	12	Fiberglass Reinforced Pipe	176	Infiltration drippers and runners throughout pipe. Broken pipe with infiltration weeper at 51.2' DS. Clear water running from laterals at 32.2' DS, 81.7' DS, and 156.8' DS. Candidate for Dig & Replace.	CIPP	5	432	2,016	2,448	\$10,553	\$4.31
220	1312	1311	HS11	Fields Rd	8	Unknown	264	Lining slightly detached at 27' US, clear water running from lateral at 81' US (Unknown Source), roots in lateral at 99' US. Survey abandoned at 170' US due to debris in pipe (no reversal attempted)	Inspect Lateral, Complete CCTV	3	0	1,440	1,440	\$2,199	\$1.53
239	1364	1363	HS11	Hannaford	6	Asbestos Cement	218	This is a 6" Pipe. Infiltration weeper at 19' US, infiltration stain at 36' US. Deformed vertically at 203.3' US. Survey abandoned due to large amounts of debris in pipe and vertical deformation (no reversal attempted)	T&S, CIPP	5	144	0	144	\$19,108	\$132.69
3243	EOP	1439	HS11	Islington St	8	Vitrified Clay Pipe	149	Clear water coming from lateral at 135.9' US. Clear water running from laterals at 63.2' and 122.8' US (unknown source). Hinge fracture 3 at 144' US.	Grout Lateral, Inspect Lateral, Short Liner	5	0	576	576	\$4,470	\$7.76
3525	605	5400	HS11	Islington St	8	Vitrified Clay Pipe	217	Includes Pipe SewerID 3850, 3851 and 6429. Fractures and voids throughout pipe, intruding laterals at 103.2' DS, 115.5' DS, and 216.8' DS. Clear water coming from laterals at 20', 133.9', and 161.3' DS. Clear water coming from lateral at 115.5' DS (unknown source)	T&S, Grout Lateral, Inspect Lateral, CIPP, Cut Service	5	0	432	432	\$21,837	\$50.55
3408	5096	1340	HS11	Lovell St	12	PolyVinyl Chloride	76	Clear water running from lateral at 3' DS (Unknown Source).	Inspect Lateral	0	0	720	720	\$750	\$1.04
237	1361	1360	HS11	Lovell St	8	Asbestos Cement	183	Infiltration weeper at 46.1' DS. Intruding lateral with clear water running at 53.1' DS (Unknown Source). Broken pipe void visible 1' US. Clear water running from laterals at 10 and 94' US. Broken pipe void visible at 123.1' US	T&S, Inspect Lateral, CIPP	5	576	2,880	3,456	\$13,077	\$3.78
238	1360	2741	HS11	Lovell St	8	Asbestos Cement	220	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00

Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
5763	5550	5551	HS11	Lovell St	12	PolyVinyl Chloride	208	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3511	1344	5844	HS11	Lovell St	10	PolyVinyl Chloride	312	Clear water running from laterals at 3', 126.6', 161.5', and 282.3' DS (Unknown Source). Intruding laterals at 157.6, 161.5, 168.2, and 170.1' DS.	Inspect Lateral, Cut Service	2	0	2,880	2,880	\$4,720	\$1.64
3416	1344A	1344	HS11	Madison St	12	PolyVinyl Chloride	180	Intruding laterals 49.7' and 122.7' US. Clear water running from laterals at 49.7', 122.7', 137.3', and 142.7' US (Unknown Source). Survey abandoned at 146.1' US due to size change (no reversal attempted)	Inspect Lateral, Cut Service, Complete CCTV	2	0	864	864	\$4,941	\$5.72
3495	5109A	5110	HS11	Manor Dr	8	Asbestos Cement	206	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3496	5109	5109A	HS11	Manor Dr	8	PolyVinyl Chloride	33	Clear water running from lateral at 24' DS (Unknown Source)	Inspect Lateral	0	0	288	288	\$750	\$2.60
5006	End of Pipe	589	HS11	Melbourne St	10	Vitrified Clay Pipe	242	Roots fine and ball throughout pipe, Intruding tap at 169.5' US causing abandoned survey.	Cut Service, Complete CCTV, Root Treatment	4	0	0	0	\$3,209	\$0.00
201	589	590	HS11	Melbourne St	10	Vitrified Clay Pipe	456	Fracture multiple at 217' US. Roots and infiltration stains throughout pipe. Survey abandoned at 218' US due to sharp uphill bend (Reversal Complete)	CIPP, Spot Repair	5	0	0	0	\$33,377	\$0.00
204	590	End Of Pipe	HS11	Rutland St	8	Vitrified Clay Pipe	240	Clear water dripping from laterals at 9.1' and 31' DS, intruding lateral at 10' DS. roots fine joint throughout pipe. Survey abandoned at 152' DS due to debris in pipe (reversal incomplete)	T&S, Grout Lateral, Cut Service, Complete CCTV, Root Treatment	5	0	1,584	1,584	\$10,076	\$6.36
200	583	589	HS11	Sheffield Rd	8	Vitrified Clay Pipe	240	Hole soil visible at 15.4' US from separated joint. Fracture longitudinal at 22' US. Hole soil visible at 49' US (Bell completely separated from pipe). Infiltration stain at 107' US. Hole soil visible at 132.7' US. Survey abandoned at 132.7' US due to separated joint (no reversal attempted)	T&S, CIPP, Complete CCTV, Spot Repair	5	0	0	0	\$26,689	\$0.00
1372	End of Pipe	1303	HS11	Thaxter Rd	8	Vitrified Clay Pipe	44	Deposits settled gravel at 2.5' US. Pipe changes to 6" VCP at 9' US causing abandoned survey.	Complete CCTV	2	0	0	0	\$243	\$0.00
329	1414	1415	HS11	US 1B Off Ramp	8	Vitrified Clay Pipe	258	Infiltration runner at 6' DS due to fracture. Infiltration stains and debris throughout pipe. Protruding lateral at 76' DS causing abandoned survey (reversal incomplete). Protruding lateral at 185.8' DS (found on reversal inspection)	T&S, Cut Service, Complete CCTV, Spot Repair	4	1,440	0	1,440	\$11,226	\$7.80
331	1415	1416	HS11	US 1B Off Ramp	8	Vitrified Clay Pipe	296	Debris buildup throughout pipe, survey abandoned at 37.8' DS due to debris (no reversal attempted)	Complete CCTV	3	0	0	0	\$1,625	\$0.00
6514	EOP	5736	HS11	US Route 1 Bypass	6	Vitrified Clay Pipe	43	Too small to navigate with 8" CCTV camera	Complete CCTV	0	0	0	0	\$235	\$0.00
195	1384	1383	HS11	US Rt 1 Bypass	12	Vitrified Clay Pipe	358	Infiltration stains and drippers throughout. Roots fine joint at 22' US. Settled gravel at 187' US causing abandoned survey (no reversal attempted)	T&S, Complete CCTV	3	288	0	288	\$11,108	\$38.57
337	1421	1422	HS11	US Rt 1 Bypass	8	Vitrified Clay Pipe	110	Survey abandoned at 11' DS due to turn in pipe (reversal incomplete)	Complete CCTV	0	0	0	0	\$606	\$0.00
236	1362	1361	HS11	Yoga Parking Lot	8	Asbestos Cement	109	Clear water running from lateral at 105.3' DS. Clear water dripping from lateral at 53.8' DS (Unknown Source). Protruding lateral at 53.8' DS	Clean, T&S, Grout Lateral, Inspect Lateral, Cut Service	2	0	1,152	1,152	\$3,051	\$2.65
5092	527	5410	HS14	Barberry Ln XC	12	PolyVinyl Chloride	136	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
192	2219	530	HS14	Borthwick Ave	10	PolyVinyl Chloride	341	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
321	533	534	HS14	Coakley Rd	8	Vitrified Clay Pipe	315	Fractures throughout pipe. Hole and broken pipe soil visible at 143' DS. Survey abandoned at 143' DS due to broken pipe (reversal incomplete)	CIPP, Spot Repair	5	0	0	0	\$21,381	\$0.00
320	532	533	HS14	Coakley Rd	8	Vitrified Clay Pipe	178	Hinge fracture 4 at 34' DS, Clear water dripping from lateral at 48' DS, Hinge fracture 3 at 48-52' DS. Hinge fracture 3 from 149'-160' DS. Fractures throughout pipe. Candidate for Dig & Replace.	CIPP	4	0	144	144	\$10,685	\$74.20
187	538	540	HS14	Coakley Rd	8	Vitrified Clay Pipe	560	Includes Pipe SewerID 1335. Roots throughout pipe. Broken pipe at 17.9' US. Fracture longitudinal at 61' US. Clear water running from laterals at 173' and 389' US (Unknown Source). Protruding lateral at 247' US. Fracture spiral at 288' US. Hole soil visible at 481' US.	Inspect Lateral, CIPP, Root Treatment	5	0	720	720	\$37,710	\$52.38



Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
1334	541	5341	HS14	Coakley Rd	8	Vitrified Clay Pipe	88	Roots, fractures, and infiltration throughout pipe. Hinge fracture 3 at 47' DS	T&S, CIPP, Spot Repair, Root Treatment	5	1,728	0	1,728	\$10,527	\$6.09
323	540	541	HS14	Coakley St	8	Vitrified Clay Pipe	121	Fractures throughout pipe. Hinge fracture 3 at 35' DS. Hinge fracture 4 at 38' DS. Broken pipe void visible at 39' DS. Fracture spiral at 48' DS. Survey abandoned at large offset joint (52.4' DS) (no reversal attempted)	CIPP, Spot Repair	5	0	0	0	\$12,288	\$0.00
4802	5342	541	HS14	Coakley St	8	PolyVinyl Chloride	111	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
322	534	5342	HS14	Coakley St	8	PolyVinyl Chloride	230	Clear water running from lateral at 93.6' DS.	Clean, T&S, Grout Lateral	2	0	288	288	\$3,042	\$10.56
193	5316	527	HS14	X-Country	12	PolyVinyl Chloride	170	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
5095	524	5411	HS14	X-Country	18	PolyVinyl Chloride	412	Clear Water Gushing from around lateral at 388.2' DS.	Clean, T&S, Grout Lateral	3	0	2,880	2,880	\$6,882	\$2.39
6377	530	5316	HS14	X-Country Brothwick Ave	12	PolyVinyl Chloride	289	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
4156	593	580	HS15	Essex Ave	8	Vitrified Clay Pipe	318	Infiltration stains and roots throughout pipe. Fracture at 47.4.	T&S, Short Liner, Root Treatment	4	0	0	0	\$12,389	\$0.00
4154	600	594	HS15	Essex Ave	8	Vitrified Clay Pipe	235	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1389	596	598	HS15	Essex Ave	8	Vitrified Clay Pipe	390	Fractures and roots throughout pipe, clear water dripping from lateral at 165.8' US (Unknown Source). Collapsed pipe at 150.6 DS.	Inspect Lateral, CIPP, Spot Repair, Root Treatment	5	0	432	432	\$29,017	\$67.17
4165	2211	587	HS15	Hampshire Rd	10	Vitrified Clay Pipe	89	Infiltration stains at 11.1' US. Survey abandoned at 68.8' US due to high grease and water level (reversal incomplete)	T&S, Complete CCTV	4	0	0	0	\$2,717	\$0.00
4172	587	1381	HS15	Hampshire Rd	10	Vitrified Clay Pipe	153	Infiltration and fractures throughout, broken pipe void visible at 35.2'.	T&S, CIPP	5	288	0	288	\$13,009	\$45.17
202	2728	596	HS15	Melbourne St	8	Vitrified Clay Pipe	248	Roots and fractures throughout pipe, hole with soil visible at 210' DS, chipped bell at 233' DS.	CIPP, Root Treatment	5	0	0	0	\$16,377	\$0.00
5008	5401	2728	HS15	Melbourne St	8	Vitrified Clay Pipe	480	Fractures, holes, and roots throughout pipe. Intruding laterals at 21.6', 261', 301.4', 322.3', and 429.6' DS. Clear water running from laterals at 70.8', 261.7', 301.4', 350.7, and 364' DS.	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	5	0	2,592	2,592	\$48,069	\$18.55
4163	581	580	HS15	Sheffield Rd	8	Vitrified Clay Pipe	242	Hinge fracture 3 with broken pipe at 2' DS. Fractures throughout remainder of pipe. Intruding laterals at 58.6', 136', 145.4', and 167.5' DS. Clear water running from lateral at 167.5' DS (Unknown Source). Hole soil visible at 57.5' DS. Infiltration stains and mineral deposits throughout pipe with infiltration runner from joint at 156.1' DS.	T&S, Inspect Lateral, CIPP, Cut Service, Spot Repair	5	1,440	288	1,728	\$25,556	\$14.79
4161	5685	580	HS15	Sheffield Rd	8	PolyVinyl Chloride	160	Infiltration stains throughout pipe. Survey abandoned at 11' DS due to turns (reversal incomplete)	Complete CCTV	0	0	0	0	\$881	\$0.00
6468	597	5685	HS15	Sheffield Rd	8	Vitrified Clay Pipe	173	Fractures throughout pipe. Intruding laterals at 124.8' and 151.7' DS. Clear water dripping from lateral at 124.8' DS	T&S, Grout Lateral, CIPP, Cut Service	4	0	288	288	\$16,030	\$55.66
4188	2728	598	HS15	Sims Ave	8	Vitrified Clay Pipe	238	Broken pipe at 69' DS. Infiltration Stains throughout pipe. Clear Water coming from lateral at 131.4 DS. Protruding lateral at 135.6' DS causing abandoned survey (reversal incomplete)	T&S, Grout Lateral, CIPP, Short Liner	4	0	288	288	\$23,222	\$80.63
4153	599	600	HS15	Sims Ave	8	Vitrified Clay Pipe	80	Infiltration Runner at DS MH Connection	Clean, T&S	4	720	0	720	\$2,440	\$3.39
547	1423	1382	HS15	US Rt 1 Bypass	8	Vitrified Clay Pipe	83	Infiltration stains throughout pipe. Crack longitudinal at 21' US, Broken pipe void visible at 56.8' US, Large rock intruding into broken pipe at 79.9' US with infiltration runner around rock. Roots medium joint at 82.1' US. Candidate for Dig & Replace.	CIPP	5	720	0	720	\$4,956	\$6.88
4554	1382	1383	HS15	US Rt 1 Bypass	12	Vitrified Clay Pipe	290	Includes Pipe Sewer ID 4555. Infiltration stains and drippers throughout pipe. Clear water running from laterals at 190.7 and 191.3' DS. lateral intruding at 190.7' DS. Survey abandoned at 290' DS due to high water level (no reversal attempted)	T&S, Grout Lateral, Complete CCTV	4	432	720	1,152	\$9,893	\$8.59
548	1381	1382	HS15	US Rt 1 Bypass N	8	Vitrified Clay Pipe	71	No defects observed	Monitor	0	0	0	0	\$0	\$0.00

Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
194	1383	1384	HS15	US Rt 1 Bypass N	10	Vitrified Clay Pipe	399	Fracture spiral at 22' US. Infiltration drippers throughout pipe	Clean, T&S, Short Liner	3	1,728	0	1,728	\$14,747	\$8.53
4164	580	2211	HS15	X-Country	8	PolyVinyl Chloride	105	No report or video provided	Complete CCTV	0	0	0	0	\$577	\$0.00
3102	828	829	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	242	Infiltration, fractures, and roots throughout pipe. Clear water coming from laterals at 88', 172', and 198' US (Unknown Source).	T&S, Inspect Lateral, CIPP, Complete CCTV, Root Treatment	4	288	1,152	1,440	\$25,631	\$17.80
2979	932	920	LD1	Blue Heron Dr	6	PolyVinyl Chloride	208	Clear water running from lateral at 133' DS (Unknown Source). Survey abandoned at 160' DS due to hard left turn (no reversal attempted)	Inspect Lateral, Complete CCTV	2	0	1,440	1,440	\$1,894	\$1.32
2983	925	924	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	165	Fracture spiral at 1.6' DS. Clear water dripping from lateral at 42.3' DS (Unknown Source). Crack longitudinal at 105' DS. Broken pipe no void visible at 131' DS.	CIPP	3	0	144	144	\$9,899	\$68.74
2982	926	925	LD1	Blue Heron dr	8	Vitrified Clay Pipe	228	Roots throughout pipe. Infiltration weeper at joint 117' DS. Clear Water coming from laterals at 145' and 148' DS (Unknown source). Fracture spiral with infiltration runner at 147' DS.	T&S, Inspect Lateral, Spot Repair, Root Treatment	5	1,152	1,008	2,160	\$11,064	\$5.12
2981	927	926	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	195	Survey abandoned at 7' US due to roots (no reversal attempted)	Root Treatment	5	0	0	0	\$1,170	\$0.00
2977	928	926	LD1	Blue Heron Dr	8	Vitrified Clay Pipe	154	Roots throughout pipe. Broken pipe void visible at 146.2' DS. Fracture spiral at 0' US.	Short Liner, Root Treatment	5	0	0	0	\$3,442	\$0.00
2980	929	927	LD1	Blue Heron Dr	6	PolyVinyl Chloride	198	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
2976	930	928	LD1	Blue Heron Dr	6	PolyVinyl Chloride	243	Roots ball joint at 3' US. Clear Water running from lateral at 81' US (Unknown Source). Fracture spiral at 239.8' US (material changed to VCP at 232' US)	Inspect Lateral, Root Treatment	4	0	1,440	1,440	\$2,206	\$1.53
6451	5496	930	LD1	Blue Heron Dr	6	PolyVinyl Chloride	131	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
2974	EOP	931	LD1	Blue Heron Dr	6	PolyVinyl Chloride	174	Survey abandoned at 41.4' US due to hard left turn (could not inspect by reversal)	Complete CCTV	2	0	0	0	\$956	\$0.00
2978	EOP	932	LD1	Blue Heron Dr	6	PolyVinyl Chloride	211	Clear water running from laterals at 32.7 and 61.1' US. Clear water running from laterals at 37' and 58.4' US (unknown source)	Clean, T&S, Grout Lateral, Inspect Lateral	0	0	3,024	3,024	\$4,774	\$1.58
2975	931	5496	LD1	Blue Heron Dr	6	PolyVinyl Chloride	216	Clear water running from laterals at 56' DS and 187.6' DS (Unknown Source)	Inspect Lateral	2	0	432	432	\$1,500	\$3.47
2966	924	923	LD1	Dunlin Way	8	Vitrified Clay Pipe	242	Fractures throughout pipe. Sag in pipe at 41' DS. Broken pipe no void visible at 95' DS. Pipe sag at 110' DS. Hinge fracture 3 from 135'-170' DS. Broken pipe with Hole soil visible at 160' DS (continuation of fracture).	CIPP, Spot Repair	5	0	0	0	\$21,995	\$0.00
2967	923	837	LD1	Dunlin Way	8	Vitrified Clay Pipe	258	Water level 2/3 at beginning of survey. Fracture longitudinal at 142' US, Roots fine joint throughout pipe. Large offset joint with fernco visible at 206' US	Spot Repair, Root Treatment	3	0	0	0	\$4,046	\$0.00
2965	933	924	LD1	Dunlin Way	8	Vitrified Clay Pipe	126	Roots throughout pipe	Root Treatment	3	0	0	0	\$755	\$0.00
2964	934	933	LD1	Dunlin Way	8	Vitrified Clay Pipe	99	Debris and roots throughout pipe	Root Treatment	3	0	0	0	\$595	\$0.00
2972	2457	2454	LD1	Dunlin Way	10	PolyVinyl Chloride	194	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
896	78	73	LD1	Leslie Dr	8	PolyVinyl Chloride	154	Clear Water Weeping from lateral at 102' DS	Clean, T&S, Grout Lateral	2	0	144	144	\$2,186	\$15.18
894	2133	78	LD1	Leslie Dr	8	PolyVinyl Chloride	78	Clear Water Weeping from laterals at 39.1' US and 42.4' US (Unknown Source)	Inspect Lateral	0	0	144	144	\$1,500	\$10.42
895	2140	78	LD1	Leslie Dr	8	PolyVinyl Chloride	11	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
893	79	2133	LD1	Leslie Dr	8	PolyVinyl Chloride	125	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1453	EOP	2140	LD1	Leslie Dr	8	Vitrified Clay Pipe	304	Clear water running from lateral at 24.3' US. Survey abandoned at 46.6' US due to offset joint (could not inspect by reversal)	T&S, Grout Lateral, Cut Service, Complete CCTV	1	0	144	144	\$10,156	\$70.53
918	981	982	LD1	Market St	10	Asbestos Cement	248	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
919	982	983	LD1	Market St	10	Asbestos Cement	196	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
916	984	985	LD1	Market St	8	Vitrified Clay Pipe	301	Infiltration stains throughout pipe	Monitor	0	0	0	0	\$0	\$0.00

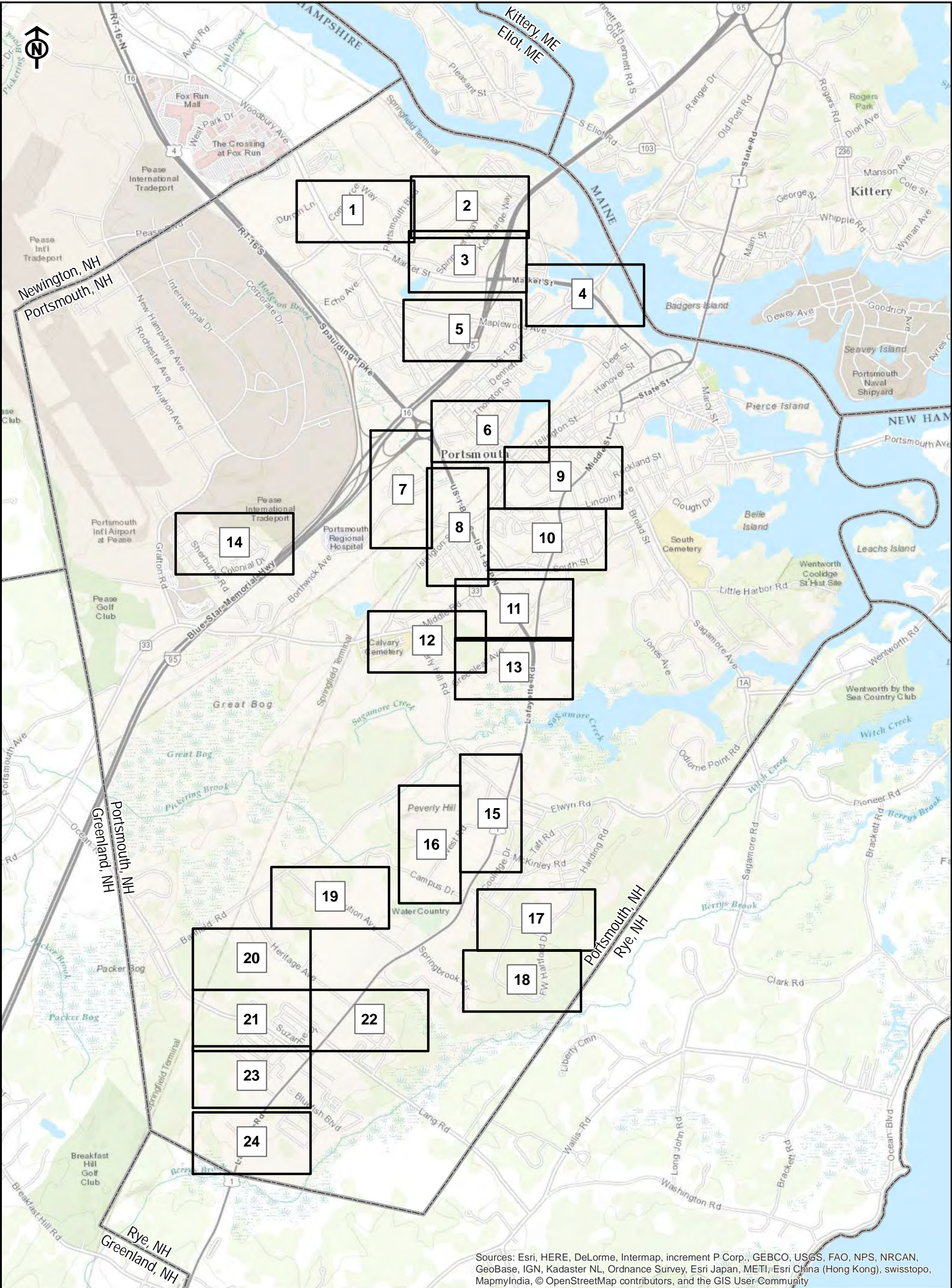
Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
842	5565	2369	LD1	Market St	8	PolyVinyl Chloride	207	Light debris throughout pipe. Infiltration weeper and stain at 192' DS.	Clean, T&S	2	144	0	144	\$2,329	\$16.17
6464	2361	5564	LD1	Market St	8	PolyVinyl Chloride	272	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
6465	5564	5565	LD1	Market St	8	PolyVinyl Chloride	71	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
2986	911	842	LD1	Osprey Dr	6	Vitrified Clay Pipe	270	Roots throughout pipe, clear water running from laterals at 84 and 87.4' US (Unknown Source). Survey abandoned at 91.5' US due to large offset joint (no reversal attempted)	Inspect Lateral, Complete CCTV, Root Treatment	3	0	576	576	\$4,601	\$7.99
2989	840	839	LD1	Osprey Dr	8	Vitrified Clay Pipe	326	Roots and fractures throughout pipe. Hinge fracture 3 at 120.2' DS.	CIPP	4	0	0	0	\$19,533	\$0.00
2988	841	840	LD1	Osprey Dr	8	Vitrified Clay Pipe	146	Fractures and infiltration stains throughout pipe. Roots ball joint at 111' DS	CIPP, Root Treatment	5	0	288	288	\$9,605	\$33.35
5419	End of Pipe	842	LD1	Osprey Dr	8	PolyVinyl Chloride	157	Light Grease throughout pipe. Survey abandoned at 98.5' US due to left turn (could not inspect by reversal)	Complete CCTV	2	0	0	0	\$865	\$0.00
3108	830	17	LD1	Portsmouth Blvd	10	PolyVinyl Chloride	46	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
2960	938	937	LD1	Spinnaker Way	8	Vitrified Clay Pipe	277	Buried/Could not locate	Complete CCTV	0	0	0	0	\$1,524	\$0.00
2957	941	942	LD1	Spinnaker Way	8	Vitrified Clay Pipe	225	Surface spalling at 14' US. Clear water coming from laterals at 69', 106', 166', and 204' US. Clear water from lateral at 21' US (unknown source). Crack longitudinal at 22' US. Broken pipe at 30' (no void visible). Fracture spiral at 44' US. Roots in lateral at 69' US. Roots fine barrel at 100' US. Infiltration stains at 126' US. Fracture spiral at 217' US with infiltration runner	Grout Lateral, Inspect Lateral, Short Liner, Spot Repair	5	288	3,312	3,600	\$7,570	\$2.10
2958	942	932	LD1	Spinnaker Way	8	Vitrified Clay Pipe	219	Crack longitudinal at 10' US With infiltration weeper. Crack circumferential and infiltration stains at 14' US. Pipe half full of debris at 28' (grass and toilet paper). Settled gravel deposits at 36' US. Infiltration stain joint at 40' US. Clear water leaking from lateral at 62' US. Roots joint fine and roots barrel fine at 100' US with Clear water running from lateral 100' US. Infiltration dripper at joint 112' US. Heavy debris and gravel blocking remaining survey. (Reversal complete)	T&S, Grout Lateral, CIPP, Short Liner	4	288	432	720	\$23,750	\$32.99
2963	935	934	LD1	Spinnaker Way	8	Vitrified Clay Pipe	206	Roots and debris throughout pipe. Broken pipe void visible at 62' US. Infiltration weeper joint at 98' US and 102' US. Collapsed pipe at 106' US. Hinge fracture 3 from 130' and 155' US.	T&S, Spot Repair, Root Treatment	5	720	0	720	\$22,653	\$31.46
2962	936	935	LD1	Spinnaker Way	8	Vitrified Clay Pipe	206	Joint offset large at 60' DS change from VCP to PVC. Survey abandoned at 60' DS (no reversal attempted)	Complete CCTV, Spot Repair	2	0	0	0	\$3,634	\$0.00
2961	937	936	LD1	Spinnaker Way	8	Vitrified Clay Pipe	212	Infiltration dripper at 55' US. Broken pipe soil visible at 55' US. PVC Spot Repair at 79' US with Joint Offset Severe (sinking into ground)	Complete CCTV, Spot Repair	5	144	0	144	\$13,667	\$94.91
2955	939	940	LD1	Spinnaker Way	8	Vitrified Clay Pipe	246	Roots throughout pipe. Infiltration runner at 92' DS coming from crack longitudinal. Infiltration runner at 114' DS. Deposits attached grease and encrustation throughout pipe. Clear water running from lateral at 146' DS (Unknown source). Infiltration dripper joint at 174' DS. Infiltration runner joint at 180' DS. Infiltration dripper at 206' DS.	Clean, T&S, Inspect Lateral, Spot Repair	5	2,160	432	2,592	\$10,769	\$4.15
2956	940	941	LD1	Spinnaker Way	8	Vitrified Clay Pipe	186	Fractures, roots, and infiltration stains throughout pipe. Clear water running from lateral at 114.8' DS (Unknown Source)	T&S, Inspect Lateral, CIPP, Root Treatment	4	0	432	432	\$17,682	\$40.93
3027	943	2361	LD1	Spinnaker Way	8	Vitrified Clay Pipe	279	Infiltration runner in lateral at 207.6' DS. Infiltration stains and roots throughout pipe	T&S, Grout Lateral, Root Treatment	4	0	1,440	1,440	\$8,646	\$6.00
3035	2444	2440	LD1	Spinnaker Way XC	10	PolyVinyl Chloride	200	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1481	2460	2458	LR3	Nathaniel Dr	10	Asbestos Cement	285	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$3,706	\$0.00
1483	2455	2452	LR3	Nathaniel Dr XC	10	Asbestos Cement	249	Fracture spiral at 76' DS. Heavy infiltration during flow isolation.	Clean, T&S	3	0	0	0	\$3,241	\$0.00
1482	2458	2455	LR3	Nathaniel Dr XC	10	Asbestos Cement	243	Infiltration stain at 159.4' US. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$3,154	\$0.00
1994	2462	2460	LR3	Nathaniel Dr XC	10	PolyVinyl Chloride	182	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$2,052	\$0.00
1506	2464	2462	LR3	Nathaniel Dr XC	10	Asbestos Cement	219	No defects observed. Heavy infiltration during flow isolation.	Clean, T&S	0	0	0	0	\$2,849	\$0.00
3352	1646	2464	LR3	Nathaniel Dr XC	10	Asbestos Cement	211	Light grease throughout pipe. Heavy infiltration during flow isolation.	Clean, T&S	2	0	0	0	\$2,745	\$0.00
1552	2593	2591	LR3	Suzanne Dr	8	PolyVinyl Chloride	160	Roots fine joint at 82.2' US. Heavy infiltration during flow isolation.	Clean, T&S	1	0	0	0	\$1,799	\$0.00

Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
1513	2595	2593	LR3	Suzanne Dr	8	Asbestos Cement	78	Infiltration gusher from hole at 15' US	Clean, T&S, Spot Repair	5	5,760	0	5,760	\$6,011	\$1.04
1883	390	389	LR4	Greenleaf Ave	8	Asbestos Cement	209	Clear water running from lateral at 94.4' DS	Clean, T&S, Grout Lateral	0	0	720	720	\$3,170	\$4.40
1884	391	390	LR4	Greenleaf Ave	8	Asbestos Cement	222	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
4753	392	391	LR4	Greenleaf Ave	8	Asbestos Cement	274	Clear water running from lateral at 13.4' US (Unknown Source). Debris buildup at MH 392	Inspect Lateral	4	0	288	288	\$750	\$2.60
1881	394	392	LR4	Greenleaf Ave	10	Asbestos Cement	321	Infiltration stains throughout pipe with gusher and runner at 238 and 248' DS, respectively. Protruding lateral at 256.8' DS	Clean, T&S, Cut Service, Spot Repair	5	5,040	0	5,040	\$7,599	\$1.51
564	1631	394	LR4	Greenleaf Ave	8	Asbestos Cement	172	Deposits settled gravel with broken pipe debris at 149.3' DS (unknown origin)	Monitor	2	0	0	0	\$0	\$0.00
1830	396	395	LR4	Greenleaf Ave	10	Asbestos Cement	162	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
555	1056	1047	LR4	Greenleaf Ave	8	Asbestos Cement	305	Fractures and infiltration stains throughout pipe. Clear water running from laterals at 24.5' and 138.5' US. Clear water coming from lateral at 217.2' US (unknown source).	T&S, Grout Lateral, Inspect Lateral, CIPP	5	144	864	1,008	\$22,229	\$22.05
563	1047	1631	LR4	Greenleaf Ave	8	Vitrified Clay Pipe	89	Clear water running from lateral at 80.5' DS (Unknown Source)	Inspect Lateral	2	0	576	576	\$750	\$1.30
1833	395	372	LR4	Greenleaf Ave XC	10	Asbestos Cement	216	Survey abandoned at 214' DS due to severe root ball. Infiltration dripper at MH372.	T&S, Root Treatment	5	288	0	288	\$2,921	\$10.14
1834	372	5872	LR4	Greenleaf Ave XC	10	Asbestos Cement	184	Clear water dripping from lateral at 22.2' DS, Infiltration runner at DS MH connection	Clean, T&S, Grout Lateral	4	1,440	288	1,728	\$2,842	\$1.64
1876	373	374	LR4	Greenleaf Ave X-Country	10	Asbestos Cement	208	Could not find MH's	Complete CCTV	0	0	0	0	\$1,141	\$0.00
560	1050	1049	LR4	Hillside Dr	8	Vitrified Clay Pipe	29	Roots fine barrel at 16' US	Root Treatment	2	0	0	0	\$176	\$0.00
556	1055	1056	LR4	Hillside Dr	8	PolyVinyl Chloride	397	Clear water running from laterals at 187.9' and 315.2' DS (Unknown Source)	Inspect Lateral	2	0	1,440	1,440	\$1,500	\$1.04
1888	389	388	LR4	Holiday Dr	8	Asbestos Cement	256	Grease and debris throughout pipe, survey abandoned at 250' DS due to grease	Complete CCTV	3	0	0	0	\$1,408	\$0.00
642	564	565	LR4	Marjorie St	8	Asbestos Cement	199	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1848	2726	544	LR4	McClintock Ave	8	PolyVinyl Chloride	200	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1850	551	2726	LR4	McClintock Ave	8	PolyVinyl Chloride	207	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
4142	554	555	LR4	Middle Rd	8	Vitrified Clay Pipe	161	Infiltration stains, roots, and fractures throughout pipe. Clear water coming from protruding lateral at 96' DS. reversal complete	T&S, Grout Lateral, CIPP, Cut Service, Root Treatment	4	0	432	432	\$15,537	\$35.97
637	2208	2209	LR4	Middle Rd	8	Asbestos Cement	250	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1843	419	418	LR4	Moffat St	8	PolyVinyl Chloride	169	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1842	420	419	LR4	Moffat St	8	Asbestos Cement	39	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
5121	5422	5394	LR4	Parking lot	8	Asbestos Cement	180	Clear water coming from laterals at 44.4' and 86.2' DS (Unknown Source)	Inspect Lateral	1	0	1,152	1,152	\$1,500	\$1.30
5122	5423	5421	LR4	Parking lot	8	Asbestos Cement	325	Infiltration stains throughout pipe, Fractures at 120.5' DS.	Clean, T&S	4	0	0	0	\$4,220	\$0.00
5120	5421	5422	LR4	Parking lot	8	Asbestos Cement	237	Clear water coming from laterals at 59', 75', and 154.9' US (Unknown Source). Broken pipe void visible with infiltration dripper at 65' US. Infiltration drippers and stains throughout pipe	Clean, T&S, Inspect Lateral, Spot Repair	5	144	1,296	1,440	\$7,837	\$5.44
640	562	565	LR4	Sylvester St	8	Asbestos Cement	199	Clear water coming from lateral at 160.3' DS. Infiltration gusher from hole in pipe at 190' DS	Clean, T&S, Grout Lateral, Spot Repair	5	2,880	144	3,024	\$5,533	\$1.83
1845	545	420	LR4	X-Country	8	Asbestos Cement	195	Infiltration gusher at US MH Connection, roots at DS MH Connection	Clean, T&S	5	1,152	0	1,152	\$2,537	\$2.20
1844	544	545	LR4	X-Country	8	Asbestos Cement	206	Clear water weeping from lateral at 91.4' DS (Unknown Source)	Inspect Lateral	2	0	144	144	\$750	\$5.21
1892	374	375	LR4	X-Country Greenleaf woods Dr	10	Asbestos Cement	231	Infiltration runner joint at 116' US. Roots at US MH Connection	Clean, T&S	4	1,440	0	1,440	\$3,000	\$2.08
1893	375	376	LR4	X-Country Greenleaf Woods Dr	10	Asbestos Cement	214	Broken pipe at 34.8' US	Short Liner	5	0	0	0	\$2,580	\$0.00

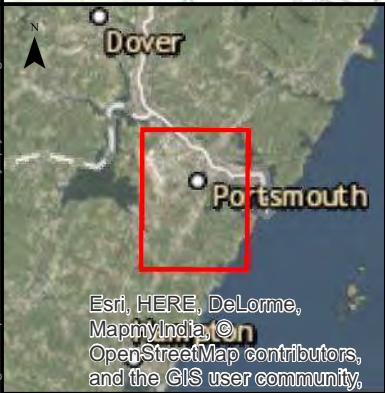
Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
1907	1062	1063	LR5	Lafayette Rd	8	Asbestos Cement	245	50% Full of Debris, could not attempt survey	Clean, Complete CCTV	0	0	0	0	\$2,699	\$0.00
1918	1068	1067	LR5	Lafayette Rd	10	Asbestos Cement	114	Could not locate line	Clean, Complete CCTV	0	0	0	0	\$1,254	\$0.00
1917	1069	1068	LR5	Lafayette Rd	10	Asbestos Cement	158	Surface spalling at 4' DS, debris at 79' US causing abandoned survey (no reversal attempted)	Complete CCTV	2	0	0	0	\$868	\$0.00
1916	1046	1069	LR5	Lafayette Rd XC	10	Asbestos Cement	135	Infiltration runner at 30.3' DS, MH 1069 has infiltration at walls (1.5 gpm)	Clean, T&S	4	432	0	432	\$1,751	\$4.05
1914	1044	1045	LR5	Ledgewood Dr	10	Asbestos Cement	233	MH 1044 is buried, line is full of debris	Clean, Complete CCTV	0	0	0	0	\$2,565	\$0.00
1915	1045	1046	LR5	Ledgewood Dr	10	Asbestos Cement	167	Broken pipe at 17.4' US. Hole soil visible at 40' US. Infiltration stains throughout pipe, infiltration runner joint at 224' US. Survey abandoned due to high water level in pipe at 226' US (no reversal attempted)	T&S, Complete CCTV, Spot Repair	5	288	0	288	\$5,168	\$17.94
1911	1039	1038	LR5	Ledgewood Dr	8	Asbestos Cement	329	Survey abandoned due to hard right turn at 131.5' DS	Complete CCTV	2	0	0	0	\$1,808	\$0.00
1909	1038	1040	LR5	Ledgewood Dr	8	Vitrified Clay Pipe	98	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1908	1040	1062	LR5	Ledgewood Dr	8	Vitrified Clay Pipe	134	Deposits attached grease throughout pipe. Survey abandoned at 86.5' DS due to grease blockage (no reversal attempted)	Complete CCTV	5	0	0	0	\$735	\$0.00
570	1042	1043	LR5	Portsmouth High School Fields	10	Asbestos Cement	167	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1919	1043	1044	LR5	Portsmouth High School Fields	10	Asbestos Cement	165	Survey abandoned at 75' DS due to debris (no reversal attempted)	Complete CCTV	3	0	0	0	\$909	\$0.00
1925	1066	1065	LR5	Tuscan Market Parking lot	8	Asbestos Cement	173	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
569	1042A	1042	LR5	X-Country Highschool	10	Asbestos Cement	360	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
1640	237	236	LR6	Constitution Ave	8	Asbestos Cement	230	Clear water coming from lateral at 97.1' US (Unknown Source). Roots medium barrel at 104' US. Infiltration gusher at 107' US. Roots fine joint at 118' US.	T&S, Inspect Lateral, Root Treatment	4	4,320	0	4,320	\$3,853	\$0.89
1587	2641	136	LR6	Heritage Rd	8	Asbestos Cement	285	Heavy grease and debris buildup in pipe. Infiltration gusher at 9.6' DS from defective wye. Infiltration stains at 127' DS	Clean, T&S, Spot Repair	5	4,320	0	4,320	\$3,961	\$0.92
1858	2479	2477	LR6	Lafayette Rd	8	Asbestos Cement	30	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
2000	2484	2479	LR6	Lafayette Rd	8	Asbestos Cement	284	Clear water running from lateral at 96.3' DS (Unknown Source), Infiltration runner from broken pipe/fracture spiral at 265' DS.	Inspect Lateral, Spot Repair	5	2,880	720	3,600	\$3,250	\$0.90
1488	2489	2487	LR6	Lafayette Rd	8	Asbestos Cement	43	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1988	2652	143	LR6	Ricci Ave	8	Asbestos Cement	314	Infiltration runner at intruding lateral 26.6' DS. Intruding lateral at 106' DS. Debris buildup at 307' DS	Clean, T&S, Grout Lateral, Cut Service	4	720	0	720	\$5,396	\$7.49
1573	2651	2652	LR6	Ricci Ave	8	Asbestos Cement	110	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1579	2646	2647	LR6	Robert Ave	8	Asbestos Cement	119	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
3348	2794	95	M1	Cutts St	10	Vitrified Clay Pipe	37	Deposits settled gravel at 0' DS	Monitor	2	0	0	0	\$0	\$0.00
834	111	110	M1	Fairview Ave	8	PolyVinyl Chloride	28	Joint separated medium at 22.2' DS	Monitor	1	0	0	0	\$0	\$0.00
831	2132	103	M1	Maplewood Ave	8	PolyVinyl Chloride	137	Moderate grease and debris buildup throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
872	99	98	M1	Maplewood Ave	10	PolyVinyl Chloride	19	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
1448	100	99	M1	Maplewood Ave	10	PolyVinyl Chloride	274	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
827	101	100	M1	Maplewood Ave	10	PolyVinyl Chloride	36	No defects observed	Monitor	0	0	0	0	\$0	\$0.00
826	102	101	M1	Maplewood Ave	8	PolyVinyl Chloride	138	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
832	103	102	M1	Maplewood Ave	8	PolyVinyl Chloride	89	Light grease throughout pipe	Monitor	2	0	0	0	\$0	\$0.00
838	769	106	M1	Maplewood Ave	8	PolyVinyl Chloride	141	Intruding lateral at 24' US causing abandoned survey (no reversal attempted)	Cut Service, Complete CCTV	2	0	0	0	\$1,206	\$0.00
837	767	769	M1	Maplewood St	8	Vitrified Clay Pipe	213	Clear water running from lateral at 45.5' DS. Cracks and fractures throughout pipe. Survey abandoned at 110' DS due to turn in pipe (reversal incomplete) - City Currently Digging, Removed from Recommendation.	Monitor	4	0	0	0	\$0	\$0.00

Appendix A.3 - Pipeline Rehabilitation Recommendations - Prioritization Per Basin Per Street															
SewerID	US MH	DS MH	Metering Basin	Street	Diameter (in.)	Material	Pipe Length (LF)	Observations	Rehab Recommendations	Max Defect Score	Mainline Infiltration (gpd)	Lateral Infiltration (gpd)	Estimated Infiltration from CCTV (gpd)	Estimated Rehab Cost	Cost Effectiveness (\$ spent / GPD removed)
833	759	111	M1	Oleary Pl	6	Asbestos Cement	100	Rag wedged in joint at 29' DS. Survey abandoned at 33' DS due to offset joint (no reversal attempted)	Complete CCTV	5	0	0	0	\$553	\$0.00





Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



### Legend

Pipe Rehabilitation Page Outline

City Boundary

01,2502,5005,000

Feet

City of Portsmouth, NH 2017 SSES	
FIGURE 4-1: Pipe Rehabilitation Key Plan	
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**General Notes:**

- Assets labeled in italic text reflect those with higher rehabilitation priority
- Symbology does not reflect actual position of defect and/or recommended repair.
- Refer to recommended rehabilitation tables for detailed quantities and location(s) of defects.
- Not for construction.

**LEGEND**

- Sewer Manhole
- SewerLine
- SewerLine**
- Sanitary Sewer System Features**
- Infiltration
- Structural/O&M
- Monitor
- Metering Basin
- City/Town Boundary
- Rehabilitation Type**
- Geographical Features**

**City of Portsmouth, NH 2017 SSES**

**Figure 4-1: Recommended Pipeline Rehabilitation**  
*MAP 1 of 24*

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SCALE: 1" = 200'

DATE: DECEMBER 2017

PROJECT #: 227950.01

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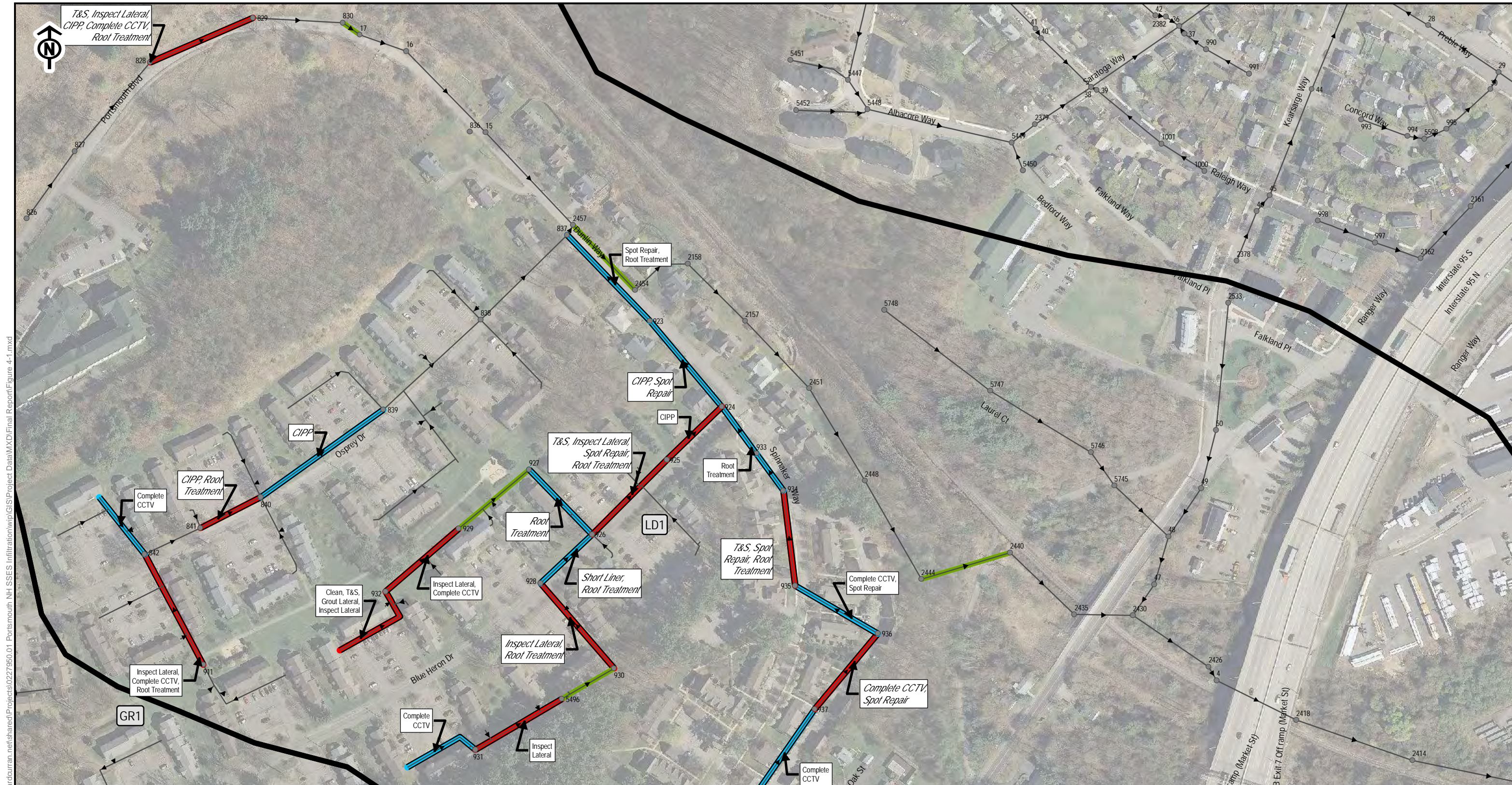
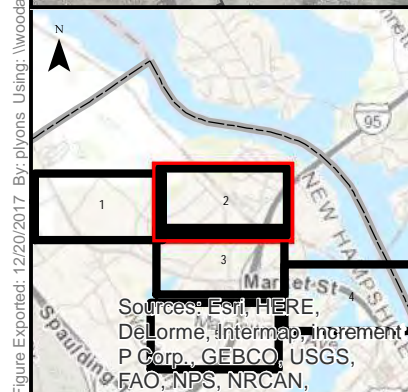


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**General Notes:**

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- Not for construction.

Sources: ESRI, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN,

● Sewer Manhole

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**LEGEND**

**SewerLine**

**Sanitary Sewer System Features**

- Metering Basin

**Geographical Features**

- City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation

MAP 2 of 24

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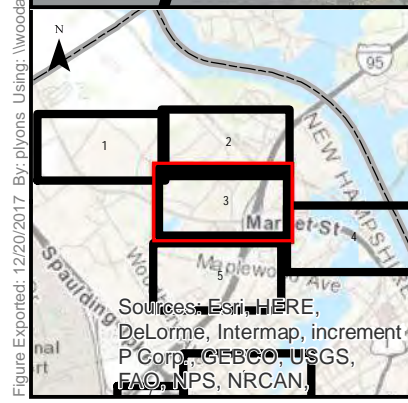
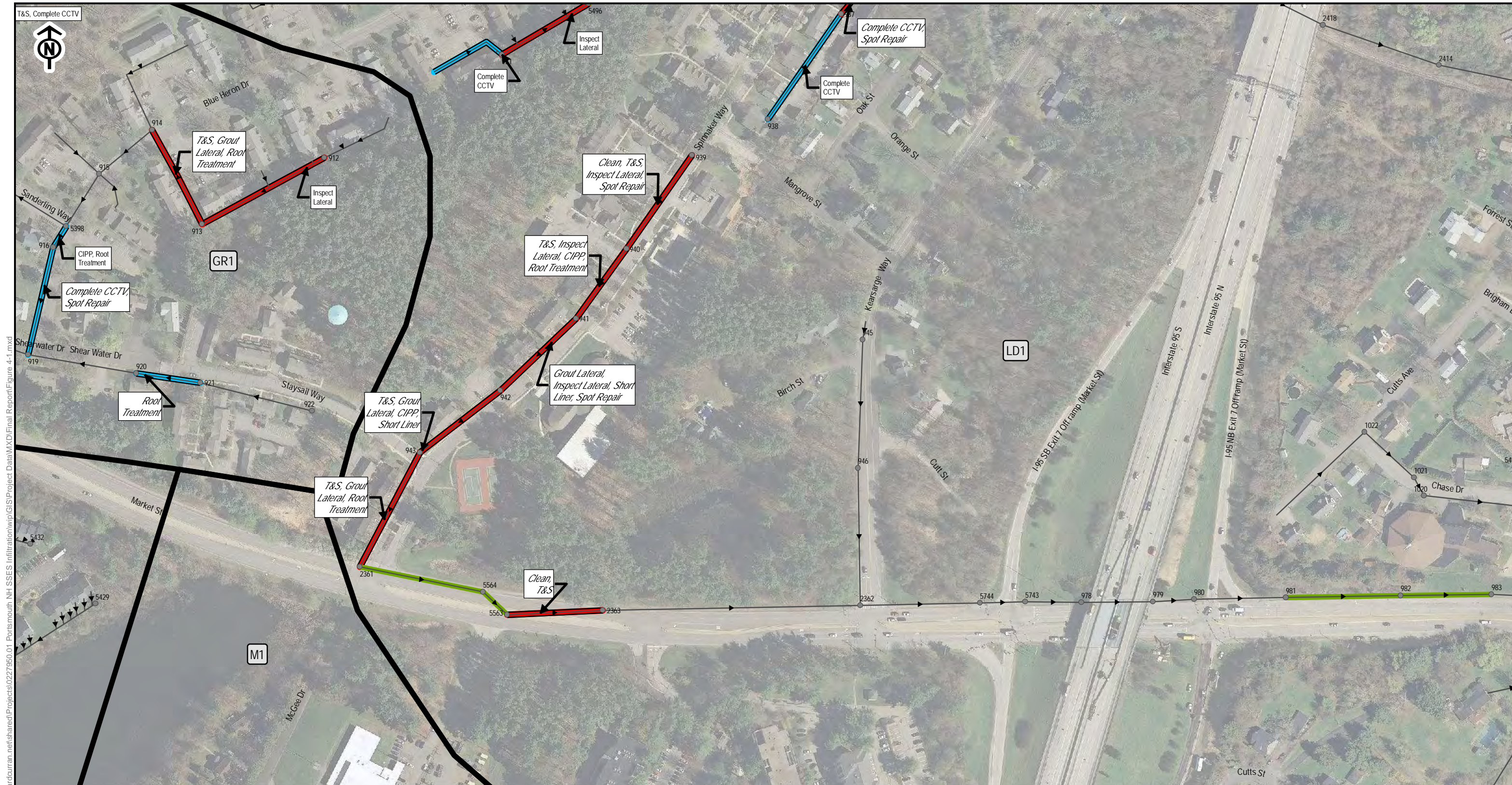
SCALE: 1" = 200'

DATE: DECEMBER 2017

PROJECT #: 227950.01

DRAWN BY: AM





**General Notes:**

- Assets labeled in italic text reflect those with higher rehabilitation priority
- Symbology does not reflect actual position of defect and/or recommended repair.
- Refer to recommended rehabilitation tables for detailed quantities and location(s) of defects.
- Not for construction.

**LEGEND**

**SewerLine**

- Sewer Manhole
- SewerLine

**Sanitary Sewer System Features**

- ▭ Metering Basin

**Rehabilitation Type**

- Red line: Infiltration
- Blue line: Structural/O&M
- Green line: Monitor

**Geographical Features**

- ▭ City/Town Boundary

**City of Portsmouth, NH 2017 SSES**

**Figure 4-1: Recommended Pipeline Rehabilitation**

*MAP 3 of 24*

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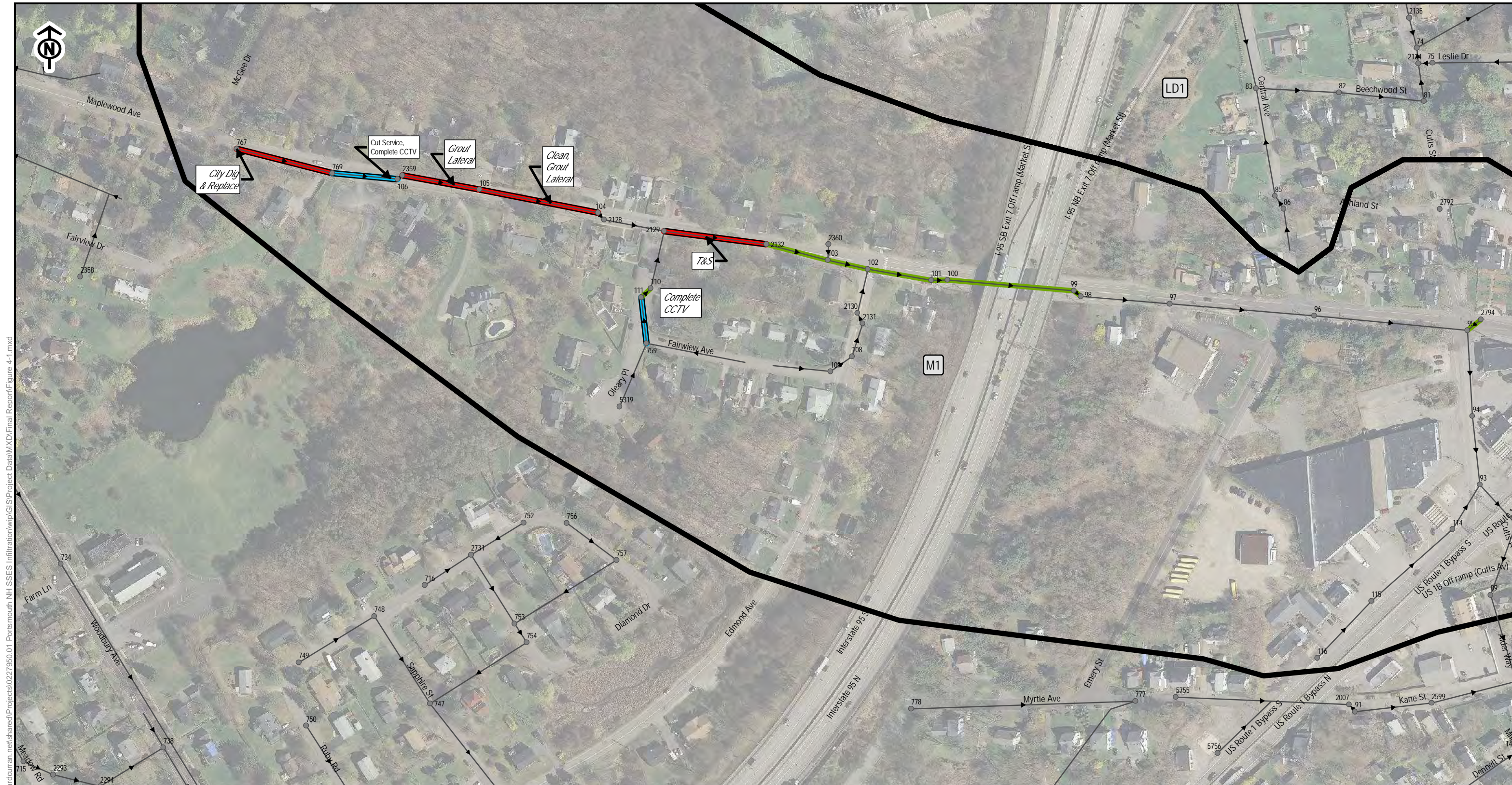
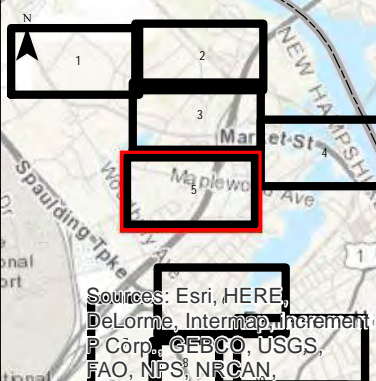


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- Not for construction.

0 100 200 400 Feet

**LEGEND**

● Sewer Manhole	<b>SewerLine</b>	<b>Sanitary Sewer System Features</b>
→ SewerLine		▭ Metering Basin
<b>Rehabilitation Type</b>	<b>Geographical Features</b>	
Red Line: Infiltration	▭ City/Town Boundary	
Blue Line: Structural/O&M		
Green Line: Monitor		

<b>City of Portsmouth, NH 2017 SSES</b>	
<b>Figure 4-1: Recommended Pipeline Rehabilitation</b> <i>MAP 5 of 24</i>	
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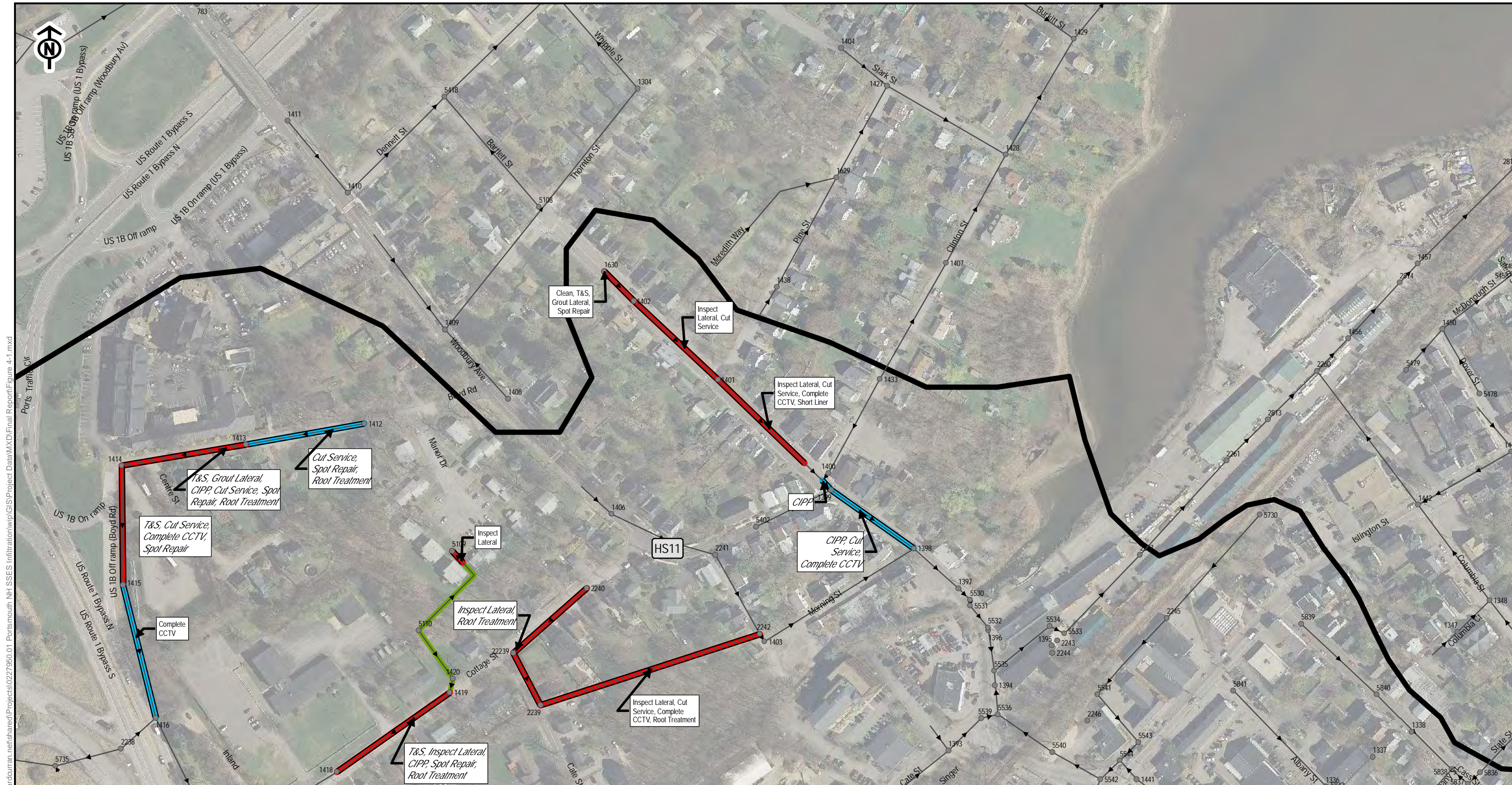
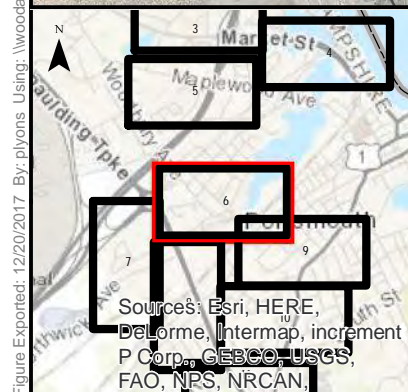


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- Not for construction.

0 100 200 400 Feet

**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

■ Metering Basin

**Geographical Features**

□ City/Town Boundary

**City of Portsmouth, NH 2017 SSES**

**Figure 4-1: Recommended Pipeline Rehabilitation**

*MAP 6 of 24*

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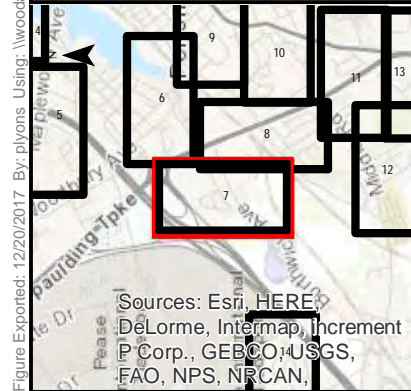
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- Not for construction.

0 100 200 400 Feet

LEGEND

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red Infiltration

Blue Structural/O&M

Green Monitor

**Sanitary Sewer System Features**

Black Metering Basin

**Geographical Features**

Grey City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation

MAP 7 of 24

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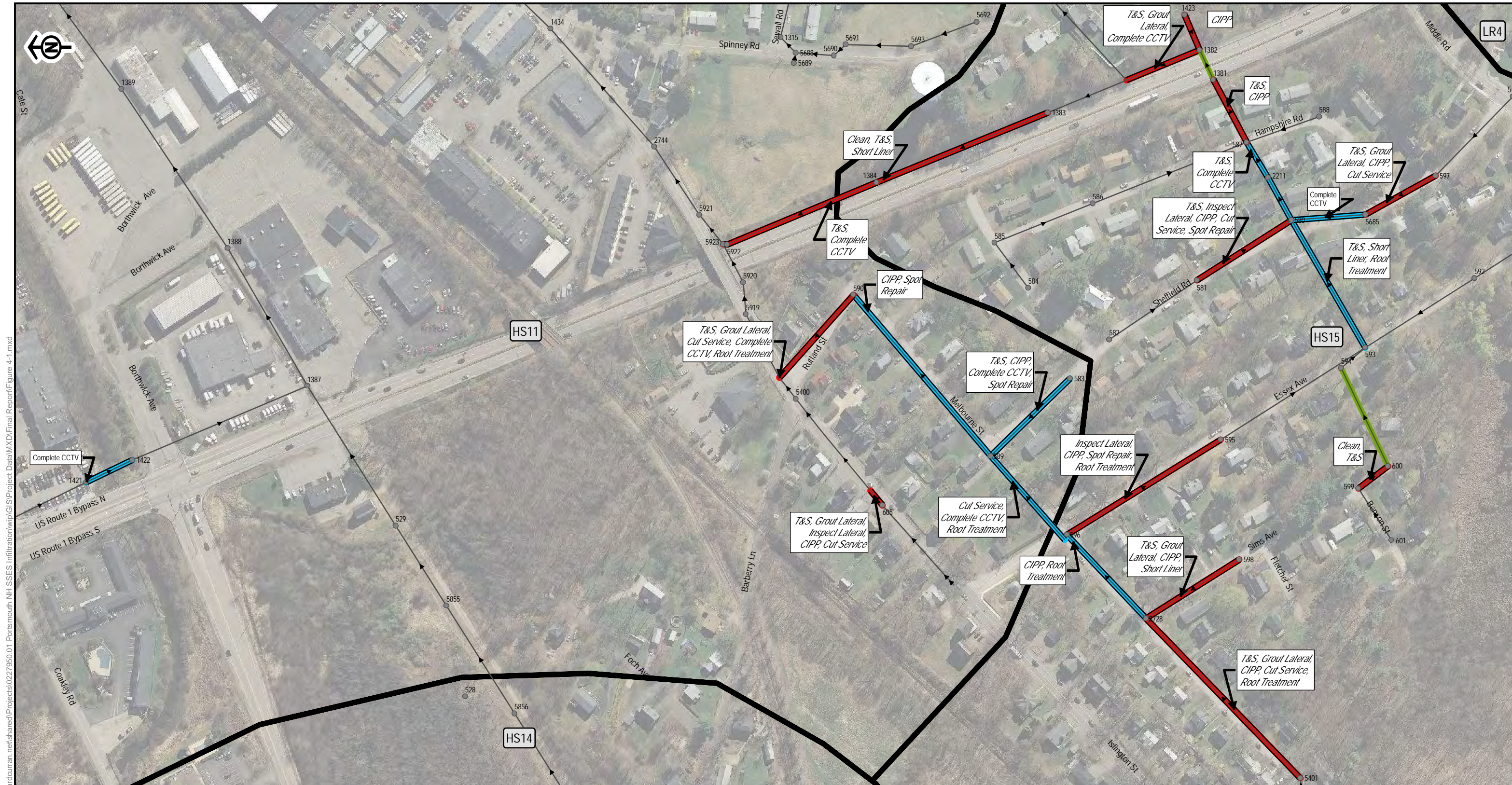
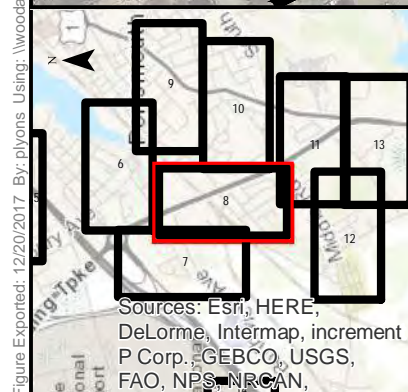


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0 100 200 400 Feet

**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

■ Metering Basin

**Geographical Features**

□ City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation

MAP 8 of 24

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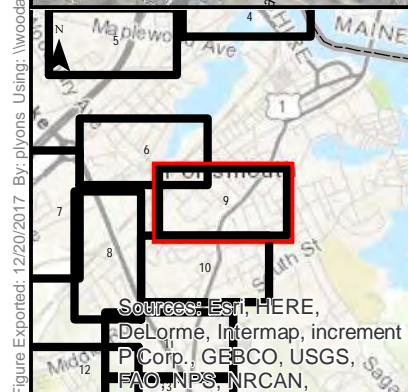
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- Not for construction.

**Sources:** Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN,

**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

■ Metering Basin

**Geographical Features**

□ City/Town Boundary

**City of Portsmouth, NH 2017 SSES**

**Figure 4-1: Recommended Pipeline Rehabilitation**

*MAP 9 of 24*

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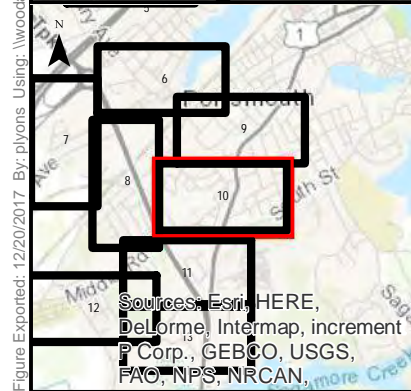
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● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red Infiltration

Blue Structural/O&M

Green Monitor

**LEGEND**

**Sanitary Sewer System Features**

Black Metering Basin

**Geographical Features**

Grey City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation

MAP 10 of 24

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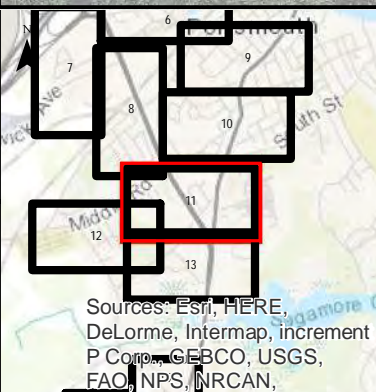
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- Not for construction.

0 100 200 400 Feet

**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

■ Metering Basin

**Geographical Features**

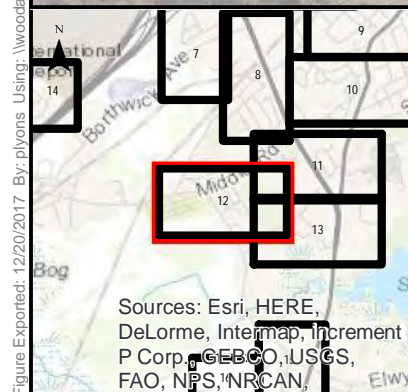
□ City/Town Boundary

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Figure 4-1: Recommended Pipeline Rehabilitation	
MAP 11 of 24	
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- Not for construction.

Sources: Esri, HERE, DeLorme, Intermap, Increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, Esri

0 100 200 400 Feet

**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

■ Metering Basin

**Geographical Features**

□ City/Town Boundary

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Figure 4-1: Recommended Pipeline Rehabilitation	
MAP 12 of 24	
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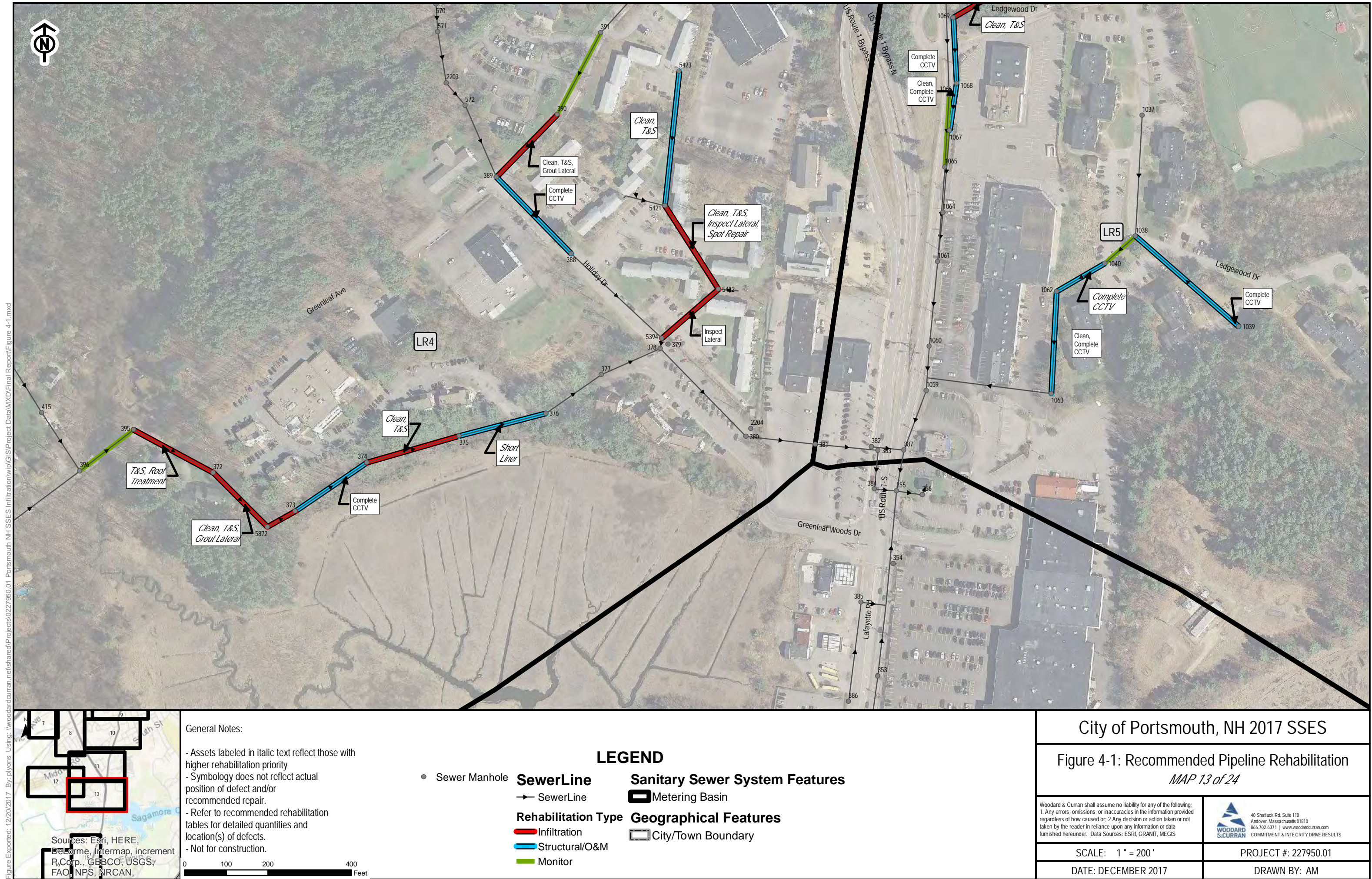


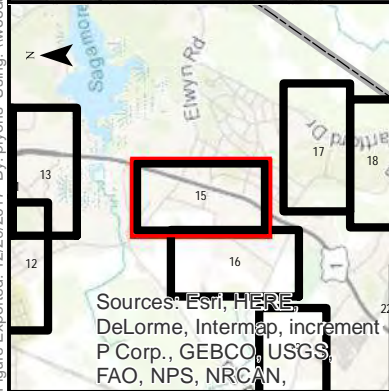


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- Not for construction.

#### LEGEND

- Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red Infiltration

Blue Structural/O&M

Green Monitor

**Sanitary Sewer System Features**

Black Metering Basin

**Geographical Features**

Grey City/Town Boundary

## City of Portsmouth, NH 2017 SSES

### Figure 4-1: Recommended Pipeline Rehabilitation

*MAP 15 of 24*

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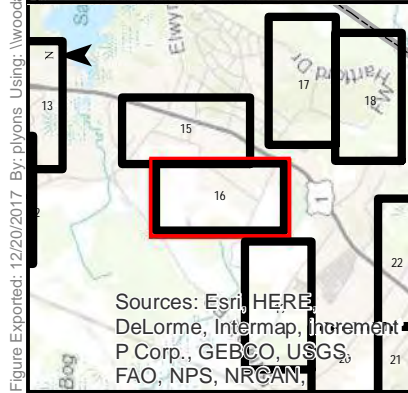
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**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red Infiltration

Blue Structural/O&M

Green Monitor

**Sanitary Sewer System Features**

Rectangular Metering Basin

**Geographical Features**

City/Town Boundary

**City of Portsmouth, NH 2017 SSES**

**Figure 4-1: Recommended Pipeline Rehabilitation**

*MAP 16 of 24*

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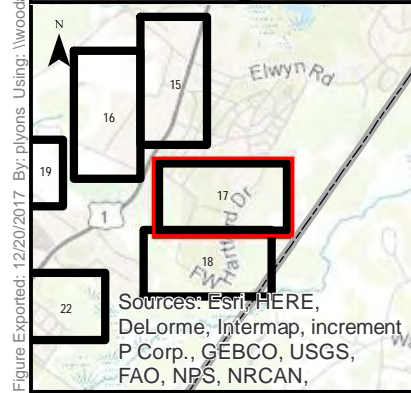
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LEGEND

● Sewer Manhole

SewerLine

→ SewerLine

Rehabilitation Type

Infiltration

Structural/O&M

Monitor

Sanitary Sewer System Features

Metering Basin

Geographical Features

City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation

MAP 17 of 24

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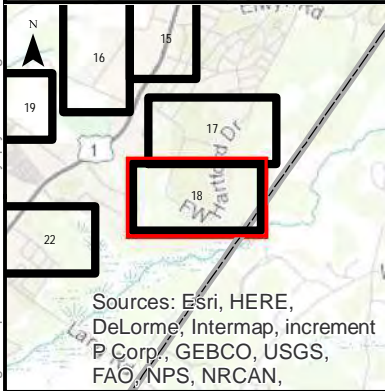
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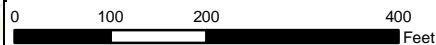


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- Not for construction.



LEGEND

● Sewer Manhole

— SewerLine

Rehabilitation Type

Infiltration

Structural/O&M

Monitor

Sanitary Sewer System Features

Metering Basin

Geographical Features

City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation

MAP 18 of 24

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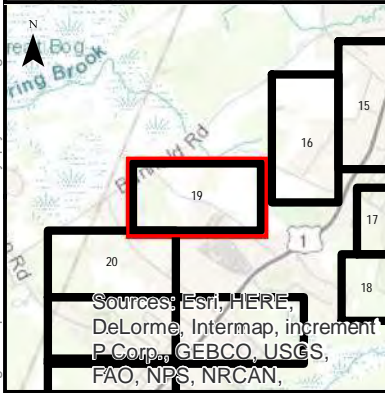
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- Not for construction.

0 100 200 400 Feet

LEGEND

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red line: Infiltration

Blue line: Structural/O&M

Green line: Monitor

**Sanitary Sewer System Features**

Black rectangle: Metering Basin

**Geographical Features**

Grey rectangle: City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation  
MAP 19 of 24

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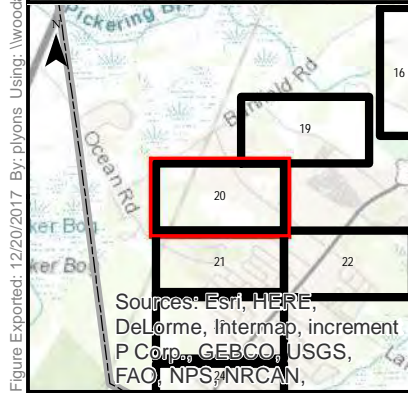
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- Not for construction.

**LEGEND**

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

▭ Metering Basin

**Geographical Features**

▭ City/Town Boundary

City of Portsmouth, NH 2017 SSES	
Figure 4-1: Recommended Pipeline Rehabilitation <i>MAP 20 of 24</i>	
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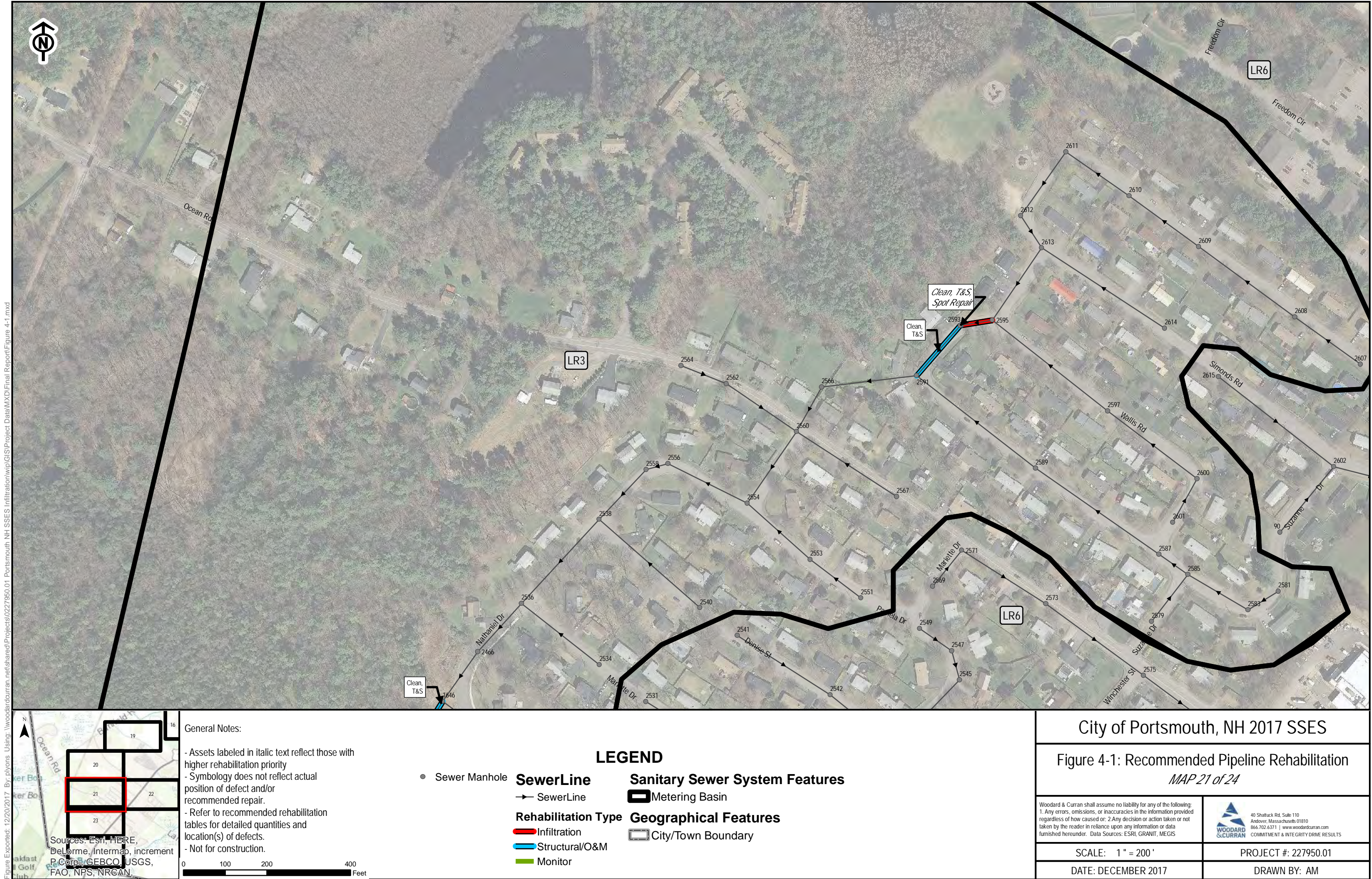
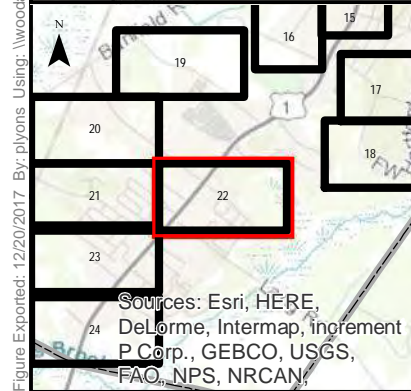




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- Not for construction.

0 100 200 400 Feet

#### LEGEND

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red Infiltration

Blue Structural/O&M

Green Monitor

**Sanitary Sewer System Features**

Black Metering Basin

**Geographical Features**

Grey City/Town Boundary

## City of Portsmouth, NH 2017 SSES

### Figure 4-1: Recommended Pipeline Rehabilitation

MAP 22 of 24

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COMMITMENT & INTEGRITY DRIVE RESULTS

SCALE: 1" = 200'

DATE: DECEMBER 2017

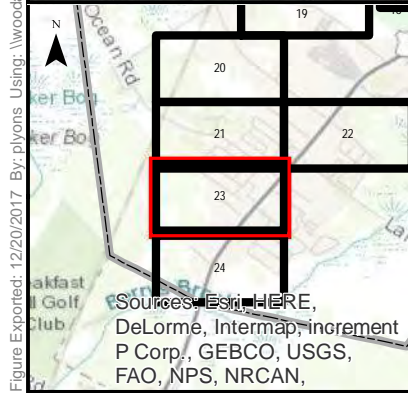
PROJECT #: 227950.01

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General Notes:

- Assets labeled in italic text reflect those with higher rehabilitation priority
- Symbology does not reflect actual position of defect and/or recommended repair.
- Refer to recommended rehabilitation tables for detailed quantities and location(s) of defects.
- Not for construction.

0 100 200 400 Feet

LEGEND

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**

Red Infiltration

Blue Structural/O&M

Green Monitor

**Sanitary Sewer System Features**

Black Metering Basin

**Geographical Features**

Grey City/Town Boundary

City of Portsmouth, NH 2017 SSES

Figure 4-1: Recommended Pipeline Rehabilitation  
MAP 23 of 24

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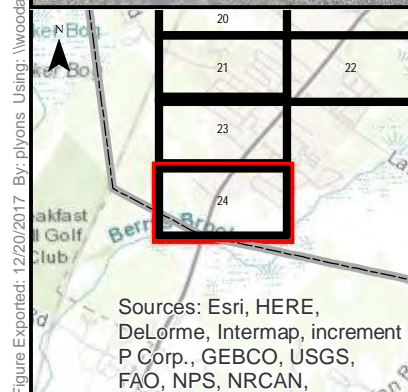
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General Notes:

- Assets labeled in italic text reflect those with higher rehabilitation priority
- Symbology does not reflect actual position of defect and/or recommended repair.
- Refer to recommended rehabilitation tables for detailed quantities and location(s) of defects.
- Not for construction.

0 100 200 400 Feet

● Sewer Manhole

**SewerLine**

→ SewerLine

**Rehabilitation Type**


- Infiltration
- Structural/O&M
- Monitor

**Sanitary Sewer System Features**

▭ Metering Basin

**Geographical Features**

▭ City/Town Boundary

City of Portsmouth, NH 2017 SSES	
Figure 4-1: Recommended Pipeline Rehabilitation MAP 24 of 24	
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## APPENDIX B: MANHOLE INSPECTIONS FINDINGS AND RECOMMENDATIONS



Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
821	GR1	Osprey Drive	9	BRICK	Manhole walls leaking at 11.6 gpm per flow isolation, no picture taken of infiltration. Also, possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	16,704	\$3,700	\$0	\$3,700	\$0.22
396	LR4	Greenleaf Woods Drive	7	PRECAST	Incoming pipe connection leak, voids visible around inlet and outlet pipe connections.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	9,360	\$2,590	\$2,200	\$4,790	\$0.28
377	LR4	Greenleaf Woods Drive	14	PRECAST	Mineral deposits at pipe connections (primary in/out) with active infiltration	Grout Manhole, Cementitious Liner	4	17,280	\$5,180	\$0	\$5,180	\$0.30
920	GR1	Shearwater Drive	9	BRICK	Pipe connection leak from north and west pipes. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	10,080	\$3,330	\$0	\$3,330	\$0.33
397	LR4	Greenleaf Avenue	8	PRECAST	Corbel missing bricks and mortar, light debris on bench. 6 gpm leak observed during flow isolation.	Corbel Repair, Grout Manhole, Cementitious Liner	3	8,640	\$2,960	\$1,000	\$3,960	\$0.34
2646	LR6	Robert Avenue	6	PRECAST	Mineral deposits at wall and void visible at outgoing pipe connection	Grout Manhole, Cementitious Liner	3	5,040	\$2,220	\$0	\$2,220	\$0.44
816	GR1	Portsmouth Boulevard	8	BRICK	Mineral deposits at wall. Pipe connection leak.	Grout Manhole, Cementitious Liner	3	7,200	\$3,330	\$0	\$3,330	\$0.46
2385	GR1	Commerce Way Easement	8	BRICK	Severe infiltration from corbel, surcharging (no bench or invert visible), ponding around frame causing inflow. Located on Pease effluent line.	Corbel Repair, Rebuild Bench, Grout Manhole, Raise to Surface	4	2,880	\$1,600	\$4,300	\$5,900	\$0.56
818	GR1	Portsmouth Boulevard	10	BLOCK	Active infiltration and mineral deposits at wall, roots	Root Treatment, Grout Manhole, Cementitious Liner	4	7,200	\$4,070	\$2,200	\$6,270	\$0.57
1646	LR3	Nathaniel Drive R.O.W.	5	PRECAST	Wall leaks, hole in wall at connection to bench	Grout Manhole, Cementitious Liner	3	2,880	\$1,850	\$0	\$1,850	\$0.64
2248	HS11	Islington Street	8	PRECAST	No bench and invert. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	2,880	\$2,960	\$2,200	\$5,160	\$1.03
2445	LR3	Nathaniel Drive R.O.W.	8	PRECAST	Light infiltration stains at walls, cracked cover	New Frame and Cover, Grout Manhole, Cementitious Liner	3	2,880	\$2,960	\$820	\$3,780	\$1.03
942	LD1	Spinnaker Way	9	BRICK	Mineral deposits at bench and invert, roots in corbel. Walls weaping during MH Inspection. Active infiltration during flow isolation.	Grout Manhole, Cementitious Liner	3	2,880	\$3,330	\$0	\$3,330	\$1.16
5316	HS14	Barberry Lane Easement	7	PRECAST	Active infiltration and mineral deposits at wall, corbel missing mortar	Corbel Repair, Grout Manhole, Cementitious Liner	3	2,160	\$2,590	\$1,000	\$3,590	\$1.20
2487	LR6	Lafayette Road at Coach Road	8	PRECAST	Light debris on bench and invert. Infiltration at bench/wall connection. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	2	2,520	\$3,330	\$0	\$3,330	\$1.32
406	LR4	Peverly Hill Road	7	PRECAST	Incoming and outgoing pipe connection leaks.	Grout Manhole, Cementitious Liner	3	2,232	\$2,960	\$0	\$2,960	\$1.33
629	GR1	Oriental Gardens R.O.W.	11	PRECAST	Heavy mineral deposits, aggregate visible at wall due to H2S	Grout Manhole, Epoxy Liner	3	1,440	\$2,200	\$5,500	\$7,700	\$1.53
5819	HS11	Aldrich Road at Aldrich Court	8	PRECAST	Incoming pipe connection leak (estimated at 2 gpm)	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1,800	\$2,960	\$2,200	\$5,160	\$1.64
1315	HS11	Sewall Road at Spinney Road	9	PRECAST	Faulty drop connection in manhole, light debris on bench and invert, walls weeping at joints	Grout Manhole, Cementitious Liner	3	1,728	\$3,330	\$0	\$3,330	\$1.93
1311	HS11	Fields Road and Sewall Road	7	BLOCK	Moderate debris in bench and invert, active infiltration from wall	Grout Manhole, Cementitious Liner	3	1,440	\$2,960	\$0	\$2,960	\$2.06
2386	GR1	Commerce Way Easement	9	BRICK	Roots in corbel, Active infiltration with mineral deposits at wall, heavy debris in invert. Located on Pease effluent line.	Root Treatment, Grout Manhole, Cementitious Liner	3	1,440	\$3,330	\$2,200	\$5,530	\$2.31
407	LR4	Peverly Hill Road at McClintock Avenue	8	PRECAST	Outgoing pipe connection leak.	Grout Manhole, Cementitious Liner	3	1,440	\$3,330	\$0	\$3,330	\$2.31
460	B1	Victory Road	8	BRICK	Roots at wall, corbel has broken bricks and missing mortar	Corbel Repair, Root Treatment, Grout Manhole	2	720	\$1,800	\$3,200	\$5,000	\$2.50
599	HS15	Sims Avenue at Benson Street	8	PRECAST	Infiltration at manhole wall	Grout Manhole	2	720	\$1,800	\$0	\$1,800	\$2.50
2362	LD1	Kearsarge Road at Market Street	10	PRECAST	Invert leak. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1,440	\$3,700	\$2,200	\$5,900	\$2.57
2642	LR6	Heritage Avenue	9	PRECAST	Light Infiltration observed at walls, mineral deposits	Grout Manhole, Cementitious Liner	3	1,440	\$3,700	\$0	\$3,700	\$2.57
587	HS15	Hampshire Road	10	BLOCK	Mineral deposits at wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole	4	720	\$2,000	\$2,200	\$4,200	\$2.78
642	GR1	Woodbury Avenue	11	PRECAST	Missing bricks and mortar from corbel, Mineral deposits at wall, debris buildup in bench.	Corbel Repair, Grout Manhole, Cementitious Liner	3	1,440	\$4,070	\$1,000	\$5,070	\$2.83
1330	HS11	Brewery Lane	11	PRECAST	Bench and invert gone/broken/sinking, infiltration staining at walls, piece of frame missing	New Frame and Cover, Rebuild Bench, Grout Manhole, Epoxy Liner	5	720	\$2,400	\$9,020	\$11,420	\$3.33
5334	GR1	Woodbury Avenue	12	PRECAST	Missing bricks in bench and invert. Light debris buildup in bench and channel. Infiltration staining at wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole	4	720	\$2,400	\$2,200	\$4,600	\$3.33
1392	HS11	Cate Street	5	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$1,200	\$0	\$1,200	\$3.33
2471	LR6	Lafayette Road	6	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	720	\$2,590	\$0	\$2,590	\$3.60
1303	HS11	Thaxter Road at Fells Road	11	BLOCK	Loose bricks in wall, no bench and invert, active infiltration at wall	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,080	\$4,070	\$2,200	\$6,270	\$3.77
1331	HS11	Brewery Lane	14	BRICK/STONE	No bench and invert, roots at wall. Large gaps in wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,440	\$5,550	\$2,200	\$7,750	\$3.85
2221	HS11	Islington Street	11	BRICK	Active infiltration at wall, bench and invert not visible, corbel missing mortar and cracked	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,080	\$4,440	\$3,200	\$7,640	\$4.11
378	LR4	Greenleaf Woods Drive	15	PRECAST	Active infiltration from wall	Grout Manhole, Cementitious Liner	4	1,440	\$5,920	\$0	\$5,920	\$4.11
540	HS14	Coakley Road	8	BLOCK	Moderate debris on bench, broken frame, loose and broken bricks from corbel, missing mortar from walls	New Frame and Cover, Corbel Repair, Grout Manhole, Cementitious Liner	3	720	\$2,960	\$1,820	\$4,780	\$4.11
17	LD1	Portsmouth Boulevard R.O.W.	7	PRECAST	Missing mortar from corbel with roots in corbel. Infiltration at pipe connection.	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$2,960	\$1,000	\$3,960	\$4.11
2727	HS14	Coakley Road	8	BLOCK	Missing mortar in wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$3,330	\$2,200	\$5,530	\$4.63
638	GR1	Commerce Way	16	PRECAST	Infiltration staining	Grout Manhole	2	720	\$3,400	\$0	\$3,400	\$4.72
108	M1	Edmund Avenue near Fairview Avenue	8	PRECAST	Cracked cover	New Frame and Cover, Grout Manhole	2	360	\$1,800	\$820	\$2,620	\$5.00
2741	HS11	Lovell Street R.O.W.	10	BLOCK	Walls missing mortar, no bench and invert, mineral deposits in incoming line	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,070	\$2,200	\$6,270	\$5.65
5852	GR1	Portsmouth Boulevard Easement	11	PRECAST	Mineral deposits at bench, broken bricks and missing mortar from corbel	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$4,070	\$1,000	\$5,070	\$5.65
2507	LR6	Lafayette Road	6	PRECAST	Infiltration at bench/wall connection	Grout Manhole, Cementitious Liner	2	432	\$2,590	\$0	\$2,590	\$6.00
2483	LR6	Lafayette Road at Coach Road	8	PRECAST	Light infiltration at manhole wall	Grout Manhole	2	288	\$1,800	\$0	\$1,800	\$6.25
2387	GR1	Woodbury Avenue	12	PRECAST	Infiltration staining at wall, aggregate visible at wall due to H2S. Located on Pease effluent line.	Grout Manhole, Epoxy Liner	2	360	\$2,400	\$6,000	\$8,400	\$6.67
1388	HS11	US Bypass 1 at rear	11	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$2,400	\$0	\$2,400	\$6.67
593	HS15	Essex Avenue	12	BLOCK	Broken and missing bricks from wall, loose bricks in corbel, no bench or invert, heavy debris buildup	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,810	\$3,200	\$8,010	\$6.68
5332	GR1	Commerce Way	13	PRECAST	Active infiltration at walls, cracked frame with broken pieces	New Frame and Cover, Grout Manhole, Cementitious Liner	3	720	\$4,810	\$820	\$5,630	\$6.68
116	M1	US Rt 1 Bypass	9	PRECAST	Light infiltration at walls and light debris in invert	Grout Manhole	2	288	\$2,000	\$0	\$2,000	\$6.94

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
631	GR1	Oriental Gardens R.O.W.	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
632	GR1	Commerce Way Easement	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
1382	HS15	US Rt 1 Bypass North	11	BLOCK	Active infiltration at wall, roots in corbel, loose bricks and debris on bench. Collapsed pipe connection found during flow isolation. Possible industrial connection/service	Remove and Replace Manhole	4	1,728	\$13,100	\$0	\$13,100	\$7.58
1044	LR5	Ledgewood Drive R.O.W.	5	PRECAST	No bench and invert, heavy debris buildup, active infiltration at wall, frame chipped	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,220	\$3,020	\$5,240	\$7.71
2219	HS14	Borthwick Avenue at Marriot Hotel	6	PRECAST	Mineral deposits at outlet pipe with active infiltration	Grout Manhole, Cementitious Liner	3	288	\$2,220	\$0	\$2,220	\$7.71
92	M1	US Rt 1 Bypass at Cutts Avenue	8	PRECAST	Broken bricks in corbel, Light infiltration at walls	Corbel Repair, Grout Manhole, Cementitious Liner	3	360	\$2,960	\$1,000	\$3,960	\$8.22
916	GR1	Blue Heron Drive Easement	8	BRICK	Roots and infiltration staining at wall	Root Treatment, Grout Manhole, Cementitious Liner	2	360	\$2,960	\$2,200	\$5,160	\$8.22
591	HS15	Essex Avenue and Middle Road	6	BLOCK	No bench and invert, active infiltration at wall, missing mortar from wall, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,590	\$2,200	\$4,790	\$8.99
1307	HS11	Sewall Road	6	PRECAST	Active infiltration at walls, hole in bench, corbel missing mortar, chipped frame	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	3	288	\$2,590	\$3,020	\$5,610	\$8.99
2455	LR3	Nathaniel Drive R.O.W.	7	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	288	\$2,590	\$0	\$2,590	\$8.99
2368	LD1	Albacore Museum Access Pump Station	18	PRECAST	Light infiltration stains at walls	Grout Manhole, Cementitious Liner	3	720	\$6,660	\$0	\$6,660	\$9.25
2657	LR6	White Cedar Boulevard R.O.W.	8	PRECAST	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	360	\$3,330	\$0	\$3,330	\$9.25
813	GR1	Portsmouth Boulevard near Market Street	11	BRICK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	432	\$4,070	\$0	\$4,070	\$9.42
1314	HS11	Sewall Road	8	PRECAST	Chipped cover, active infiltration coming from wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$2,960	\$820	\$3,780	\$10.28
1381	HS11	Hampshire Road	8	BLOCK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$2,960	\$0	\$2,960	\$10.28
1390	HS11	Cate Street	9	BLOCK	Active infiltration and mineral deposits at wall, corbel missing mortar	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
1045	LR5	Ledgewood Drive R.O.W.	8	PRECAST	Infiltration staining and mineral deposits at wall. Active infiltration from wall joints	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
2388	GR1	Woodbury Avenue	13	PRECAST	Mineral deposits, debris buildup in bench and channel. Bricks missing from bench.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	360	\$4,810	\$2,200	\$7,010	\$13.36
1064	LR5	Lafayette Road	11	PRECAST	Active infiltration with mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$4,070	\$0	\$4,070	\$14.13
2635	LR6	Heritage Avenue	12	PRECAST	Active infiltration at wall	Grout Manhole, Cementitious Liner	3	288	\$4,440	\$0	\$4,440	\$15.42
5685	HS15	Sheffield Road	7	BLOCK	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	144	\$2,590	\$0	\$2,590	\$17.99
380	LR4	Greenleaf Woods Drive	14	PRECAST	Chipped frame, Active infiltration with mineral deposits at wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$5,180	\$820	\$6,000	\$17.99
5412	HS14	Barberry Lane Easement	17	PRECAST	Infiltration staining at wall	Grout Manhole, Cementitious Liner	3	360	\$6,660	\$0	\$6,660	\$18.50
1387	HS11	US Bypass 1	12	BLOCK	Roots, Active infiltration and mineral deposits at wall	Root Treatment, Grout Manhole, Cementitious Liner	3	144	\$4,440	\$2,200	\$6,640	\$30.83
5729	GR1	Granite Street R.O.W.	6	PRECAST	Evidence of surcharge, bench and invert not visible due to high water.	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1329	HS11	Brewery Lane	14	PRECAST	No bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1344	HS11	Madison Street at Lovell Street	6	PRECAST	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1397	HS11	Bartlett Street	7	BRICK	Broken and loose bricks on corbel, missing mortar from corbel. No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,390	\$3,390	\$0.00
534	HS14	Coakley Road	10	PARGED	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
541	HS14	Coakley Road	7	BLOCK	Missing mortar in walls, No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,560	\$3,560	\$0.00
563	HS15	Marjorie Street at Middle Road	7	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
577	HS15	Middle Road	8	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
578	HS15	Middle Road	10	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
584	HS15	Hampshire Road	7	BLOCK	No bench and invert, heavy debris buildup, corbel missing mortar	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
586	HS15	Hampshire Road	7	BLOCK	No bench and invert, heavy debris	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
598	HS15	Sims Avenue	9	BRICK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2454	LD1	Dunlin Way	14	PRECAST	No bench and invert, debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2458	LR3	Nathaniel Drive R.O.W.	9	PRECAST	Rocks on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
554	LR4	Middle Road at Leavitt Avenue	5	BLOCK	No bench and invert, heavy debris buildup, corbel blocks missing/deteriorating	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
961	LR4	Middle Road	6	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2501	LR6	Lafayette Road at Blue Fish Boulevard	6	PRECAST	Moderate debris on bench, broken cover	New Frame and Cover, Rebuild Bench	4	0	\$0	\$3,020	\$3,020	\$0.00
2631	LR6	Lafayette Road at Constitution Avenue	8	PRECAST	Broken frame, light debris on bench, bench missing bricks, corbel missing mortar	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
2632	LR6	Lafayette Road at Constitution Avenue	9	PRECAST	Broken frame, light debris on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
93	M1	Cutts Street at Rt 1 Bypass	7	PRECAST	Evidence of surcharge, heavy debris blocking flow, cracked cover	Clean, New Frame and Cover	4	0	\$0	\$1,370	\$1,370	\$0.00
111	M1	Fairview Avenue	4	PRECAST	Cracked cover	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
767	M1	Maplewood Avenue	6	BRICK	No bench and invert, corbel breaking	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
5495	GR1	Osprey Drive Easement	8		Cover broken	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
5271	B1	Victory Road Easement	8	PRECAST	Roots at wall	Root Treatment, Cementitious Liner	3	0	\$0	\$3,730	\$3,730	\$0.00
1432	HS11	Islington Street	8	PRECAST	Light debris on bench, heavy debris in channel	Clean	3	0	\$0	\$550	\$550	\$0.00
5503	HS11	Thaxter Road	9	PRECAST	Evidence of surcharge, moderate debris on bench	Clean	3	0	\$0	\$550	\$550	\$0.00
5550	HS11	Lovell Street R.O.W.	8	PRECAST	Frame and cover below grade	Raise to Surface	3	0	\$0	\$1,100	\$1,100	\$0.00
5855	HS11	Barberry Lane Easement	11	PRECAST	Outside of corbel exposed, moderate debris on bench and invert	Clean, Corbel Repair	3	0	\$0	\$1,550	\$1,550	\$0.00
595	HS15	Essex Avenue	14	BLOCK	Missing mortar from corbel and walls, loose/broken bricks in corbel. Open joint in clay invert.	Corbel Repair, Cementitious Liner	3	0	\$0	\$3,550	\$3,550	\$0.00
1384	HS15	Rt 1 Bypass near Islington Street	12	BLOCK	Deteriorating wall	Cementitious Liner	3	0	\$0	\$2,040	\$2,040	\$0.00
985	LD1	Market Street at Michael Succi Drive	9	PRECAST	Cracked around drop connection, bench separating from base section, rocks on bench	Cementitious Liner	3	0	\$0	\$1,700	\$1,700	\$0.00
2366	LD1	Market Street at Michael Succi Drive	17	PRECAST	Floor Missing Bricks	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2608	LR3	Suzanne Drive	6	PRECAST	Missing mortar from corbel	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
410	LR4	Middle Road at Peverly Hill Road	13	PRECAST	Missing pieces of frame	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
556	LR4	Middle Road	9	BLOCK	Heavy debris on bench and invert, missing mortar from corbel	Clean	3	0	\$0	\$550	\$550	\$0.00

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
387	LR5	Lafayette Drive	9	PRECAST	Chipped frame, broken bricks in corbel	New Frame and Cover, Corbel Repair	3	0	\$0	\$1,820	\$1,820	\$0.00
1062	LR5	Lafayette Road	14	PRECAST	Mineral deposits at wall, Exposed aggregate at MH wall due to H2S, moderate debris in bench and invert	Epoxy Liner	3	0	\$0	\$7,000	\$7,000	\$0.00
1074	LR5	Lafayette Road at Andrew Jarvis Drive	8	PRECAST	Frame and cover below grade	Raise to Surface	3	0	\$0	\$1,100	\$1,100	\$0.00
1075	LR5	Lafayette Road	9	PRECAST	Moderate debris on bench and roots at wall	Cementitious Liner	3	0	\$0	\$1,700	\$1,700	\$0.00
107	LR6	Lafayette Road	6	PRECAST	Light debris buildup, missing mortar at corbel.	Cementitious Liner	3	0	\$0	\$1,020	\$1,020	\$0.00
2479	LR6	Lafayette Road	6	PRECAST	Manhole cover significantly below grade, roots at bench and wall. Debris on bench	Corbel Repair, Root Treatment, Cementitious Liner, Raise to Surface	3	0	\$0	\$5,490	\$5,490	\$0.00
2484	LR6	Lafayette Road at Coach Road	6	PRECAST	Infiltration staining at wall, frame missing piece	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
2499	LR6	Lafayette Road	7	PRECAST	Brick loose on bench, moderate debris on bench. Possible industrial connection/service infiltration.	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2505	LR6	Lafayette Road	7	PRECAST	Moderate debris on bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2511	LR6	Lafayette Road at Longmeadow Road	4	PRECAST	Moderate debris on bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2617	LR6	Lafayette Road	7	PRECAST	Exposed aggregate at MH wall due to H2S. Missing mortar from bench	Epoxy Liner	3	0	\$0	\$4,000	\$4,000	\$0.00
2619	LR6	Lafayette Road at Lang Road	6	PRECAST	Broken invert and bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
106	M1	Maplewood Avenue	7	PRECAST	Cracked cover, corbel missing bricks	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
112	M1	US Rt 1 Bypass	7	PRECAST	Broken and missing bricks in corbel, Light debris in bench and invert	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
113	M1	US Rt 1 Bypass	5	PRECAST	Broken and missing bricks in corbel, Light debris in bench and invert, infiltration stains at walls	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
114	M1	US Rt 1 Bypass at Cutts Street	6	PRECAST	Broken and missing bricks in corbel, Light debris throughout manhole	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
2131	M1	Edmond Avenue	11	PRECAST	Missing mortar and bricks from corbel	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
2169	P2A	TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	3	0	\$0	\$0	\$0	\$0.00
458	B1	Colonial Drive at Worthen Road	7	BRICK	Missing bricks and mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
459	B1	Colonial Drive	6	BRICK	Missing bricks and mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
628	GR1	Oriental Gardens R.O.W.	12	PRECAST	Roots in corbel and wall	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
639	GR1	Portsmouth Boulevard Easement	10	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
640	GR1	Commerce Way	11	PRECAST	Roots and debris on bench	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
643	GR1	Woodbury Avenue	13	PRECAST	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
656	GR1	Woodbury Avenue	6	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
657	GR1	Woodbury Avenue at Arthur Brady Drive	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
658	GR1	Woodbury Avenue	10	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
812	GR1	Granite Street R.O.W.	9	BRICK	Roots and debris on bench	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
817	GR1	Sanderling Way Easement	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
820	GR1	Portsmouth Boulevard at Osprey Drive	5	BRICK	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
823	GR1	Portsmouth Boulevard	7	BRICK	Frame cracked and missing pieces, Roots and debris on bench, corbel missing mortar	New Frame and Cover, Root Treatment	2	0	\$0	\$3,020	\$3,020	\$0.00
824	GR1	Portsmouth Boulevard	8	BRICK	Manhole cover below grade, no bench and invert in manhole. Manhole bottom full of debris, corbel missing bricks and mortar	Clean, Corbel Repair	2	0	\$0	\$1,550	\$1,550	\$0.00
913	GR1	Blue Heron Drive	6	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
915	GR1	Blue Heron Drive near Sanderling Way	9	BRICK	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
917	GR1	Shearwater Drive	9	BRICK	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
921	GR1	Staysail Way	8	BRICK	Missing bricks and mortar from corbel.Possible industrial connection/service infiltration.	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
2372	GR1	Shearwater Drive	10	PRECAST	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2373	GR1	Shearwater Drive	10	PRECAST	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5399	GR1	Sanderling Way	8	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5490	GR1	Shearwater Drive near Portsmouth Boulevard	12	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
529	HS11	Barberry Lane Easement	10	PRECAST	Heavy debris on bench, corbel missing mortar	Clean	2	0	\$0	\$550	\$550	\$0.00
1308	HS11	Fields Road	7	BLOCK	Light debris on bench, chipped frame	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
1310	HS11	Fields Road	8	PRECAST	Crack in wall, frame missing pieces. Possible industrial connection/service infiltration.	New Frame and Cover, Cementitious Liner	2	0	\$0	\$2,180	\$2,180	\$0.00
1389	HS11	US Bypass 1 at rear	11	BRICK	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1441	HS11	Islington Street	9	PRECAST	Bench and invert missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2245	HS11	Islington Street	12	PRECAST	Moderate debris in bench and invert, roots at wall. Brick repair at bottom of MH wall.	Cementitious Liner	2	0	\$0	\$2,210	\$2,210	\$0.00
2253	HS11	Islington Street	9	PRECAST	Bench and invert missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
5530	HS11	Bartlett Street	7	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5531	HS11	Bartlett Street	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5532	HS11	Bartlett Street	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5533	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5535	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5536	HS11	Bartlett Street at Cate Street	8	PRECAST	Broken bricks in corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
5547	HS11	Brewery Lane	15	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5549	HS11	Lovell Street R.O.W.	10	PRECAST	Disconnected drop connection in manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5818	HS11	Aldrich Road	8	PRECAST	Heavy debris in invert	Clean	2	0	\$0	\$550	\$550	\$0.00
523	HS14	Borthwick Avenue	18	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
530	HS14	Borthwick Avenue	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
531	HS14	Coakley Road	6	BLOCK	Heavy debris in bench and invert, missing mortar in wall	Cementitious Liner	2	0	\$0	\$1,190	\$1,190	\$0.00
532	HS14	Coakley Road	7	BLOCK	Loose brick in corbel, missing mortar in wall. Possible industrial connection/service infiltration.	Cementitious Liner	2	0	\$0	\$1,190	\$1,190	\$0.00

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
533	HS14	Coakley Road	10	BLOCK	Missing mortar from wall, light debris on bench. Loose, missing, and broken bricks from corbel	Corbel Repair, Cementitious Liner	2	0	\$0	\$2,870	\$2,870	\$0.00
535	HS14	Larry Lane	5	BLOCK	Missing mortar from corbel and walls, loose bricks in corbel	Corbel Repair, Cementitious Liner	2	0	\$0	\$2,020	\$2,020	\$0.00
537	HS14	Coakley Road	7	BLOCK	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2237	HS14	Larry Lane	6	PRECAST	Loose bricks in corbel, missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
5212	HS14	Borthwick Avenue	6	PRECAST	Moderate debris on bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
5213	HS14	Borthwick Avenue	9	PRECAST	Heavy debris on bench and invert, missing mortar from corbel.Possible industrial connection/service infiltration.	Clean	2	0	\$0	\$550	\$550	\$0.00
5341	HS14	Granite Group parking lot	7	PRECAST	Heavy sediment on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
580	HS15	Sheffield Road	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
581	HS15	Sheffield Road	7	BLOCK	Crack in invert, light debris on bench, broken brick and missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
582	HS15	Sheffield Road	5	BLOCK	Broken and loose bricks on corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
585	HS15	Hampshire Road	7	BLOCK	Moderate debris on bench, broken and loose bricks in corbel	Clean, Corbel Repair	2	0	\$0	\$1,550	\$1,550	\$0.00
592	HS15	Essex Avenue near easement	6	BLOCK	Missing mortar from corbel and walls. Open joint in clay invert.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
596	HS15	Essex Avenue and Melbourne Street	12	BLOCK	Broken frame, missing mortar from corbel, missing mortar from walls	New Frame and Cover, Cementitious Liner	2	0	\$0	\$2,860	\$2,860	\$0.00
601	HS15	Benson Street	4	PRECAST	Missing mortar from corbel. Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2728	HS15	Melbourne Street at Sims Avenue	9	BRICK	Missing bricks and mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5401	HS15	Melbourne Street at Vine Street	5	BRICK	Broken corbel with loose and missing bricks	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
830	LD1	Portsmouth Boulevard R.O.W.	5	BRICK	Light debris in bench and invert, deteriorating corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
836	LD1	Dunlin Way	11	BRICK	Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1014	LD1	Michael Succi Drive	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1015	LD1	Michael Succi Drive	6	PRECAST	Light infiltration stains at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1016	LD1	Michael Succi Drive	8	PRECAST	Roots coming in at bench, moderate debris buildup on bench.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2157	LD1	Dunlin Way R.O.W.	11	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2158	LD1	Dunlin Way R.O.W.	13	PRECAST	Missing bricks in invert, moderate debris buildup	Clean	2	0	\$0	\$550	\$550	\$0.00
2365	LD1	Market Street at Michael Succi Drive	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2367	LD1	Albacore Museum Access Pump Station	16	PRECAST	Cracked and missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
2375	LD1	Michael Succi Drive	9	PRECAST	Light infiltration stains at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2440	LD1	Kearsarge Way R.O.W.	8	PRECAST	Roots at wall and bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2451	LD1	Spinnaker Way R.O.W.	12	PRECAST	Bricks missing from bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1648	LR3	Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1649	LR3	Nathaniel Drive	5	PRECAST	Light debris buildup	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2422	LR3	Nathaniel Drive R.O.W.	10	PRECAST	Rocks on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2431	LR3	Nathaniel Drive R.O.W.	8	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2449	LR3	Nathaniel Drive R.O.W.	5	PRECAST	Loose Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2460	LR3	Nathaniel Drive R.O.W.	7	PRECAST	Rocks on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2551	LR3	Pamela Drive	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2583	LR3	Suzanne Drive	6	PRECAST	Moderate debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
2585	LR3	Suzanne Drive	8	PRECAST	Moderate debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
2591	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2613	LR3	Simmons Road at Suzanne Drive	8	PRECAST	Warped Cover	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
411	LR4	Plains Avenue at Peverly Hill Road	12	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
555	LR4	Middle Road at Woodbury Avenue	8	BLOCK	Heavy debris on bench and invert, moderate roots throughout manhole	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
557	LR4	Middle Road	8	BLOCK	Missing mortar from walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5394	LR4	Holiday Drive	8	PRECAST	Roots at corbel	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
1037	LR5	Ledgewood Drive	7	PRECAST	Missing mortar from corbel, light debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
1040	LR5	Ledgewood Drive	9	PRECAST	Missing mortar and bricks from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
1041	LR5	Portsmouth High School Parking lot	7	PRECAST	Frame cracked. Possible industrial connection/service infiltration.	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
1065	LR5	Lafayette Road	10	PRECAST	Roots at corbel. No channel for pipe connection. Corbel missing brick.	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
117	LR6	Lafayette Road	11	PRECAST	Light debris in channel	Clean	2	0	\$0	\$550	\$550	\$0.00
118	LR6	Lafayette Road	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
132	LR6	Heritage Avenue at Post Road	5	PRECAST	Missing mortar from invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
133	LR6	Post Road	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
150	LR6	Robert Avenue R.O.W.	7	PRECAST	Corroded Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
226	LR6	Constitution Avenue at Lafayette Road	6	PRECAST	Light debris on bench, corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2469	LR6	Lafayette Road	9	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2473	LR6	Lafayette Road	6	PRECAST	Roots in corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2475	LR6	Lafayette Road	7	PRECAST	Moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
2483	LR6	Lafayette Road at Coach Road	8	PRECAST	Light debris on bench, invert not fully visible	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2485	LR6	Lafayette Road at Coach Road	9	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2489	LR6	Lafayette Road at Coach Road	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2493	LR6	Lafayette Road	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2497	LR6	Lafayette Road	7	PRECAST	Light debris in bench and invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2509	LR6	Lafayette Road	6	PRECAST	Missing mortar from corbel, Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2578	LR6	Lafayette Road at Ocean Road	7	PRECAST	Missing mortar from bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2618	LR6	Lafayette Road	8	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2621	LR6	Lafayette Road at Freedom Circle	9	PRECAST	Missing mortar from corbel. Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
2624	LR6	Heritage Avenue at Lafayette Road	11	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2625	LR6	Lafayette Road	14	PRECAST	Cracked frame, bricks missing from bench and invert	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
2626	LR6	Lafayette Road	13	PRECAST	Corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2627	LR6	Lafayette Road	8	PRECAST	Infiltration staining on wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2628	LR6	Lafayette Road	8	PRECAST	Corroded Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2629	LR6	Lafayette Road	7	PRECAST	Debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2630	LR6	Lafayette Road	6	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2639	LR6	Heritage Avenue	6	PRECAST	Chipped frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2644	LR6	Heritage Avenue	8	PRECAST	Bench missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2645	LR6	Heritage Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2658	LR6	White Cedar Boulevard R.O.W.	10	PRECAST	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2661	LR6	Springbrook Circle R.O.W.	11	PRECAST	Roots at corbel and wall	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
89	M1	Alder Way	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
94	M1	Cutts Street	7	PRECAST	Light debris on bench, cracked cover	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
95	M1	Maplewood Avenue at Cutts Street	11	PRECAST	Infiltration staining at walls, missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
96	M1	Maplewood Avenue	12	PRECAST	Moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
97	M1	Maplewood Avenue	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
98	M1	Maplewood Avenue	5	PRECAST	Missing mortar and bricks from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
99	M1	Maplewood Avenue near Rt 95 overpass	6	PRECAST	Light debris on bench, loose bricks and missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
100	M1	Maplewood Avenue	7	PRECAST	Infiltration staining at walls, moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
101	M1	Maplewood Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
103	M1	Maplewood Avenue	11	PRECAST	Loose bricks in corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
104	M1	Maplewood Avenue	8	PRECAST	Loose debris on bench, corbel missing bricks and mortar, loose frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
105	M1	Maplewood Avenue	9	PRECAST	Infiltration staining at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
110	M1	Fairview Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
115	M1	US Rt 1 Bypass	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
759	M1	Fairview Avenue at O'Leary Place	4	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2128	M1	Maplewood Avenue	7	PRECAST	Light debris on bench, corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2129	M1	Maplewood Avenue at Fairview Avenue	9	PRECAST	Missing mortar from corbel, loose frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2359	M1	Maplewood Avenue	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2360	M1	Maplewood Avenue	5	PRECAST	Evidence of surcharge, bench and invert non-existent	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2794	M1	Maplewood Avenue at Cutts Street	12	PRECAST	Light debris in bench and invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5319	M1	O'Leary Place	6	PRECAST	Light debris in manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2165	P2A	FW Hartford Drive	6	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2166	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2170	P2A	FW Hartford Drive	12	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
514	B1	Victory Road	8		Manhole buried	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
633	GR1	Commerce Way Easement	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
634	GR1	Commerce Way Easement	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
815	GR1	Portsmouth Boulevard near Shearwater Drive	14	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
819	GR1	Portsmouth Boulevard at Commerce Way	6	BRICK	Light debris on bench and invert	Clean	1	0	\$0	\$550	\$550	\$0.00
912	GR1	Blue Heron Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
914	GR1	Blue Heron Drive	12	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
919	GR1	Shearwater Drive at Blue Heron Drive	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
922	GR1	Staysail Way	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5307	GR1	Commerce Way R.O.W.	15	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5398	GR1	Blue Heron Drive at Sanderling Way	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5491	GR1	Shearwater Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5492	GR1	Shearwater Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5493	GR1	Sanderling Way	6	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1302	HS11	Fells Road	8	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1305	HS11	Thaxter Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1306	HS11	Thaxter Road	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1309	HS11	Fields Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1325	HS11	Aldrich Road	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1326	HS11	Chevrolet Avenue R.O.W.	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1393	HS11	Cate Street	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1437	HS11	Islington Street at Aldrich Road	10	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1439	HS11	Islington Street at Elm Court	8	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2247	HS11	Ricci Lumber Yard	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2249	HS11	Islington Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2744	HS11	Islington Street	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5534	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5539	HS11	Bartlett Street at Cate Street	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5540	HS11	Islington Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5542	HS11	Islington Street at Bartlett Street	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5544	HS11	Islington Street	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
5545	HS11	Islington Street at Jewell Court	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5546	HS11	Islington Street	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5548	HS11	Brewery Lane	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5551	HS11	Brewery Lane	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5830	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5831	HS11	Cass Street at Lovell Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5834	HS11	Cass Street at Lovell Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5839	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5840	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5844	HS11	Lovell Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
524	HS14	Borthwick Avenue Easement	20	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
527	HS14	Barberry Lane Easement	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
538	HS14	Coakley Road	7	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5342	HS14	Coakley Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5410	HS14	Barberry Lane Easement	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5411	HS14	Barberry Lane Easement	16	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5854	HS14	Barberry Lane Easement	16	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5856	HS14	Barberry Lane Easement	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
594	HS15	Essex Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
597	HS15	Sheffield Road	6	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
837	LD1	Dunlin Way and Osprey Drive	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1017	LD1	Chase Drive at Michael Succi Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2430	LD1	Kearsarge Way R.O.W.	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2444	LD1	Spinnaker Way R.O.W.	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2448	LD1	Spinnaker Way R.O.W.	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2457	LD1	Dunlin Way	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1647	LR3	Nathaniel Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2415	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2419	LR3	Nathaniel Drive R.O.W.	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2427	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2436	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2437	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2441	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2452	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2462	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2464	LR3	Nathaniel Drive R.O.W.	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2466	LR3	Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2534	LR3	Mariette Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2536	LR3	Mariette Drive at Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2538	LR3	Mariette Drive	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2540	LR3	Denise Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2554	LR3	Mariette Drive	17	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2556	LR3	Mariette Drive	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2558	LR3	Mariette Drive	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2560	LR3	Mariette Drive at Ocean Road	17	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2566	LR3	Ocean Road	8		Manhole buried behind home	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2567	LR3	Ocean Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2579	LR3	Suzanne Drive near Ocean Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2581	LR3	Suzanne Drive	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2587	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2589	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2593	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2595	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2597	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2600	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2601	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2607	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2609	LR3	Suzanne Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2610	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2611	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2612	LR3	Simmons Road at Suzanne Drive	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2614	LR3	Simmons Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
558	LR4	Middle Road	8	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
559	LR4	Middle Road	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
560	LR4	Middle Road at entrance of The Chase Home	6	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2208	LR4	Middle Road at The Chase Home	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2209	LR4	Middle Road	15	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
2210	LR4	Middle Road	13	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
381	LR5	Lafayette Drive	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1038	LR5	Ledgewood Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1039	LR5	Ledgewood Drive	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1046	LR5	Ledgewood Drive R.O.W.	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1059	LR5	Lafayette Road	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1060	LR5	Lafayette Road	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1063	LR5	Ledgewood Drive	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1068	LR5	Lafayette Road	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1070	LR5	Lafayette Road at Edgewood Drive	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1071	LR5	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1072	LR5	Lafayette Road at Artwill Avenue	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1073	LR5	Lafayette Road at Andrew Jarvis Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
136	LR6	Heritage Avenue	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
149	LR6	Lafayette Road	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2477	LR6	Lafayette Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2481	LR6	Lafayette Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2491	LR6	Lafayette Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2495	LR6	Lafayette Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2503	LR6	Lafayette Road at Blue Fish Boulevard	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2616	LR6	Lafayette Road at Suzanne Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2620	LR6	Lafayette Road	8		Manhole buried	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2622	LR6	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2623	LR6	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2633	LR6	Lafayette Road	8	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2636	LR6	Heritage Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2637	LR6	Heritage Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2638	LR6	Heritage Avenue	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2641	LR6	Heritage Avenue	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2643	LR6	Heritage Avenue	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2653	LR6	Robert Avenue R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2654	LR6	Robert Avenue R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2655	LR6	White Cedar Boulevard R.O.W.	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2656	LR6	White Cedar Boulevard R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2659	LR6	White Cedar Boulevard R.O.W.	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2660	LR6	Springbrook Circle Parking lot	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
102	M1	Maplewood Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
109	M1	Fairview Avenue	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2130	M1	Edmond Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2132	M1	Maplewood Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
167	P2A	FW Hartford Drive Easement	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
278	P2A	FW Hartford Drive at TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
279	P2A	FW Hartford Drive	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
280	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
281	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
283	P2A	TJ Gamester Avenue	6	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
496	P2A	TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2167	P2A	FW Hartford Drive	11	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2168	P2A	FW Hartford Drive at TJ Gamester Avenue	12	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2405	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2412	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2416	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2420	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2423	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2428	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2432	P2A	FW Hartford Drive	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2438	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2442	P2A	FW Hartford Drive	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2446	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2668	P2A	FW Hartford Drive Easement	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5850	P2A	FW Hartford Road	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
630	GR1	Oriental Gardens R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
637	GR1	Commerce Way	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
641	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
659	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
814	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
825	GR1	Portsmouth Boulevard	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00

Appendix B.1 - Manhole Rehabilitation Recommendations - Infiltration Removal Cost Effectiveness Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
918	GR1	Shearwater Drive R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2374	GR1	Shearwater Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2384	GR1		8		Can not locate manhole. Located on Pease effluent line.	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5494	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5505	GR1	Commerce Way Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1327	HS11	Brewery Avenue R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1328	HS11	Jewell Court R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1333	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1334	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1335	HS11	Albany Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1338	HS11	Cass Street	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1339	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1340	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1394	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1395	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1396	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1434	HS11	Islington Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1440	HS11	Islington Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2243	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2244	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2246	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2251	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2254	HS11	Chevrolet Avenue	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2255	HS11	Chevrolet Avenue	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5096	HS11	Lovell Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5333	HS11	Brewery Avenue R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5537	HS11	Jewell Court	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
588	HS15	Hampshire Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1383	HS15	US Rt 1 Bypass	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1423	HS15	Spinney Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2211	HS15	Hampshire Road R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
600 Duplicate	HS15	Sims Avenue	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
4	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
64	LD1	Market Street R.O.W.	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
65	LD1	Market Street R.O.W.	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
2410	LD1	Michael Succi Drive Railroad Easement	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
2414	LD1	Michael Succi Drive Railroad Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2418	LD1	Michael Succi Drive Railroad Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2426	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2435	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2553	LR3	Pamela Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2562	LR3	Ocean Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2564	LR3	Ocean Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2204	LR4	Greenleaf Woods Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1042	LR5	Portsmouth High School fields	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1043	LR5	Portsmouth High School fields	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1061	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1066	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1067	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1069 Duplicate	LR5	Lafayette Road R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2634	LR6	Lafayette Road	8		Can not locate manhole	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
769	M1	Maplewood Avenue	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2792	M1	Cutts Street at Ashland Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
168	P2A	FW Hartford Drive	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$100	\$100	\$0.00
282	P2A	TJ Gamester Avenue	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$100	\$100	\$0.00



Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
1330	HS11	Brewery Lane	11	PRECAST	Bench and invert gone/broken/sinking, infiltration staining at walls, piece of frame missing	New Frame and Cover, Rebuild Bench, Grout Manhole, Epoxy Liner	5	720	\$2,400	\$9,020	\$11,420	\$3.33
2458	LR3	Nathaniel Drive R.O.W.	9	PRECAST	Rocks on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
2631	LR6	Lafayette Road at Constitution Avenue	8	PRECAST	Broken frame, light debris on bench, bench missing bricks, corbel missing mortar	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
2632	LR6	Lafayette Road at Constitution Avenue	9	PRECAST	Broken frame, light debris on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
111	M1	Fairview Avenue	4	PRECAST	Cracked cover	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
5495	GR1	Osprey Drive Easement	8		Cover broken	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
93	M1	Cutts Street at Rt 1 Bypass	7	PRECAST	Evidence of surcharge, heavy debris blocking flow, cracked cover	Clean, New Frame and Cover	4	0	\$0	\$1,370	\$1,370	\$0.00
5729	GR1	Granite Street R.O.W.	6	PRECAST	Evidence of surcharge, bench and invert not visible due to high water.	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1329	HS11	Brewery Lane	14	PRECAST	No bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1344	HS11	Madison Street at Lovell Street	6	PRECAST	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
534	HS14	Coakley Road	10	PARGED	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
563	HS15	Marjorie Street at Middle Road	7	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
577	HS15	Middle Road	8	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
578	HS15	Middle Road	10	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
584	HS15	Hampshire Road	7	BLOCK	No bench and invert, heavy debris buildup, corbel missing mortar	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
586	HS15	Hampshire Road	7	BLOCK	No bench and invert, heavy debris	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
598	HS15	Sims Avenue	9	BRICK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2454	LD1	Dunlin Way	14	PRECAST	No bench and invert, debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
961	LR4	Middle Road	6	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2501	LR6	Lafayette Road at Blue Fish Boulevard	6	PRECAST	Moderate debris on bench, broken cover	New Frame and Cover, Rebuild Bench	4	0	\$0	\$3,020	\$3,020	\$0.00
554	LR4	Middle Road at Leavitt Avenue	5	BLOCK	No bench and invert, heavy debris buildup, corbel blocks missing/deteriorating	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
767	M1	Maplewood Avenue	6	BRICK	No bench and invert, corbel breaking	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
920	GR1	Shearwater Drive	9	BRICK	Pipe connection leak from north and west pipes. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	10,080	\$3,330	\$0	\$3,330	\$0.33
1397	HS11	Bartlett Street	7	BRICK	Broken and loose bricks on corbel, missing mortar from corbel. No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,390	\$3,390	\$0.00
541	HS14	Coakley Road	7	BLOCK	Missing mortar in walls, No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,560	\$3,560	\$0.00
821	GR1	Osprey Drive	9	BRICK	Manhole walls leaking at 11.6 gpm per flow isolation, no picture taken of infiltration. Also, possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	16,704	\$3,700	\$0	\$3,700	\$0.22
587	HS15	Hampshire Road	10	BLOCK	Mineral deposits at wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole	4	720	\$2,000	\$2,200	\$4,200	\$2.78
5334	GR1	Woodbury Avenue	12	PRECAST	Missing bricks in bench and invert. Light debris buildup in bench and channel. Infiltration staining at wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole	4	720	\$2,400	\$2,200	\$4,600	\$3.33
591	HS15	Essex Avenue and Middle Road	6	BLOCK	No bench and invert, active infiltration at wall, missing mortar from wall, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,590	\$2,200	\$4,790	\$8.99
2248	HS11	Islington Street	8	PRECAST	No bench and invert. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	2,880	\$2,960	\$2,200	\$5,160	\$1.03
377	LR4	Greenleaf Woods Drive	14	PRECAST	Mineral deposits at pipe connections (primary in/out) with active infiltration	Grout Manhole, Cementitious Liner	4	17,280	\$5,180	\$0	\$5,180	\$0.30
1044	LR5	Ledgewood Drive R.O.W.	5	PRECAST	No bench and invert, heavy debris buildup, active infiltration at wall, frame chipped	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,220	\$3,020	\$5,240	\$7.71
2727	HS14	Coakley Road	8	BLOCK	Missing mortar in wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$3,330	\$2,200	\$5,530	\$4.63
2385	GR1	Commerce Way Easement	8	BRICK	Severe infiltration from corbel, surcharging (no bench or invert visible), ponding around frame causing inflow. Located on Pease effluent line.	Corbel Repair, Rebuild Bench, Grout Manhole, Raise to Surface	4	2,880	\$1,600	\$4,300	\$5,900	\$0.56
378	LR4	Greenleaf Woods Drive	15	PRECAST	Active infiltration from wall	Grout Manhole, Cementitious Liner	4	1,440	\$5,920	\$0	\$5,920	\$4.11
818	GR1	Portsmouth Boulevard	10	BLOCK	Active infiltration and mineral deposits at wall, roots	Root Treatment, Grout Manhole, Cementitious Liner	4	7,200	\$4,070	\$2,200	\$6,270	\$0.57
1303	HS11	Thaxter Road at Fells Road	11	BLOCK	Loose bricks in wall, no bench and invert, active infiltration at wall	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,080	\$4,070	\$2,200	\$6,270	\$3.77
2741	HS11	Lovell Street R.O.W.	10	BLOCK	Walls missing mortar, no bench and invert, mineral deposits in incoming line	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,070	\$2,200	\$6,270	\$5.65
2221	HS11	Islington Street	11	BRICK	Active infiltration at wall, bench and invert not visible, corbel missing mortar and cracked	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,080	\$4,440	\$3,200	\$7,640	\$4.11
1331	HS11	Brewery Lane	14	BRICK/STONE	No bench and invert, roots at wall. Large gaps in wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,440	\$5,550	\$2,200	\$7,750	\$3.85
593	HS15	Essex Avenue	12	BLOCK	Broken and missing bricks from wall, loose bricks in corbel, no bench or invert, heavy debris buildup	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,810	\$3,200	\$8,010	\$6.68
1382	HS15	US Rt 1 Bypass North	11	BLOCK	Active infiltration at wall, roots in corbel, loose bricks and debris on bench. Collapsed pipe connection found during flow isolation. Possible industrial connection/service	Remove and Replace Manhole	4	1,728	\$13,100	\$0	\$13,100	\$7.58
2169	P2A	TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	3	0	\$0	\$0	\$0	\$0.00
1432	HS11	Islington Street	8	PRECAST	Light debris on bench, heavy debris in channel	Clean	3	0	\$0	\$550	\$550	\$0.00
5503	HS11	Thaxter Road	9	PRECAST	Evidence of surcharge, moderate debris on bench	Clean	3	0	\$0	\$550	\$550	\$0.00
556	LR4	Middle Road	9	BLOCK	Heavy debris on bench and invert, missing mortar from corbel	Clean	3	0	\$0	\$550	\$550	\$0.00
410	LR4	Middle Road at Peverly Hill Road	13	PRECAST	Missing pieces of frame	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
2484	LR6	Lafayette Road at Coach Road	6	PRECAST	Infiltration staining at wall, frame missing piece	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
106	M1	Maplewood Avenue	7	PRECAST	Cracked cover, corbel missing bricks	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
2608	LR3	Suzanne Drive	6	PRECAST	Missing mortar from corbel	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
112	M1	US Rt 1 Bypass	7	PRECAST	Broken and missing bricks in corbel, Light debris in bench and invert	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
113	M1	US Rt 1 Bypass	5	PRECAST	Broken and missing bricks in corbel, Light debris in bench and invert, infiltration stains at walls	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
114	M1	US Rt 1 Bypass at Cutts Street	6	PRECAST	Broken and missing bricks in corbel, Light debris throughout manhole	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
2131	M1	Edmond Avenue	11	PRECAST	Missing mortar and bricks from corbel	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00

Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
107	LR6	Lafayette Road	6	PRECAST	Light debris buildup, missing mortar at corbel.	Cementitious Liner	3	0	\$0	\$1,020	\$1,020	\$0.00
5550	HS11	Lovell Street R.O.W.	8	PRECAST	Frame and cover below grade	Raise to Surface	3	0	\$0	\$1,100	\$1,100	\$0.00
1074	LR5	Lafayette Road at Andrew Jarvis Drive	8	PRECAST	Frame and cover below grade	Raise to Surface	3	0	\$0	\$1,100	\$1,100	\$0.00
5855	HS11	Barberry Lane Easement	11	PRECAST	Outside of corbel exposed, moderate debris on bench and invert	Clean, Corbel Repair	3	0	\$0	\$1,550	\$1,550	\$0.00
985	LD1	Market Street at Michael Succi Drive	9	PRECAST	Cracked around drop connection, bench separating from base section, rocks on bench	Cementitious Liner	3	0	\$0	\$1,700	\$1,700	\$0.00
1075	LR5	Lafayette Road	9	PRECAST	Moderate debris on bench and roots at wall	Cementitious Liner	3	0	\$0	\$1,700	\$1,700	\$0.00
387	LR5	Lafayette Drive	9	PRECAST	Chipped frame, broken bricks in corbel	New Frame and Cover, Corbel Repair	3	0	\$0	\$1,820	\$1,820	\$0.00
1646	LR3	Nathaniel Drive R.O.W.	5	PRECAST	Wall leaks, hole in wall at connection to bench	Grout Manhole, Cementitious Liner	3	2,880	\$1,850	\$0	\$1,850	\$0.64
1384	HS15	Rt 1 Bypass near Islington Street	12	BLOCK	Deteriorating wall	Cementitious Liner	3	0	\$0	\$2,040	\$2,040	\$0.00
2366	LD1	Market Street at Michael Succi Drive	17	PRECAST	Floor Missing Bricks	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2499	LR6	Lafayette Road	7	PRECAST	Brick loose on bench, moderate debris on bench. Possible industrial connection/service infiltration.	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2505	LR6	Lafayette Road	7	PRECAST	Moderate debris on bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2511	LR6	Lafayette Road at Longmeadow Road	4	PRECAST	Moderate debris on bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2619	LR6	Lafayette Road at Lang Road	6	PRECAST	Broken invert and bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2646	LR6	Robert Avenue	6	PRECAST	Mineral deposits at wall and void visible at outgoing pipe connection	Grout Manhole, Cementitious Liner	3	5,040	\$2,220	\$0	\$2,220	\$0.44
2219	HS14	Borthwick Avenue at Marriot Hotel	6	PRECAST	Mineral deposits at outlet pipe with active infiltration	Grout Manhole, Cementitious Liner	3	288	\$2,220	\$0	\$2,220	\$7.71
2471	LR6	Lafayette Road	6	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	720	\$2,590	\$0	\$2,590	\$3.60
2455	LR3	Nathaniel Drive R.O.W.	7	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	288	\$2,590	\$0	\$2,590	\$8.99
5685	HS15	Sheffield Road	7	BLOCK	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	144	\$2,590	\$0	\$2,590	\$17.99
1311	HS11	Fields Road and Sewall Road	7	BLOCK	Moderate debris in bench and invert, active infiltration from wall	Grout Manhole, Cementitious Liner	3	1,440	\$2,960	\$0	\$2,960	\$2.06
1381	HS11	Hampshire Road	8	BLOCK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$2,960	\$0	\$2,960	\$10.28
406	LR4	Peverly Hill Road	7	PRECAST	Incoming and outgoing pipe connection leaks.	Grout Manhole, Cementitious Liner	3	2,232	\$2,960	\$0	\$2,960	\$1.33
816	GR1	Portsmouth Boulevard	8	BRICK	Mineral deposits at wall. Pipe connection leak.	Grout Manhole, Cementitious Liner	3	7,200	\$3,330	\$0	\$3,330	\$0.46
942	LD1	Spinnaker Way	9	BRICK	Mineral deposits at bench and invert, roots in corbel. Walls weeping during MH Inspection. Active infiltration during flow isolation.	Grout Manhole, Cementitious Liner	3	2,880	\$3,330	\$0	\$3,330	\$1.16
1315	HS11	Sewall Road at Spinney Road	9	PRECAST	Faulty drop connection in manhole, light debris on bench and invert, walls weeping at joints	Grout Manhole, Cementitious Liner	3	1,728	\$3,330	\$0	\$3,330	\$1.93
2657	LR6	White Cedar Boulevard R.O.W.	8	PRECAST	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	360	\$3,330	\$0	\$3,330	\$9.25
1390	HS11	Cate Street	9	BLOCK	Active infiltration and mineral deposits at wall, corbel missing mortar	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
1045	LR5	Ledgewood Drive R.O.W.	8	PRECAST	Infiltration staining and mineral deposits at wall. Active infiltration from wall joints	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
407	LR4	Peverly Hill Road at McClintock Avenue	8	PRECAST	Outgoing pipe connection leak.	Grout Manhole, Cementitious Liner	3	1,440	\$3,330	\$0	\$3,330	\$2.31
595	HS15	Essex Avenue	14	BLOCK	Missing mortar from corbel and walls, loose/broken bricks in corbel. Open joint in clay invert.	Corbel Repair, Cementitious Liner	3	0	\$0	\$3,550	\$3,550	\$0.00
5316	HS14	Barberry Lane Easement	7	PRECAST	Active infiltration and mineral deposits at wall, corbel missing mortar	Corbel Repair, Grout Manhole, Cementitious Liner	3	2,160	\$2,590	\$1,000	\$3,590	\$1.20
2642	LR6	Heritage Avenue	9	PRECAST	Light Infiltration observed at walls, mineral deposits	Grout Manhole, Cementitious Liner	3	1,440	\$3,700	\$0	\$3,700	\$2.57
5271	B1	Victory Road Easement	8	PRECAST	Roots at wall	Root Treatment, Cementitious Liner	3	0	\$0	\$3,730	\$3,730	\$0.00
2445	LR3	Nathaniel Drive R.O.W.	8	PRECAST	Light infiltration stains at walls, cracked cover	New Frame and Cover, Grout Manhole, Cementitious Liner	3	2,880	\$2,960	\$820	\$3,780	\$1.03
1314	HS11	Sewall Road	8	PRECAST	Chipped cover, active infiltration coming from wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$2,960	\$820	\$3,780	\$10.28
92	M1	US Rt 1 Bypass at Cutts Avenue	8	PRECAST	Broken bricks in corbel, Light infiltration at walls	Corbel Repair, Grout Manhole, Cementitious Liner	3	360	\$2,960	\$1,000	\$3,960	\$8.22
397	LR4	Greenleaf Avenue	8	PRECAST	Corbel missing bricks and mortar, light debris on bench. 6 gpm leak observed during flow isolation.	Corbel Repair, Grout Manhole, Cementitious Liner	3	8,640	\$2,960	\$1,000	\$3,960	\$0.34
2617	LR6	Lafayette Road	7	PRECAST	Exposed aggregate at MH wall due to H2S. Missing mortar from bench	Epoxy Liner	3	0	\$0	\$4,000	\$4,000	\$0.00
813	GR1	Portsmouth Boulevard near Market Street	11	BRICK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	432	\$4,070	\$0	\$4,070	\$9.42
1064	LR5	Lafayette Road	11	PRECAST	Active infiltration with mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$4,070	\$0	\$4,070	\$14.13
2635	LR6	Heritage Avenue	12	PRECAST	Active infiltration at wall	Grout Manhole, Cementitious Liner	3	288	\$4,440	\$0	\$4,440	\$15.42
540	HS14	Coakley Road	8	BLOCK	Moderate debris on bench, broken frame, loose and broken bricks from corbel, missing mortar from walls	New Frame and Cover, Corbel Repair, Grout Manhole, Cementitious Liner	3	720	\$2,960	\$1,820	\$4,780	\$4.11
396	LR4	Greenleaf Woods Drive	7	PRECAST	Incoming pipe connection leak, voids visible around inlet and outlet pipe connections.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	9,360	\$2,590	\$2,200	\$4,790	\$0.28
642	GR1	Woodbury Avenue	11	PRECAST	Missing bricks and mortar from corbel, Mineral deposits at wall, debris buildup in bench.	Corbel Repair, Grout Manhole, Cementitious Liner	3	1,440	\$4,070	\$1,000	\$5,070	\$2.83
5819	HS11	Aldrich Road at Aldrich Court	8	PRECAST	Incoming pipe connection leak (estimated at 2 gpm)	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1,800	\$2,960	\$2,200	\$5,160	\$1.64
2479	LR6	Lafayette Road	6	PRECAST	Manhole cover significantly below grade, roots at bench and wall. Debris on bench	Corbel Repair, Root Treatment, Cementitious Liner, Raise to Surface	3	0	\$0	\$5,490	\$5,490	\$0.00
2386	GR1	Commerce Way Easement	9	BRICK	Roots in corbel, Active infiltration with mineral deposits at wall, heavy debris in invert. Located on Pease effluent line.	Root Treatment, Grout Manhole, Cementitious Liner	3	1,440	\$3,330	\$2,200	\$5,530	\$2.31
1307	HS11	Sewall Road	6	PRECAST	Active infiltration at walls, hole in bench, corbel missing mortar, chipped frame	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	3	288	\$2,590	\$3,020	\$5,610	\$8.99
5332	GR1	Commerce Way	13	PRECAST	Active infiltration at walls, cracked frame with broken pieces	New Frame and Cover, Grout Manhole, Cementitious Liner	3	720	\$4,810	\$820	\$5,630	\$6.68
2362	LD1	Kearsarge Road at Market Street	10	PRECAST	Invert leak. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1,440	\$3,700	\$2,200	\$5,900	\$2.57
380	LR4	Greenleaf Woods Drive	14	PRECAST	Chipped frame, Active infiltration with mineral deposits at wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$5,180	\$820	\$6,000	\$17.99
1387	HS11	US Bypass 1	12	BLOCK	Roots, Active infiltration and mineral deposits at wall	Root Treatment, Grout Manhole, Cementitious Liner	3	144	\$4,440	\$2,200	\$6,640	\$30.83
2368	LD1	Albacore Museum Access Pump Station	18	PRECAST	Light infiltration stains at walls	Grout Manhole, Cementitious Liner	3	720	\$6,660	\$0	\$6,660	\$9.25
5412	HS14	Barberry Lane Easement	17	PRECAST	Infiltration staining at wall	Grout Manhole, Cementitious Liner	3	360	\$6,660	\$0	\$6,660	\$18.50

Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
1062	LR5	Lafayette Road	14	PRECAST	Mineral deposits at wall, Exposed aggregate at MH wall due to H2S, moderate debris in bench and invert	Epoxy Liner	3	0	\$0	\$7,000	\$7,000	\$0.00
2388	GR1	Woodbury Avenue	13	PRECAST	Mineral deposits, debris buildup in bench and channel. Bricks missing from bench.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	360	\$4,810	\$2,200	\$7,010	\$13.36
629	GR1	Oriental Gardens R.O.W.	11	PRECAST	Heavy mineral deposits, aggregate visible at wall due to H2S	Grout Manhole, Epoxy Liner	3	1,440	\$2,200	\$5,500	\$7,700	\$1.53
639	GR1	Portsmouth Boulevard Easement	10	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
643	GR1	Woodbury Avenue	13	PRECAST	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
656	GR1	Woodbury Avenue	6	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
657	GR1	Woodbury Avenue at Arthur Brady Drive	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
658	GR1	Woodbury Avenue	10	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
817	GR1	Sanderling Way Easement	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
820	GR1	Portsmouth Boulevard at Osprey Drive	5	BRICK	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
913	GR1	Blue Heron Drive	6	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
915	GR1	Blue Heron Drive near Sanderling Way	9	BRICK	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
917	GR1	Shearwater Drive	9	BRICK	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2372	GR1	Shearwater Drive	10	PRECAST	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2373	GR1	Shearwater Drive	10	PRECAST	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5399	GR1	Sanderling Way	8	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5490	GR1	Shearwater Drive near Portsmouth Boulevard	12	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1389	HS11	US Bypass 1 at rear	11	BRICK	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5530	HS11	Bartlett Street	7	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5531	HS11	Bartlett Street	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5532	HS11	Bartlett Street	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5533	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5535	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5547	HS11	Brewery Lane	15	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5549	HS11	Lovell Street R.O.W.	10	PRECAST	Disconnected drop connection in manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
523	HS14	Borthwick Avenue	18	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
530	HS14	Borthwick Avenue	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
537	HS14	Coakley Road	7	BLOCK	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
580	HS15	Sheffield Road	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
592	HS15	Essex Avenue near easement	6	BLOCK	Missing mortar from corbel and walls. Open joint in clay invert.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
601	HS15	Benson Street	4	PRECAST	Missing mortar from corbel. Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2728	HS15	Melbourne Street at Sims Avenue	9	BRICK	Missing bricks and mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
830	LD1	Portsmouth Boulevard R.O.W.	5	BRICK	Light debris in bench and invert, deteriorating corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
836	LD1	Dunlin Way	11	BRICK	Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1014	LD1	Michael Succi Drive	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1015	LD1	Michael Succi Drive	6	PRECAST	Light infiltration stains at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1016	LD1	Michael Succi Drive	8	PRECAST	Roots coming in at bench, moderate debris buildup on bench.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2157	LD1	Dunlin Way R.O.W.	11	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2365	LD1	Market Street at Michael Succi Drive	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2375	LD1	Michael Succi Drive	9	PRECAST	Light infiltration stains at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2440	LD1	Kearsarge Way R.O.W.	8	PRECAST	Roots at wall and bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2451	LD1	Spinnaker Way R.O.W.	12	PRECAST	Bricks missing from bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1648	LR3	Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1649	LR3	Nathaniel Drive	5	PRECAST	Light debris buildup	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2422	LR3	Nathaniel Drive R.O.W.	10	PRECAST	Rocks on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2431	LR3	Nathaniel Drive R.O.W.	8	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2449	LR3	Nathaniel Drive R.O.W.	5	PRECAST	Loose Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2460	LR3	Nathaniel Drive R.O.W.	7	PRECAST	Rocks on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2551	LR3	Pamela Drive	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2591	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
411	LR4	Plains Avenue at Peverly Hill Road	12	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
557	LR4	Middle Road	8	BLOCK	Missing mortar from walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
118	LR6	Lafayette Road	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
132	LR6	Heritage Avenue at Post Road	5	PRECAST	Missing mortar from invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
133	LR6	Post Road	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
150	LR6	Robert Avenue R.O.W.	7	PRECAST	Corroded Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
226	LR6	Constitution Avenue at Lafayette Road	6	PRECAST	Light debris on bench, corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2469	LR6	Lafayette Road	9	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2473	LR6	Lafayette Road	6	PRECAST	Roots in corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2483	LR6	Lafayette Road at Coach Road	8	PRECAST	Light debris on bench, invert not fully visible	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2485	LR6	Lafayette Road at Coach Road	9	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2489	LR6	Lafayette Road at Coach Road	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2493	LR6	Lafayette Road	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2497	LR6	Lafayette Road	7	PRECAST	Light debris in bench and invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2509	LR6	Lafayette Road	6	PRECAST	Missing mortar from corbel, Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2578	LR6	Lafayette Road at Ocean Road	7	PRECAST	Missing mortar from bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00

Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
2618	LR6	Lafayette Road	8	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2621	LR6	Lafayette Road at Freedom Circle	9	PRECAST	Missing mortar from corbel. Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2624	LR6	Heritage Avenue at Lafayette Road	11	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2626	LR6	Lafayette Road	13	PRECAST	Corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2627	LR6	Lafayette Road	8	PRECAST	Infiltration staining on wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2628	LR6	Lafayette Road	8	PRECAST	Corroded Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2629	LR6	Lafayette Road	7	PRECAST	Debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2630	LR6	Lafayette Road	6	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2639	LR6	Heritage Avenue	6	PRECAST	Chipped frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2645	LR6	Heritage Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2658	LR6	White Cedar Boulevard R.O.W.	10	PRECAST	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
89	M1	Alder Way	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
95	M1	Maplewood Avenue at Cutts Street	11	PRECAST	Infiltration staining at walls, missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
97	M1	Maplewood Avenue	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
98	M1	Maplewood Avenue	5	PRECAST	Missing mortar and bricks from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
99	M1	Maplewood Avenue near Rt 95 overpass	6	PRECAST	Light debris on bench, loose bricks and missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
101	M1	Maplewood Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
103	M1	Maplewood Avenue	11	PRECAST	Loose bricks in corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
104	M1	Maplewood Avenue	8	PRECAST	Loose debris on bench, corbel missing bricks and mortar, loose frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
105	M1	Maplewood Avenue	9	PRECAST	Infiltration staining at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
110	M1	Fairview Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
115	M1	US Rt 1 Bypass	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
759	M1	Fairview Avenue at O'Leary Place	4	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2128	M1	Maplewood Avenue	7	PRECAST	Light debris on bench, corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2129	M1	Maplewood Avenue at Fairview Avenue	9	PRECAST	Missing mortar from corbel, loose frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2359	M1	Maplewood Avenue	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2794	M1	Maplewood Avenue at Cutts Street	12	PRECAST	Light debris in bench and invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5319	M1	O'Leary Place	6	PRECAST	Light debris in manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2165	P2A	FW Hartford Drive	6	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2166	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2170	P2A	FW Hartford Drive	12	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
529	HS11	Barberry Lane Easement	10	PRECAST	Heavy debris on bench, corbel missing mortar	Clean	2	0	\$0	\$550	\$550	\$0.00
5818	HS11	Aldrich Road	8	PRECAST	Heavy debris in invert	Clean	2	0	\$0	\$550	\$550	\$0.00
5212	HS14	Borthwick Avenue	6	PRECAST	Moderate debris on bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
5213	HS14	Borthwick Avenue	9	PRECAST	Heavy debris on bench and invert, missing mortar from corbel.Possible industrial connection/service infiltration.	Clean	2	0	\$0	\$550	\$550	\$0.00
5341	HS14	Granite Group parking lot	7	PRECAST	Heavy sediment on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
2158	LD1	Dunlin Way R.O.W.	13	PRECAST	Missing bricks in invert, moderate debris buildup	Clean	2	0	\$0	\$550	\$550	\$0.00
2583	LR3	Suzanne Drive	6	PRECAST	Moderate debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
2585	LR3	Suzanne Drive	8	PRECAST	Moderate debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
1037	LR5	Ledgewood Drive	7	PRECAST	Missing mortar from corbel, light debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
117	LR6	Lafayette Road	11	PRECAST	Light debris in channel	Clean	2	0	\$0	\$550	\$550	\$0.00
2475	LR6	Lafayette Road	7	PRECAST	Moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
96	M1	Maplewood Avenue	12	PRECAST	Moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
100	M1	Maplewood Avenue	7	PRECAST	Infiltration staining at walls, moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
1308	HS11	Fields Road	7	BLOCK	Light debris on bench, chipped frame	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
2613	LR3	Simmons Road at Suzanne Drive	8	PRECAST	Warped Cover	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
1041	LR5	Portsmouth High School Parking lot	7	PRECAST	Frame cracked. Possible industrial connection/service infiltration.	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
2625	LR6	Lafayette Road	14	PRECAST	Cracked frame, bricks missing from bench and invert	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
94	M1	Cutts Street	7	PRECAST	Light debris on bench, cracked cover	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
458	B1	Colonial Drive at Worthen Road	7	BRICK	Missing bricks and mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
459	B1	Colonial Drive	6	BRICK	Missing bricks and mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
921	GR1	Staysail Way	8	BRICK	Missing bricks and mortar from corbel.Possible industrial connection/service infiltration.	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
5536	HS11	Bartlett Street at Cate Street	8	PRECAST	Broken bricks in corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
2237	HS14	Larry Lane	6	PRECAST	Loose bricks in corbel, missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
581	HS15	Sheffield Road	7	BLOCK	Crack in invert, light debris on bench, broken brick and missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
582	HS15	Sheffield Road	5	BLOCK	Broken and loose bricks on corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
5401	HS15	Melbourne Street at Vine Street	5	BRICK	Broken corbel with loose and missing bricks	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
2367	LD1	Albacore Museum Access Pump Station	16	PRECAST	Cracked and missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
1040	LR5	Ledgewood Drive	9	PRECAST	Missing mortar and bricks from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
531	HS14	Coakley Road	6	BLOCK	Heavy debris in bench and invert, missing mortar in wall	Cementitious Liner	2	0	\$0	\$1,190	\$1,190	\$0.00
532	HS14	Coakley Road	7	BLOCK	Loose brick in corbel, missing mortar in wall. Possible industrial connection/service infiltration.	Cementitious Liner	2	0	\$0	\$1,190	\$1,190	\$0.00
1392	HS11	Cate Street	5	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$1,200	\$0	\$1,200	\$3.33
824	GR1	Portsmouth Boulevard	8	BRICK	Manhole cover below grade, no bench and invert in manhole. Manhole bottom full of debris, corbel missing bricks and mortar	Clean, Corbel Repair	2	0	\$0	\$1,550	\$1,550	\$0.00
585	HS15	Hampshire Road	7	BLOCK	Moderate debris on bench, broken and loose bricks in corbel	Clean, Corbel Repair	2	0	\$0	\$1,550	\$1,550	\$0.00

Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
599	HS15	Sims Avenue at Benson Street	8	PRECAST	Infiltration at manhole wall	Grout Manhole	2	720	\$1,800	\$0	\$1,800	\$2.50
2483	LR6	Lafayette Road at Coach Road	8	PRECAST	Light infiltration at manhole wall	Grout Manhole	2	288	\$1,800	\$0	\$1,800	\$6.25
116	M1	US Rt 1 Bypass	9	PRECAST	Light infiltration at walls and light debris in invert	Grout Manhole	2	288	\$2,000	\$0	\$2,000	\$6.94
535	HS14	Larry Lane	5	BLOCK	Missing mortar from corbel and walls, loose bricks in corbel	Corbel Repair, Cementitious Liner	2	0	\$0	\$2,020	\$2,020	\$0.00
1310	HS11	Fields Road	8	PRECAST	Crack in wall, frame missing pieces. Possible industrial connection/service infiltration.	New Frame and Cover, Cementitious Liner	2	0	\$0	\$2,180	\$2,180	\$0.00
628	GR1	Oriental Gardens R.O.W.	12	PRECAST	Roots in corbel and wall	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
640	GR1	Commerce Way	11	PRECAST	Roots and debris on bench	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
812	GR1	Granite Street R.O.W.	9	BRICK	Roots and debris on bench	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
1441	HS11	Islington Street	9	PRECAST	Bench and invert missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2253	HS11	Islington Street	9	PRECAST	Bench and invert missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
555	LR4	Middle Road at Woodbury Avenue	8	BLOCK	Heavy debris on bench and invert, moderate roots throughout manhole	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
5394	LR4	Holiday Drive	8	PRECAST	Roots at corbel	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
1065	LR5	Lafayette Road	10	PRECAST	Roots at corbel. No channel for pipe connection. Corbel missing brick.	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2644	LR6	Heritage Avenue	8	PRECAST	Bench missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2661	LR6	Springbrook Circle R.O.W.	11	PRECAST	Roots at corbel and wall	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
2360	M1	Maplewood Avenue	5	PRECAST	Evidence of surcharge, bench and invert non-existent	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2245	HS11	Islington Street	12	PRECAST	Moderate debris in bench and invert, roots at wall. Brick repair at bottom of MH wall.	Cementitious Liner	2	0	\$0	\$2,210	\$2,210	\$0.00
1388	HS11	US Bypass 1 at rear	11	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$2,400	\$0	\$2,400	\$6.67
2507	LR6	Lafayette Road	6	PRECAST	Infiltration at bench/wall connection	Grout Manhole, Cementitious Liner	2	432	\$2,590	\$0	\$2,590	\$6.00
631	GR1	Oriental Gardens R.O.W.	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
632	GR1	Commerce Way Easement	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
108	M1	Edmund Avenue near Fairview Avenue	8	PRECAST	Cracked cover	New Frame and Cover, Grout Manhole	2	360	\$1,800	\$820	\$2,620	\$5.00
596	HS15	Essex Avenue and Melbourne Street	12	BLOCK	Broken frame, missing mortar from corbel, missing mortar from walls	New Frame and Cover, Cementitious Liner	2	0	\$0	\$2,860	\$2,860	\$0.00
533	HS14	Coakley Road	10	BLOCK	Missing mortar from wall, light debris on bench. Loose, missing, and broken bricks from corbel	Corbel Repair, Cementitious Liner	2	0	\$0	\$2,870	\$2,870	\$0.00
823	GR1	Portsmouth Boulevard	7	BRICK	Frame cracked and missing pieces, Roots and debris on bench, corbel missing mortar	New Frame and Cover, Root Treatment	2	0	\$0	\$3,020	\$3,020	\$0.00
2487	LR6	Lafayette Road at Coach Road	8	PRECAST	Light debris on bench and invert. Infiltration at bench/wall connection. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	2	2,520	\$3,330	\$0	\$3,330	\$1.32
638	GR1	Commerce Way	16	PRECAST	Infiltration staining	Grout Manhole	2	720	\$3,400	\$0	\$3,400	\$4.72
17	LD1	Portsmouth Boulevard R.O.W.	7	PRECAST	Missing mortar from corbel with roots in corbel. Infiltration at pipe connection.	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$2,960	\$1,000	\$3,960	\$4.11
460	B1	Victory Road	8	BRICK	Roots at wall, corbel has broken bricks and missing mortar	Corbel Repair, Root Treatment, Grout Manhole	2	720	\$1,800	\$3,200	\$5,000	\$2.50
5852	GR1	Portsmouth Boulevard Easement	11	PRECAST	Mineral deposits at bench, broken bricks and missing mortar from corbel	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$4,070	\$1,000	\$5,070	\$5.65
916	GR1	Blue Heron Drive Easement	8	BRICK	Roots and infiltration staining at wall	Root Treatment, Grout Manhole, Cementitious Liner	2	360	\$2,960	\$2,200	\$5,160	\$8.22
2387	GR1	Woodbury Avenue	12	PRECAST	Infiltration staining at wall, aggregate visible at wall due to H2S. Located on Pease effluent line.	Grout Manhole, Epoxy Liner	2	360	\$2,400	\$6,000	\$8,400	\$6.67
633	GR1	Commerce Way Easement	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
634	GR1	Commerce Way Easement	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
815	GR1	Portsmouth Boulevard near Shearwater Drive	14	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
912	GR1	Blue Heron Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
914	GR1	Blue Heron Drive	12	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
919	GR1	Shearwater Drive at Blue Heron Drive	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
922	GR1	Staysail Way	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5307	GR1	Commerce Way R.O.W.	15	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5398	GR1	Blue Heron Drive at Sanderling Way	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5491	GR1	Shearwater Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5492	GR1	Shearwater Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5493	GR1	Sanderling Way	6	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1302	HS11	Fells Road	8	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1305	HS11	Thaxter Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1306	HS11	Thaxter Road	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1309	HS11	Fields Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1325	HS11	Aldrich Road	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1326	HS11	Chevrolet Avenue R.O.W.	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1393	HS11	Cate Street	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1437	HS11	Islington Street at Aldrich Road	10	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1439	HS11	Islington Street at Elm Court	8	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2247	HS11	Ricci Lumber Yard	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2249	HS11	Islington Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2744	HS11	Islington Street	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5534	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5539	HS11	Bartlett Street at Cate Street	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5540	HS11	Islington Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5542	HS11	Islington Street at Bartlett Street	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5544	HS11	Islington Street	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5545	HS11	Islington Street at Jewell Court	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5546	HS11	Islington Street	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5548	HS11	Brewery Lane	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00

Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
5551	HS11	Brewery Lane	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5830	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5831	HS11	Cass Street at Lovell Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5834	HS11	Cass Street at Lovell Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5839	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5840	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5844	HS11	Lovell Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
524	HS14	Borthwick Avenue Easement	20	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
527	HS14	Barberry Lane Easement	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
538	HS14	Coakley Road	7	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5342	HS14	Coakley Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5410	HS14	Barberry Lane Easement	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5411	HS14	Barberry Lane Easement	16	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5854	HS14	Barberry Lane Easement	16	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5856	HS14	Barberry Lane Easement	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
594	HS15	Essex Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
597	HS15	Sheffield Road	6	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
837	LD1	Dunlin Way and Osprey Drive	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1017	LD1	Chase Drive at Michael Succi Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2430	LD1	Kearsarge Way R.O.W.	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2444	LD1	Spinnaker Way R.O.W.	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2448	LD1	Spinnaker Way R.O.W.	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2457	LD1	Dunlin Way	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1647	LR3	Nathaniel Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2415	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2419	LR3	Nathaniel Drive R.O.W.	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2427	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2436	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2437	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2441	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2452	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2462	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2464	LR3	Nathaniel Drive R.O.W.	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2466	LR3	Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2534	LR3	Mariette Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2536	LR3	Mariette Drive at Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2538	LR3	Mariette Drive	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2540	LR3	Denise Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2554	LR3	Mariette Drive	17	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2556	LR3	Mariette Drive	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2558	LR3	Mariette Drive	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2560	LR3	Mariette Drive at Ocean Road	17	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2567	LR3	Ocean Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2579	LR3	Suzanne Drive near Ocean Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2581	LR3	Suzanne Drive	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2587	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2589	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2593	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2595	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2597	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2600	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2601	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2607	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2609	LR3	Suzanne Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2610	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2611	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2612	LR3	Simmons Road at Suzanne Drive	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2614	LR3	Simmons Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
558	LR4	Middle Road	8	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
559	LR4	Middle Road	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
560	LR4	Middle Road at entrance of The Chase Home	6	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2208	LR4	Middle Road at The Chase Home	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2209	LR4	Middle Road	15	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2210	LR4	Middle Road	13	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
381	LR5	Lafayette Drive	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1038	LR5	Ledgewood Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1039	LR5	Ledgewood Drive	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00

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MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
1046	LR5	Ledgewood Drive R.O.W.	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1059	LR5	Lafayette Road	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1060	LR5	Lafayette Road	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1063	LR5	Ledgewood Drive	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1068	LR5	Lafayette Road	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1070	LR5	Lafayette Road at Edgewood Drive	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1071	LR5	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1072	LR5	Lafayette Road at Artwill Avenue	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1073	LR5	Lafayette Road at Andrew Jarvis Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
136	LR6	Heritage Avenue	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
149	LR6	Lafayette Road	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2477	LR6	Lafayette Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2481	LR6	Lafayette Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2491	LR6	Lafayette Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2495	LR6	Lafayette Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2503	LR6	Lafayette Road at Blue Fish Boulevard	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2616	LR6	Lafayette Road at Suzanne Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2622	LR6	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2623	LR6	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2633	LR6	Lafayette Road	8	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2636	LR6	Heritage Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2637	LR6	Heritage Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2638	LR6	Heritage Avenue	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2641	LR6	Heritage Avenue	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2643	LR6	Heritage Avenue	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2653	LR6	Robert Avenue R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2654	LR6	Robert Avenue R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2655	LR6	White Cedar Boulevard R.O.W.	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2656	LR6	White Cedar Boulevard R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2659	LR6	White Cedar Boulevard R.O.W.	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2660	LR6	Springbrook Circle Parking lot	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
102	M1	Maplewood Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
109	M1	Fairview Avenue	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2130	M1	Edmond Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2132	M1	Maplewood Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
167	P2A	FW Hartford Drive Easement	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
278	P2A	FW Hartford Drive at TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
279	P2A	FW Hartford Drive	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
280	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
281	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
283	P2A	TJ Gamester Avenue	6	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
496	P2A	TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2167	P2A	FW Hartford Drive	11	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2168	P2A	FW Hartford Drive at TJ Gamester Avenue	12	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2405	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2412	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2416	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2420	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2423	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2428	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2432	P2A	FW Hartford Drive	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2438	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2442	P2A	FW Hartford Drive	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2446	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2668	P2A	FW Hartford Drive Easement	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5850	P2A	FW Hartford Road	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1338	HS11	Cass Street	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1339	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1340	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2251	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2254	HS11	Chevrolet Avenue	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2255	HS11	Chevrolet Avenue	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5096	HS11	Lovell Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
630	GR1	Oriental Gardens R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
637	GR1	Commerce Way	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
641	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
659	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00

Appendix B.2 - Manhole Rehabilitation Recommendations - Max Defect Score Prioritization												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
814	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
825	GR1	Portsmouth Boulevard	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
918	GR1	Shearwater Drive R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2374	GR1	Shearwater Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2384	GR1		8		Can not locate manhole. Located on Pease effluent line.	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5494	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5505	GR1	Commerce Way Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1327	HS11	Brewery Avenue R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1328	HS11	Jewell Court R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1333	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1334	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1335	HS11	Albany Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1394	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1395	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1396	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1434	HS11	Islington Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1440	HS11	Islington Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2243	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2244	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2246	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5333	HS11	Brewery Avenue R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5537	HS11	Jewell Court	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
588	HS15	Hampshire Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1383	HS15	US Rt 1 Bypass	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1423	HS15	Spinney Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2211	HS15	Hampshire Road R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
600 Duplicate	HS15	Sims Avenue	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
4	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2414	LD1	Michael Succi Drive Railroad Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2418	LD1	Michael Succi Drive Railroad Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2426	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2435	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2553	LR3	Pamela Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2562	LR3	Ocean Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2564	LR3	Ocean Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2204	LR4	Greenleaf Woods Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1042	LR5	Portsmouth High School fields	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1043	LR5	Portsmouth High School fields	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1061	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1066	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1067	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1069 Duplicate	LR5	Lafayette Road R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
769	M1	Maplewood Avenue	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2792	M1	Cutts Street at Ashland Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
168	P2A	FW Hartford Drive	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$100	\$100	\$0.00
282	P2A	TJ Gamester Avenue	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$100	\$100	\$0.00
819	GR1	Portsmouth Boulevard at Commerce Way	6	BRICK	Light debris on bench and invert	Clean	1	0	\$0	\$550	\$550	\$0.00
64	LD1	Market Street R.O.W.	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
65	LD1	Market Street R.O.W.	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
2410	LD1	Michael Succi Drive Railroad Easement	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
514	B1	Victory Road	8		Manhole buried	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2566	LR3	Ocean Road	8		Manhole buried behind home	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2620	LR6	Lafayette Road	8		Manhole buried	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2634	LR6	Lafayette Road	8		Can not locate manhole	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00



Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
459	B1	Colonial Drive	6	BRICK	Missing bricks and mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
458	B1	Colonial Drive at Worthen Road	7	BRICK	Missing bricks and mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
460	B1	Victory Road	8	BRICK	Roots at wall, corbel has broken bricks and missing mortar	Corbel Repair, Root Treatment, Grout Manhole	2	720	\$1,800	\$3,200	\$5,000	\$2.50
514	B1	Victory Road	8		Manhole buried	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
5271	B1	Victory Road Easement	8	PRECAST	Roots at wall	Root Treatment, Cementitious Liner	3	0	\$0	\$3,730	\$3,730	\$0.00
641	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
659	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
814	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2384	GR1		8		Can not locate manhole. Located on Pease effluent line.	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5494	GR1		8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
912	GR1	Blue Heron Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
913	GR1	Blue Heron Drive	6	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
914	GR1	Blue Heron Drive	12	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5398	GR1	Blue Heron Drive at Sanderling Way	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
916	GR1	Blue Heron Drive Easement	8	BRICK	Roots and infiltration staining at wall	Root Treatment, Grout Manhole, Cementitious Liner	2	360	\$2,960	\$2,200	\$5,160	\$8.22
915	GR1	Blue Heron Drive near Sanderling Way	9	BRICK	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
637	GR1	Commerce Way	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
638	GR1	Commerce Way	16	PRECAST	Infiltration staining	Grout Manhole	2	720	\$3,400	\$0	\$3,400	\$4.72
640	GR1	Commerce Way	11	PRECAST	Roots and debris on bench	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
5332	GR1	Commerce Way	13	PRECAST	Active infiltration at walls, cracked frame with broken pieces	New Frame and Cover, Grout Manhole, Cementitious Liner	3	720	\$4,810	\$820	\$5,630	\$6.68
632	GR1	Commerce Way Easement	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
633	GR1	Commerce Way Easement	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
634	GR1	Commerce Way Easement	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2385	GR1	Commerce Way Easement	8	BRICK	Severe infiltration from corbel, surcharging (no bench or invert visible), ponding around frame causing inflow. Located on Pease effluent line.	Corbel Repair, Rebuild Bench, Grout Manhole, Raise to Surface	4	2,880	\$1,600	\$4,300	\$5,900	\$0.56
2386	GR1	Commerce Way Easement	9	BRICK	Roots in corbel, Active infiltration with mineral deposits at wall, heavy debris in invert. Located on Pease effluent line.	Root Treatment, Grout Manhole, Cementitious Liner	3	1,440	\$3,330	\$2,200	\$5,530	\$2.31
5505	GR1	Commerce Way Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5307	GR1	Commerce Way R.O.W.	15	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
812	GR1	Granite Street R.O.W.	9	BRICK	Roots and debris on bench	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
5729	GR1	Granite Street R.O.W.	6	PRECAST	Evidence of surcharge, bench and invert not visible due to high water.	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
628	GR1	Oriental Gardens R.O.W.	12	PRECAST	Roots in corbel and wall	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
629	GR1	Oriental Gardens R.O.W.	11	PRECAST	Heavy mineral deposits, aggregate visible at wall due to H2S	Grout Manhole, Epoxy Liner	3	1,440	\$2,200	\$5,500	\$7,700	\$1.53
630	GR1	Oriental Gardens R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
631	GR1	Oriental Gardens R.O.W.	13	PRECAST	Mineral deposits	Grout Manhole	2	360	\$2,600	\$0	\$2,600	\$7.22
821	GR1	Osprey Drive	9	BRICK	Manhole walls leaking at 11.6 gpm per flow isolation, no picture taken of infiltration. Also, possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	16,704	\$3,700	\$0	\$3,700	\$0.22
5495	GR1	Osprey Drive Easement	8		Cover broken	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
816	GR1	Portsmouth Boulevard	8	BRICK	Mineral deposits at wall. Pipe connection leak.	Grout Manhole, Cementitious Liner	3	7,200	\$3,330	\$0	\$3,330	\$0.46
818	GR1	Portsmouth Boulevard	10	BLOCK	Active infiltration and mineral deposits at wall, roots	Root Treatment, Grout Manhole, Cementitious Liner	4	7,200	\$4,070	\$2,200	\$6,270	\$0.57
823	GR1	Portsmouth Boulevard	7	BRICK	Frame cracked and missing pieces, Roots and debris on bench, corbel missing mortar	New Frame and Cover, Root Treatment	2	0	\$0	\$3,020	\$3,020	\$0.00
824	GR1	Portsmouth Boulevard	8	BRICK	Manhole cover below grade, no bench and invert in manhole. Manhole bottom full of debris, corbel missing bricks and mortar	Clean, Corbel Repair	2	0	\$0	\$1,550	\$1,550	\$0.00
825	GR1	Portsmouth Boulevard	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
819	GR1	Portsmouth Boulevard at Commerce Way	6	BRICK	Light debris on bench and invert	Clean	1	0	\$0	\$550	\$550	\$0.00
820	GR1	Portsmouth Boulevard at Osprey Drive	5	BRICK	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
639	GR1	Portsmouth Boulevard Easement	10	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5852	GR1	Portsmouth Boulevard Easement	11	PRECAST	Mineral deposits at bench, broken bricks and missing mortar from corbel	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$4,070	\$1,000	\$5,070	\$5.65
813	GR1	Portsmouth Boulevard near Market Street	11	BRICK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	432	\$4,070	\$0	\$4,070	\$9.42
815	GR1	Portsmouth Boulevard near Shearwater Drive	14	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5399	GR1	Sanderling Way	8	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5493	GR1	Sanderling Way	6	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
817	GR1	Sanderling Way Easement	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
917	GR1	Shearwater Drive	9	BRICK	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
920	GR1	Shearwater Drive	9	BRICK	Pipe connection leak from north and west pipes. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	4	10,080	\$3,330	\$0	\$3,330	\$0.33
2372	GR1	Shearwater Drive	10	PRECAST	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2373	GR1	Shearwater Drive	10	PRECAST	Abandoned Manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2374	GR1	Shearwater Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5491	GR1	Shearwater Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5492	GR1	Shearwater Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
919	GR1	Shearwater Drive at Blue Heron Drive	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5490	GR1	Shearwater Drive near Portsmouth Boulevard	12	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
918	GR1	Shearwater Drive R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
921	GR1	Staysail Way	8	BRICK	Missing bricks and mortar from corbel.Possible industrial connection/service infiltration.	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
922	GR1	Staysail Way	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00

Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
642	GR1	Woodbury Avenue	11	PRECAST	Missing bricks and mortar from corbel, Mineral deposits at wall, debris buildup in bench.	Corbel Repair, Grout Manhole, Cementitious Liner	3	1,440	\$4,070	\$1,000	\$5,070	\$2.83
643	GR1	Woodbury Avenue	13	PRECAST	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
656	GR1	Woodbury Avenue	6	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
658	GR1	Woodbury Avenue	10	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2387	GR1	Woodbury Avenue	12	PRECAST	Infiltration staining at wall, aggregate visible at wall due to H2S. Located on Pease effluent line.	Grout Manhole, Epoxy Liner	2	360	\$2,400	\$6,000	\$8,400	\$6.67
2388	GR1	Woodbury Avenue	13	PRECAST	Mineral deposits, debris buildup in bench and channel. Bricks missing from bench.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	360	\$4,810	\$2,200	\$7,010	\$13.36
5334	GR1	Woodbury Avenue	12	PRECAST	Missing bricks in bench and invert. Light debris buildup in bench and channel. Infiltration staining at wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole	4	720	\$2,400	\$2,200	\$4,600	\$3.33
657	GR1	Woodbury Avenue at Arthur Brady Drive	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1335	HS11	Albany Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1325	HS11	Aldrich Road	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5818	HS11	Aldrich Road	8	PRECAST	Heavy debris in invert	Clean	2	0	\$0	\$550	\$550	\$0.00
5819	HS11	Aldrich Road at Aldrich Court	8	PRECAST	Incoming pipe connection leak (estimated at 2 gpm)	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1,800	\$2,960	\$2,200	\$5,160	\$1.64
529	HS11	Barberry Lane Easement	10	PRECAST	Heavy debris on bench, corbel missing mortar	Clean	2	0	\$0	\$550	\$550	\$0.00
5855	HS11	Barberry Lane Easement	11	PRECAST	Outside of corbel exposed, moderate debris on bench and invert	Clean, Corbel Repair	3	0	\$0	\$1,550	\$1,550	\$0.00
1333	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1334	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1394	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1396	HS11	Bartlett Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1397	HS11	Bartlett Street	7	BRICK	Broken and loose bricks on corbel, missing mortar from corbel. No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,390	\$3,390	\$0.00
5530	HS11	Bartlett Street	7	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5531	HS11	Bartlett Street	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5532	HS11	Bartlett Street	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5533	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5534	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5535	HS11	Bartlett Street	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5536	HS11	Bartlett Street at Cate Street	8	PRECAST	Broken bricks in corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
5539	HS11	Bartlett Street at Cate Street	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1395	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2243	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2244	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2246	HS11	Bartlett Street R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1327	HS11	Brewery Avenue R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5333	HS11	Brewery Avenue R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1329	HS11	Brewery Lane	14	PRECAST	No bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1330	HS11	Brewery Lane	11	PRECAST	Bench and invert gone/broken/sinking, infiltration staining at walls, piece of frame missing	New Frame and Cover, Rebuild Bench, Grout Manhole, Epoxy Liner	5	720	\$2,400	\$9,020	\$11,420	\$3.33
1331	HS11	Brewery Lane	14	BRICK/STONE	No bench and invert, roots at wall. Large gaps in wall. Possible industrial connection/service infiltration.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,440	\$5,550	\$2,200	\$7,750	\$3.85
5547	HS11	Brewery Lane	15	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5548	HS11	Brewery Lane	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5551	HS11	Brewery Lane	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1338	HS11	Cass Street	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1339	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1340	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2251	HS11	Cass Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5830	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5839	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5840	HS11	Cass Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5831	HS11	Cass Street at Lovell Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5834	HS11	Cass Street at Lovell Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1390	HS11	Cate Street	9	BLOCK	Active infiltration and mineral deposits at wall, corbel missing mortar	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
1392	HS11	Cate Street	5	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$1,200	\$0	\$1,200	\$3.33
1393	HS11	Cate Street	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2254	HS11	Chevrolet Avenue	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2255	HS11	Chevrolet Avenue	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1326	HS11	Chevrolet Avenue R.O.W.	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1302	HS11	Fells Road	8	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1308	HS11	Fields Road	7	BLOCK	Light debris on bench, chipped frame	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
1309	HS11	Fields Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1310	HS11	Fields Road	8	PRECAST	Crack in wall, frame missing pieces. Possible industrial connection/service infiltration.	New Frame and Cover, Cementitious Liner	2	0	\$0	\$2,180	\$2,180	\$0.00
1311	HS11	Fields Road and Sewall Road	7	BLOCK	Moderate debris in bench and invert, active infiltration from wall	Grout Manhole, Cementitious Liner	3	1,440	\$2,960	\$0	\$2,960	\$2.06
1381	HS11	Hampshire Road	8	BLOCK	Active infiltration and mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$2,960	\$0	\$2,960	\$10.28
1432	HS11	Islington Street	8	PRECAST	Light debris on bench, heavy debris in channel	Clean	3	0	\$0	\$550	\$550	\$0.00
1434	HS11	Islington Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00

Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
1440	HS11	Islington Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1441	HS11	Islington Street	9	PRECAST	Bench and invert missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2221	HS11	Islington Street	11	BRICK	Active infiltration at wall, bench and invert not visible, corbel missing mortar and cracked	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,080	\$4,440	\$3,200	\$7,640	\$4.11
2245	HS11	Islington Street	12	PRECAST	Moderate debris in bench and invert, roots at wall. Brick repair at bottom of MH wall.	Cementitious Liner	2	0	\$0	\$2,210	\$2,210	\$0.00
2248	HS11	Islington Street	8	PRECAST	No bench and invert. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	4	2,880	\$2,960	\$2,200	\$5,160	\$1.03
2249	HS11	Islington Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2253	HS11	Islington Street	9	PRECAST	Bench and invert missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2744	HS11	Islington Street	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5540	HS11	Islington Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5544	HS11	Islington Street	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5546	HS11	Islington Street	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1437	HS11	Islington Street at Aldrich Road	10	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5542	HS11	Islington Street at Bartlett Street	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1439	HS11	Islington Street at Elm Court	8	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5545	HS11	Islington Street at Jewell Court	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5537	HS11	Jewell Court	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1328	HS11	Jewell Court R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5096	HS11	Lovell Street	8		Manhole Abandoned	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5844	HS11	Lovell Street	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2741	HS11	Lovell Street R.O.W.	10	BLOCK	Walls missing mortar, no bench and invert, mineral deposits in incoming line	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,070	\$2,200	\$6,270	\$5.65
5549	HS11	Lovell Street R.O.W.	10	PRECAST	Disconnected drop connection in manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5550	HS11	Lovell Street R.O.W.	8	PRECAST	Frame and cover below grade	Raise to Surface	3	0	\$0	\$1,100	\$1,100	\$0.00
1344	HS11	Madison Street at Lovell Street	6	PRECAST	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2247	HS11	Ricci Lumber Yard	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1307	HS11	Sewall Road	6	PRECAST	Active infiltration at walls, hole in bench, corbel missing mortar, chipped frame	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	3	288	\$2,590	\$3,020	\$5,610	\$8.99
1314	HS11	Sewall Road	8	PRECAST	Chipped cover, active infiltration coming from wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$2,960	\$820	\$3,780	\$10.28
1315	HS11	Sewall Road at Spinney Road	9	PRECAST	Faulty drop connection in manhole, light debris on bench and invert, walls weeping at joints	Grout Manhole, Cementitious Liner	3	1,728	\$3,330	\$0	\$3,330	\$1.93
1305	HS11	Thaxter Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1306	HS11	Thaxter Road	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5503	HS11	Thaxter Road	9	PRECAST	Evidence of surcharge, moderate debris on bench	Clean	3	0	\$0	\$550	\$550	\$0.00
1303	HS11	Thaxter Road at Fells Road	11	BLOCK	Loose bricks in wall, no bench and invert, active infiltration at wall	Rebuild Bench, Grout Manhole, Cementitious Liner	4	1,080	\$4,070	\$2,200	\$6,270	\$3.77
1387	HS11	US Bypass 1	12	BLOCK	Roots, Active infiltration and mineral deposits at wall	Root Treatment, Grout Manhole, Cementitious Liner	3	144	\$4,440	\$2,200	\$6,640	\$30.83
1388	HS11	US Bypass 1 at rear	11	PRECAST	Mineral deposits at wall, corbel missing mortar	Grout Manhole	2	360	\$2,400	\$0	\$2,400	\$6.67
1389	HS11	US Bypass 1 at rear	11	BRICK	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
527	HS14	Barberry Lane Easement	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5316	HS14	Barberry Lane Easement	7	PRECAST	Active infiltration and mineral deposits at wall, corbel missing mortar	Corbel Repair, Grout Manhole, Cementitious Liner	3	2,160	\$2,590	\$1,000	\$3,590	\$1.20
5410	HS14	Barberry Lane Easement	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5411	HS14	Barberry Lane Easement	16	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5412	HS14	Barberry Lane Easement	17	PRECAST	Infiltration staining at wall	Grout Manhole, Cementitious Liner	3	360	\$6,660	\$0	\$6,660	\$18.50
5854	HS14	Barberry Lane Easement	16	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5856	HS14	Barberry Lane Easement	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
523	HS14	Borthwick Avenue	18	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
530	HS14	Borthwick Avenue	8	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5212	HS14	Borthwick Avenue	6	PRECAST	Moderate debris on bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
5213	HS14	Borthwick Avenue	9	PRECAST	Heavy debris on bench and invert, missing mortar from corbel.Possible industrial connection/service infiltration.	Clean	2	0	\$0	\$550	\$550	\$0.00
2219	HS14	Borthwick Avenue at Marriot Hotel	6	PRECAST	Mineral deposits at outlet pipe with active infiltration	Grout Manhole, Cementitious Liner	3	288	\$2,220	\$0	\$2,220	\$7.71
524	HS14	Borthwick Avenue Easement	20	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
531	HS14	Coakley Road	6	BLOCK	Heavy debris in bench and invert, missing mortar in wall	Cementitious Liner	2	0	\$0	\$1,190	\$1,190	\$0.00
532	HS14	Coakley Road	7	BLOCK	Loose brick in corbel, missing mortar in wall. Possible industrial connection/service infiltration.	Cementitious Liner	2	0	\$0	\$1,190	\$1,190	\$0.00
533	HS14	Coakley Road	10	BLOCK	Missing mortar from wall, light debris on bench. Loose, missing, and broken bricks from corbel	Corbel Repair, Cementitious Liner	2	0	\$0	\$2,870	\$2,870	\$0.00
534	HS14	Coakley Road	10	PARGED	No bench and invert, heavy debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
537	HS14	Coakley Road	7	BLOCK	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
538	HS14	Coakley Road	7	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
540	HS14	Coakley Road	8	BLOCK	Moderate debris on bench, broken frame, loose and broken bricks from corbel, missing mortar from walls	New Frame and Cover, Corbel Repair, Grout Manhole, Cementitious Liner	3	720	\$2,960	\$1,820	\$4,780	\$4.11
541	HS14	Coakley Road	7	BLOCK	Missing mortar in walls, No bench and invert, heavy debris buildup	Rebuild Bench, Cementitious Liner	4	0	\$0	\$3,560	\$3,560	\$0.00
2727	HS14	Coakley Road	8	BLOCK	Missing mortar in wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$3,330	\$2,200	\$5,530	\$4.63
5342	HS14	Coakley Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5341	HS14	Granite Group parking lot	7	PRECAST	Heavy sediment on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
535	HS14	Larry Lane	5	BLOCK	Missing mortar from corbel and walls, loose bricks in corbel	Corbel Repair, Cementitious Liner	2	0	\$0	\$2,020	\$2,020	\$0.00

Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
2237	HS14	Larry Lane	6	PRECAST	Loose bricks in corbel, missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
601	HS15	Benson Street	4	PRECAST	Missing mortar from corbel. Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
593	HS15	Essex Avenue	12	BLOCK	Broken and missing bricks from wall, loose bricks in corbel, no bench or invert, heavy debris buildup	Corbel Repair, Rebuild Bench, Grout Manhole, Cementitious Liner	4	720	\$4,810	\$3,200	\$8,010	\$6.68
594	HS15	Essex Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
595	HS15	Essex Avenue	14	BLOCK	Missing mortar from corbel and walls, loose/broken bricks in corbel. Open joint in clay invert.	Corbel Repair, Cementitious Liner	3	0	\$0	\$3,550	\$3,550	\$0.00
596	HS15	Essex Avenue and Melbourne Street	12	BLOCK	Broken frame, missing mortar from corbel, missing mortar from walls	New Frame and Cover, Cementitious Liner	2	0	\$0	\$2,860	\$2,860	\$0.00
591	HS15	Essex Avenue and Middle Road	6	BLOCK	No bench and invert, active infiltration at wall, missing mortar from wall, heavy debris buildup	Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,590	\$2,200	\$4,790	\$8.99
592	HS15	Essex Avenue near easement	6	BLOCK	Missing mortar from corbel and walls. Open joint in clay invert.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
584	HS15	Hampshire Road	7	BLOCK	No bench and invert, heavy debris buildup, corbel missing mortar	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
585	HS15	Hampshire Road	7	BLOCK	Moderate debris on bench, broken and loose bricks in corbel	Clean, Corbel Repair	2	0	\$0	\$1,550	\$1,550	\$0.00
586	HS15	Hampshire Road	7	BLOCK	No bench and invert, heavy debris	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
587	HS15	Hampshire Road	10	BLOCK	Mineral deposits at wall, no bench and invert, heavy debris buildup	Rebuild Bench, Grout Manhole	4	720	\$2,000	\$2,200	\$4,200	\$2.78
588	HS15	Hampshire Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2211	HS15	Hampshire Road R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
563	HS15	Marjorie Street at Middle Road	7	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2728	HS15	Melbourne Street at Sims Avenue	9	BRICK	Missing bricks and mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5401	HS15	Melbourne Street at Vine Street	5	BRICK	Broken corbel with loose and missing bricks	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
577	HS15	Middle Road	8	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
578	HS15	Middle Road	10	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
1384	HS15	Rt 1 Bypass near Islington Street	12	BLOCK	Deteriorating wall	Cementitious Liner	3	0	\$0	\$2,040	\$2,040	\$0.00
580	HS15	Sheffield Road	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
581	HS15	Sheffield Road	7	BLOCK	Crack in invert, light debris on bench, broken brick and missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
582	HS15	Sheffield Road	5	BLOCK	Broken and loose bricks on corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
597	HS15	Sheffield Road	6	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5685	HS15	Sheffield Road	7	BLOCK	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	144	\$2,590	\$0	\$2,590	\$17.99
598	HS15	Sims Avenue	9	BRICK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
600 Duplicate	HS15	Sims Avenue	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
599	HS15	Sims Avenue at Benson Street	8	PRECAST	Infiltration at manhole wall	Grout Manhole	2	720	\$1,800	\$0	\$1,800	\$2.50
1423	HS15	Spinney Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1383	HS15	US Rt 1 Bypass	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1382	HS15	US Rt 1 Bypass North	11	BLOCK	Active infiltration at wall, roots in corbel, loose bricks and debris on bench. Collapsed pipe connection found during flow isolation. Possible industrial connection/service	Remove and Replace Manhole	4	1,728	\$13,100	\$0	\$13,100	\$7.58
2367	LD1	Albacore Museum Access Pump Station	16	PRECAST	Cracked and missing mortar from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
2368	LD1	Albacore Museum Access Pump Station	18	PRECAST	Light infiltration stains at walls	Grout Manhole, Cementitious Liner	3	720	\$6,660	\$0	\$6,660	\$9.25
1017	LD1	Chase Drive at Michael Succi Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
836	LD1	Dunlin Way	11	BRICK	Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2454	LD1	Dunlin Way	14	PRECAST	No bench and invert, debris buildup	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2457	LD1	Dunlin Way	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
837	LD1	Dunlin Way and Osprey Drive	7	BRICK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2157	LD1	Dunlin Way R.O.W.	11	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2158	LD1	Dunlin Way R.O.W.	13	PRECAST	Missing bricks in invert, moderate debris buildup	Clean	2	0	\$0	\$550	\$550	\$0.00
2362	LD1	Kearsarge Road at Market Street	10	PRECAST	Invert leak. Infiltration at manhole wall.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	1,440	\$3,700	\$2,200	\$5,900	\$2.57
4	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2426	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2430	LD1	Kearsarge Way R.O.W.	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2435	LD1	Kearsarge Way R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2440	LD1	Kearsarge Way R.O.W.	8	PRECAST	Roots at wall and bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
985	LD1	Market Street at Michael Succi Drive	9	PRECAST	Cracked around drop connection, bench separating from base section, rocks on bench	Cementitious Liner	3	0	\$0	\$1,700	\$1,700	\$0.00
2365	LD1	Market Street at Michael Succi Drive	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2366	LD1	Market Street at Michael Succi Drive	17	PRECAST	Floor Missing Bricks	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
64	LD1	Market Street R.O.W.	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
65	LD1	Market Street R.O.W.	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
1014	LD1	Michael Succi Drive	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1015	LD1	Michael Succi Drive	6	PRECAST	Light infiltration stains at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1016	LD1	Michael Succi Drive	8	PRECAST	Roots coming in at bench, moderate debris buildup on bench.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2375	LD1	Michael Succi Drive	9	PRECAST	Light infiltration stains at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2410	LD1	Michael Succi Drive Railroad Easement	8		Cover too large to open	New Frame and Cover	1	0	\$0	\$820	\$820	\$0.00
2414	LD1	Michael Succi Drive Railroad Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2418	LD1	Michael Succi Drive Railroad Easement	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
17	LD1	Portsmouth Boulevard R.O.W.	7	PRECAST	Missing mortar from corbel with roots in corbel. Infiltration at pipe connection.	Corbel Repair, Grout Manhole, Cementitious Liner	2	720	\$2,960	\$1,000	\$3,960	\$4.11
830	LD1	Portsmouth Boulevard R.O.W.	5	BRICK	Light debris in bench and invert, deteriorating corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
942	LD1	Spinnaker Way	9	BRICK	Mineral deposits at bench and invert, roots in corbel. Walls weeping during MH Inspection. Active infiltration during flow isolation.	Grout Manhole, Cementitious Liner	3	2,880	\$3,330	\$0	\$3,330	\$1.16
2444	LD1	Spinnaker Way R.O.W.	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00

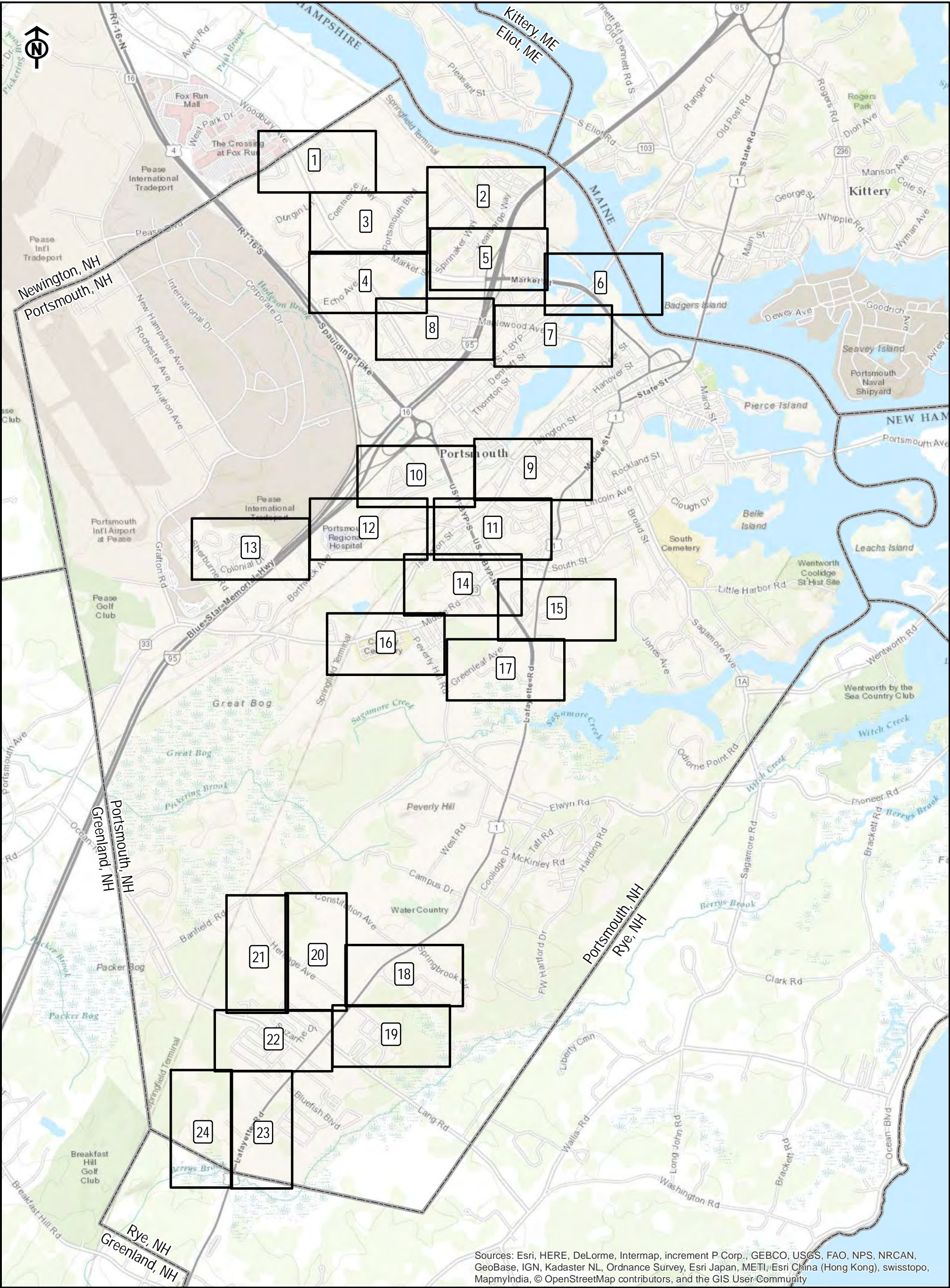
Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
2448	LD1	Spinnaker Way R.O.W.	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2451	LD1	Spinnaker Way R.O.W.	12	PRECAST	Bricks missing from bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2540	LR3	Denise Street	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2534	LR3	Mariette Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2538	LR3	Mariette Drive	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2554	LR3	Mariette Drive	17	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2556	LR3	Mariette Drive	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2558	LR3	Mariette Drive	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2536	LR3	Mariette Drive at Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2560	LR3	Mariette Drive at Ocean Road	17	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1647	LR3	Nathaniel Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1648	LR3	Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
1649	LR3	Nathaniel Drive	5	PRECAST	Light debris buildup	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2466	LR3	Nathaniel Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1646	LR3	Nathaniel Drive R.O.W.	5	PRECAST	Wall leaks, hole in wall at connection to bench	Grout Manhole, Cementitious Liner	3	2,880	\$1,850	\$0	\$1,850	\$0.64
2415	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2419	LR3	Nathaniel Drive R.O.W.	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2422	LR3	Nathaniel Drive R.O.W.	10	PRECAST	Rocks on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2427	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2431	LR3	Nathaniel Drive R.O.W.	8	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2436	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2437	LR3	Nathaniel Drive R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2441	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2445	LR3	Nathaniel Drive R.O.W.	8	PRECAST	Light infiltration stains at walls, cracked cover	New Frame and Cover, Grout Manhole, Cementitious Liner	3	2,880	\$2,960	\$820	\$3,780	\$1.03
2449	LR3	Nathaniel Drive R.O.W.	5	PRECAST	Loose Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2452	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2455	LR3	Nathaniel Drive R.O.W.	7	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	288	\$2,590	\$0	\$2,590	\$8.99
2458	LR3	Nathaniel Drive R.O.W.	9	PRECAST	Rocks on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
2460	LR3	Nathaniel Drive R.O.W.	7	PRECAST	Rocks on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2462	LR3	Nathaniel Drive R.O.W.	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2464	LR3	Nathaniel Drive R.O.W.	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2562	LR3	Ocean Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2564	LR3	Ocean Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2566	LR3	Ocean Road	8		Manhole buried behind home	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2567	LR3	Ocean Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2551	LR3	Pamela Drive	7	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2553	LR3	Pamela Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2614	LR3	Simmons Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2612	LR3	Simmons Road at Suzanne Drive	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2613	LR3	Simmons Road at Suzanne Drive	8	PRECAST	Warped Cover	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
2581	LR3	Suzanne Drive	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2583	LR3	Suzanne Drive	6	PRECAST	Moderate debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
2585	LR3	Suzanne Drive	8	PRECAST	Moderate debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
2587	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2589	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2591	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2593	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2595	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2607	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2608	LR3	Suzanne Drive	6	PRECAST	Missing mortar from corbel	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
2609	LR3	Suzanne Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2610	LR3	Suzanne Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2611	LR3	Suzanne Drive	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2579	LR3	Suzanne Drive near Ocean Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2597	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2600	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2601	LR3	Wallis Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
397	LR4	Greenleaf Avenue	8	PRECAST	Corbel missing bricks and mortar, light debris on bench. 6 gpm leak observed during flow isolation.	Corbel Repair, Grout Manhole, Cementitious Liner	3	8,640	\$2,960	\$1,000	\$3,960	\$0.34
377	LR4	Greenleaf Woods Drive	14	PRECAST	Mineral deposits at pipe connections (primary in/out) with active infiltration	Grout Manhole, Cementitious Liner	4	17,280	\$5,180	\$0	\$5,180	\$0.30
378	LR4	Greenleaf Woods Drive	15	PRECAST	Active infiltration from wall	Grout Manhole, Cementitious Liner	4	1,440	\$5,920	\$0	\$5,920	\$4.11
380	LR4	Greenleaf Woods Drive	14	PRECAST	Chipped frame, Active infiltration with mineral deposits at wall	New Frame and Cover, Grout Manhole, Cementitious Liner	3	288	\$5,180	\$820	\$6,000	\$17.99
396	LR4	Greenleaf Woods Drive	7	PRECAST	Incoming pipe connection leak, voids visible around inlet and outlet pipe connections.	Rebuild Bench, Grout Manhole, Cementitious Liner	3	9,360	\$2,590	\$2,200	\$4,790	\$0.28
2204	LR4	Greenleaf Woods Drive	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
5394	LR4	Holiday Drive	8	PRECAST	Roots at corbel	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00

Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
556	LR4	Middle Road	9	BLOCK	Heavy debris on bench and invert, missing mortar from corbel	Clean	3	0	\$0	\$550	\$550	\$0.00
557	LR4	Middle Road	8	BLOCK	Missing mortar from walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
558	LR4	Middle Road	8	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
559	LR4	Middle Road	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
961	LR4	Middle Road	6	BLOCK	Heavy debris in bench and invert	Rebuild Bench	4	0	\$0	\$2,200	\$2,200	\$0.00
2209	LR4	Middle Road	15	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2210	LR4	Middle Road	13	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
560	LR4	Middle Road at entrance of The Chase Home	6	BLOCK	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
554	LR4	Middle Road at Leavitt Avenue	5	BLOCK	No bench and invert, heavy debris buildup, corbel blocks missing/deteriorating	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
410	LR4	Middle Road at Peverly Hill Road	13	PRECAST	Missing pieces of frame	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
2208	LR4	Middle Road at The Chase Home	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
555	LR4	Middle Road at Woodbury Avenue	8	BLOCK	Heavy debris on bench and invert, moderate roots throughout manhole	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
406	LR4	Peverly Hill Road	7	PRECAST	Incoming and outgoing pipe connection leaks.	Grout Manhole, Cementitious Liner	3	2,232	\$2,960	\$0	\$2,960	\$1.33
407	LR4	Peverly Hill Road at McClintock Avenue	8	PRECAST	Outgoing pipe connection leak.	Grout Manhole, Cementitious Liner	3	1,440	\$3,330	\$0	\$3,330	\$2.31
411	LR4	Plains Avenue at Peverly Hill Road	12	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
381	LR5	Lafayette Drive	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
387	LR5	Lafayette Drive	9	PRECAST	Chipped frame, broken bricks in corbel	New Frame and Cover, Corbel Repair	3	0	\$0	\$1,820	\$1,820	\$0.00
1059	LR5	Lafayette Road	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1060	LR5	Lafayette Road	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1061	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1062	LR5	Lafayette Road	14	PRECAST	Mineral deposits at wall, Exposed aggregate at MH wall due to H2S, moderate debris in bench and invert	Epoxy Liner	3	0	\$0	\$7,000	\$7,000	\$0.00
1064	LR5	Lafayette Road	11	PRECAST	Active infiltration with mineral deposits at wall	Grout Manhole, Cementitious Liner	3	288	\$4,070	\$0	\$4,070	\$14.13
1065	LR5	Lafayette Road	10	PRECAST	Roots at corbel. No channel for pipe connection. Corbel missing brick.	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
1066	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1067	LR5	Lafayette Road	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1068	LR5	Lafayette Road	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1071	LR5	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1075	LR5	Lafayette Road	9	PRECAST	Moderate debris on bench and roots at wall	Cementitious Liner	3	0	\$0	\$1,700	\$1,700	\$0.00
1073	LR5	Lafayette Road at Andrew Jarvis Drive	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1074	LR5	Lafayette Road at Andrew Jarvis Drive	8	PRECAST	Frame and cover below grade	Raise to Surface	3	0	\$0	\$1,100	\$1,100	\$0.00
1072	LR5	Lafayette Road at Artwill Avenue	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1070	LR5	Lafayette Road at Edgewood Drive	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1069 Duplicate	LR5	Lafayette Road R.O.W.	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1037	LR5	Ledgewood Drive	7	PRECAST	Missing mortar from corbel, light debris in bench and invert	Clean	2	0	\$0	\$550	\$550	\$0.00
1038	LR5	Ledgewood Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1039	LR5	Ledgewood Drive	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1040	LR5	Ledgewood Drive	9	PRECAST	Missing mortar and bricks from corbel	Corbel Repair	2	0	\$0	\$1,000	\$1,000	\$0.00
1063	LR5	Ledgewood Drive	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1044	LR5	Ledgewood Drive R.O.W.	5	PRECAST	No bench and invert, heavy debris buildup, active infiltration at wall, frame chipped	New Frame and Cover, Rebuild Bench, Grout Manhole, Cementitious Liner	4	288	\$2,220	\$3,020	\$5,240	\$7.71
1045	LR5	Ledgewood Drive R.O.W.	8	PRECAST	Infiltration staining and mineral deposits at wall. Active infiltration from wall joints	Grout Manhole, Cementitious Liner	3	288	\$3,330	\$0	\$3,330	\$11.56
1046	LR5	Ledgewood Drive R.O.W.	11	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
1042	LR5	Portsmouth High School fields	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1043	LR5	Portsmouth High School fields	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
1041	LR5	Portsmouth High School Parking lot	7	PRECAST	Frame cracked. Possible industrial connection/service infiltration.	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
226	LR6	Constitution Avenue at Lafayette Road	6	PRECAST	Light debris on bench, corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
136	LR6	Heritage Avenue	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2635	LR6	Heritage Avenue	12	PRECAST	Active infiltration at wall	Grout Manhole, Cementitious Liner	3	288	\$4,440	\$0	\$4,440	\$15.42
2636	LR6	Heritage Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2637	LR6	Heritage Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2638	LR6	Heritage Avenue	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2639	LR6	Heritage Avenue	6	PRECAST	Chipped frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2641	LR6	Heritage Avenue	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2642	LR6	Heritage Avenue	9	PRECAST	Light Infiltration observed at walls, mineral deposits	Grout Manhole, Cementitious Liner	3	1,440	\$3,700	\$0	\$3,700	\$2.57
2643	LR6	Heritage Avenue	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2644	LR6	Heritage Avenue	8	PRECAST	Bench missing mortar	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
2645	LR6	Heritage Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2624	LR6	Heritage Avenue at Lafayette Road	11	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
132	LR6	Heritage Avenue at Post Road	5	PRECAST	Missing mortar from invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
107	LR6	Lafayette Road	6	PRECAST	Light debris buildup, missing mortar at corbel.	Cementitious Liner	3	0	\$0	\$1,020	\$1,020	\$0.00
117	LR6	Lafayette Road	11	PRECAST	Light debris in channel	Clean	2	0	\$0	\$550	\$550	\$0.00
118	LR6	Lafayette Road	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
149	LR6	Lafayette Road	14	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2469	LR6	Lafayette Road	9	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2471	LR6	Lafayette Road	6	PRECAST	Active infiltration at walls	Grout Manhole, Cementitious Liner	3	720	\$2,590	\$0	\$2,590	\$3.60
2473	LR6	Lafayette Road	6	PRECAST	Roots in corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00

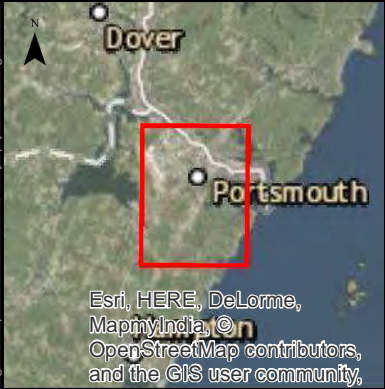
Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
2475	LR6	Lafayette Road	7	PRECAST	Moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
2477	LR6	Lafayette Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2479	LR6	Lafayette Road	6	PRECAST	Manhole cover significantly below grade, roots at bench and wall. Debris on bench	Corbel Repair, Root Treatment, Cementitious Liner, Raise to Surface	3	0	\$0	\$5,490	\$5,490	\$0.00
2481	LR6	Lafayette Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2491	LR6	Lafayette Road	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2493	LR6	Lafayette Road	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2495	LR6	Lafayette Road	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2497	LR6	Lafayette Road	7	PRECAST	Light debris in bench and invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2499	LR6	Lafayette Road	7	PRECAST	Brick loose on bench, moderate debris on bench. Possible industrial connection/service infiltration.	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2505	LR6	Lafayette Road	7	PRECAST	Moderate debris on bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2507	LR6	Lafayette Road	6	PRECAST	Infiltration at bench/wall connection	Grout Manhole, Cementitious Liner	2	432	\$2,590	\$0	\$2,590	\$6.00
2509	LR6	Lafayette Road	6	PRECAST	Missing mortar from corbel, Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2617	LR6	Lafayette Road	7	PRECAST	Exposed aggregate at MH wall due to H2S. Missing mortar from bench	Epoxy Liner	3	0	\$0	\$4,000	\$4,000	\$0.00
2618	LR6	Lafayette Road	8	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2620	LR6	Lafayette Road	8		Manhole buried	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2622	LR6	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2623	LR6	Lafayette Road	9	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2625	LR6	Lafayette Road	14	PRECAST	Cracked frame, bricks missing from bench and invert	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
2626	LR6	Lafayette Road	13	PRECAST	Corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2627	LR6	Lafayette Road	8	PRECAST	Infiltration staining on wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2628	LR6	Lafayette Road	8	PRECAST	Corroded Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2629	LR6	Lafayette Road	7	PRECAST	Debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2630	LR6	Lafayette Road	6	PRECAST	Infiltration staining at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2633	LR6	Lafayette Road	8	PRECAST	Possible industrial connection/service infiltration.	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2634	LR6	Lafayette Road	8		Can not locate manhole	Raise to Surface	1	0	\$0	\$1,100	\$1,100	\$0.00
2501	LR6	Lafayette Road at Blue Fish Boulevard	6	PRECAST	Moderate debris on bench, broken cover	New Frame and Cover, Rebuild Bench	4	0	\$0	\$3,020	\$3,020	\$0.00
2503	LR6	Lafayette Road at Blue Fish Boulevard	5	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2483	LR6	Lafayette Road at Coach Road	8	PRECAST	Light infiltration at manhole wall	Grout Manhole	2	288	\$1,800	\$0	\$1,800	\$6.25
2483	LR6	Lafayette Road at Coach Road	8	PRECAST	Light debris on bench, invert not fully visible	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2484	LR6	Lafayette Road at Coach Road	6	PRECAST	Infiltration staining at wall, frame missing piece	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
2485	LR6	Lafayette Road at Coach Road	9	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2487	LR6	Lafayette Road at Coach Road	8	PRECAST	Light debris on bench and invert. Infiltration at bench/wall connection. Possible industrial connection/service infiltration.	Grout Manhole, Cementitious Liner	2	2,520	\$3,330	\$0	\$3,330	\$1.32
2489	LR6	Lafayette Road at Coach Road	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2631	LR6	Lafayette Road at Constitution Avenue	8	PRECAST	Broken frame, light debris on bench, bench missing bricks, corbel missing mortar	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
2632	LR6	Lafayette Road at Constitution Avenue	9	PRECAST	Broken frame, light debris on bench	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
2621	LR6	Lafayette Road at Freedom Circle	9	PRECAST	Missing mortar from corbel. Possible industrial connection/service infiltration.	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2619	LR6	Lafayette Road at Lang Road	6	PRECAST	Broken invert and bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2511	LR6	Lafayette Road at Longmeadow Road	4	PRECAST	Moderate debris on bench	Rebuild Bench	3	0	\$0	\$2,200	\$2,200	\$0.00
2578	LR6	Lafayette Road at Ocean Road	7	PRECAST	Missing mortar from bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2616	LR6	Lafayette Road at Suzanne Drive	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
133	LR6	Post Road	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2646	LR6	Robert Avenue	6	PRECAST	Mineral deposits at wall and void visible at outgoing pipe connection	Grout Manhole, Cementitious Liner	3	5,040	\$2,220	\$0	\$2,220	\$0.44
150	LR6	Robert Avenue R.O.W.	7	PRECAST	Corroded Frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2653	LR6	Robert Avenue R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2654	LR6	Robert Avenue R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2660	LR6	Springbrook Circle Parking lot	13	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2661	LR6	Springbrook Circle R.O.W.	11	PRECAST	Roots at corbel and wall	Root Treatment	2	0	\$0	\$2,200	\$2,200	\$0.00
2655	LR6	White Cedar Boulevard R.O.W.	6	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2656	LR6	White Cedar Boulevard R.O.W.	8	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2657	LR6	White Cedar Boulevard R.O.W.	8	PRECAST	Mineral deposits at wall	Grout Manhole, Cementitious Liner	3	360	\$3,330	\$0	\$3,330	\$9.25
2658	LR6	White Cedar Boulevard R.O.W.	10	PRECAST	Roots at wall	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2659	LR6	White Cedar Boulevard R.O.W.	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
89	M1	Alder Way	9	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
94	M1	Cutts Street	7	PRECAST	Light debris on bench, cracked cover	New Frame and Cover	2	0	\$0	\$820	\$820	\$0.00
2792	M1	Cutts Street at Ashland Street	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
93	M1	Cutts Street at Rt 1 Bypass	7	PRECAST	Evidence of surcharge, heavy debris blocking flow, cracked cover	Clean, New Frame and Cover	4	0	\$0	\$1,370	\$1,370	\$0.00
2130	M1	Edmond Avenue	12	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2131	M1	Edmond Avenue	11	PRECAST	Missing mortar and bricks from corbel	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
108	M1	Edmund Avenue near Fairview Avenue	8	PRECAST	Cracked cover	New Frame and Cover, Grout Manhole	2	360	\$1,800	\$820	\$2,620	\$5.00
109	M1	Fairview Avenue	7	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
110	M1	Fairview Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
111	M1	Fairview Avenue	4	PRECAST	Cracked cover	New Frame and Cover	4	0	\$0	\$820	\$820	\$0.00
759	M1	Fairview Avenue at O'Leary Place	4	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
96	M1	Maplewood Avenue	12	PRECAST	Moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00

Appendix B.3 - Manhole Rehabilitation Recommendations - Prioritization Per Basin Per Street												
MH Number	Metering Basin	Street	MH Depth (ft)	Manhole Material	Observations	Rehabilitation Recommendations	Max Defect Score	Estimated Infiltration (gpd)	Estimated Infiltration Removal Cost	Estimated Structural / O&M Rehab	Estimated Total Rehab Cost	Infiltration Removal Cost Effectiveness (\$ Spent per Gallon Per Day Removed)
97	M1	Maplewood Avenue	9	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
98	M1	Maplewood Avenue	5	PRECAST	Missing mortar and bricks from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
100	M1	Maplewood Avenue	7	PRECAST	Infiltration staining at walls, moderate debris on bench	Clean	2	0	\$0	\$550	\$550	\$0.00
101	M1	Maplewood Avenue	5	PRECAST	Missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
102	M1	Maplewood Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
103	M1	Maplewood Avenue	11	PRECAST	Loose bricks in corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
104	M1	Maplewood Avenue	8	PRECAST	Loose debris on bench, corbel missing bricks and mortar, loose frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
105	M1	Maplewood Avenue	9	PRECAST	Infiltration staining at walls	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
106	M1	Maplewood Avenue	7	PRECAST	Cracked cover, corbel missing bricks	New Frame and Cover	3	0	\$0	\$820	\$820	\$0.00
767	M1	Maplewood Avenue	6	BRICK	No bench and invert, corbel breaking	Corbel Repair, Rebuild Bench	4	0	\$0	\$3,200	\$3,200	\$0.00
769	M1	Maplewood Avenue	8		Can not locate manhole	Locate Manhole	1	0	\$0	\$100	\$100	\$0.00
2128	M1	Maplewood Avenue	7	PRECAST	Light debris on bench, corbel missing mortar	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2132	M1	Maplewood Avenue	10	PRECAST	No defects	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2359	M1	Maplewood Avenue	7	PRECAST	Light debris on bench	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2360	M1	Maplewood Avenue	5	PRECAST	Evidence of surcharge, bench and invert non-existent	Rebuild Bench	2	0	\$0	\$2,200	\$2,200	\$0.00
95	M1	Maplewood Avenue at Cutts Street	11	PRECAST	Infiltration staining at walls, missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2794	M1	Maplewood Avenue at Cutts Street	12	PRECAST	Light debris in bench and invert	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2129	M1	Maplewood Avenue at Fairview Avenue	9	PRECAST	Missing mortar from corbel, loose frame	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
99	M1	Maplewood Avenue near Rt 95 overpass	6	PRECAST	Light debris on bench, loose bricks and missing mortar from corbel	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
5319	M1	O'Leary Place	6	PRECAST	Light debris in manhole	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
112	M1	US Rt 1 Bypass	7	PRECAST	Broken and missing bricks in corbel, Light debris in bench and invert	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
113	M1	US Rt 1 Bypass	5	PRECAST	Broken and missing bricks in corbel, Light debris in bench and invert, infiltration stains at walls	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
115	M1	US Rt 1 Bypass	6	PRECAST	No defects	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
116	M1	US Rt 1 Bypass	9	PRECAST	Light infiltration at walls and light debris in invert	Grout Manhole	2	288	\$2,000	\$0	\$2,000	\$6.94
92	M1	US Rt 1 Bypass at Cutts Avenue	8	PRECAST	Broken bricks in corbel, Light infiltration at walls	Corbel Repair, Grout Manhole, Cementitious Liner	3	360	\$2,960	\$1,000	\$3,960	\$8.22
114	M1	US Rt 1 Bypass at Cutts Street	6	PRECAST	Broken and missing bricks in corbel, Light debris throughout manhole	Corbel Repair	3	0	\$0	\$1,000	\$1,000	\$0.00
168	P2A	FW Hartford Drive	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$100	\$100	\$0.00
279	P2A	FW Hartford Drive	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
280	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
281	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2165	P2A	FW Hartford Drive	6	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2166	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2167	P2A	FW Hartford Drive	11	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2170	P2A	FW Hartford Drive	12	PRECAST	See Appendix F	Continue to Monitor	2	0	\$0	\$0	\$0	\$0.00
2405	P2A	FW Hartford Drive	9	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2412	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2416	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2420	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2423	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2428	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2432	P2A	FW Hartford Drive	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2438	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2442	P2A	FW Hartford Drive	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2446	P2A	FW Hartford Drive	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
278	P2A	FW Hartford Drive at TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2168	P2A	FW Hartford Drive at TJ Gamester Avenue	12	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
167	P2A	FW Hartford Drive Easement	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2668	P2A	FW Hartford Drive Easement	8	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
5850	P2A	FW Hartford Road	7	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
282	P2A	TJ Gamester Avenue	8		Can not locate manhole	Continue to Monitor	1	0	\$0	\$100	\$100	\$0.00
283	P2A	TJ Gamester Avenue	6	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
496	P2A	TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	1	0	\$0	\$0	\$0	\$0.00
2169	P2A	TJ Gamester Avenue	10	PRECAST	See Appendix F	Continue to Monitor	3	0	\$0	\$0	\$0	\$0.00





Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



### Legend

Manhole Rehabilitation Page Outline

City Boundary

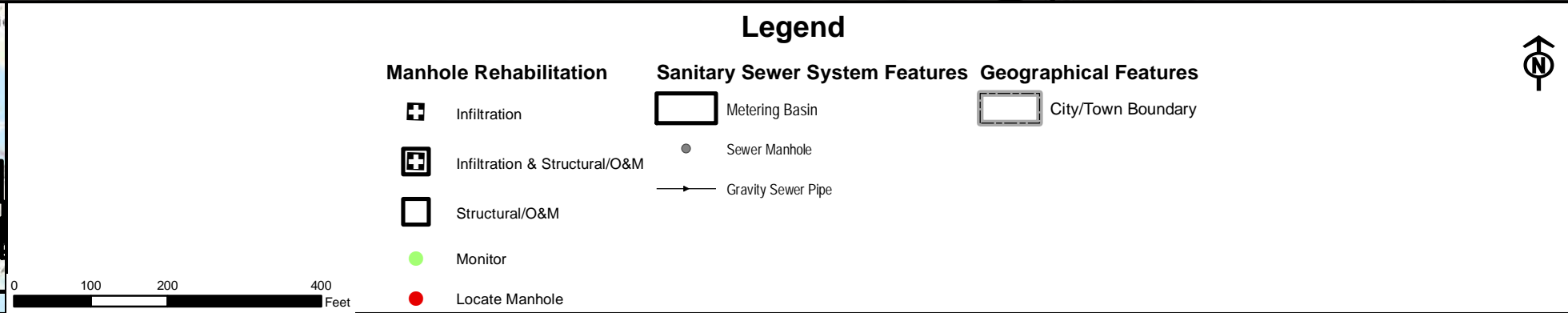
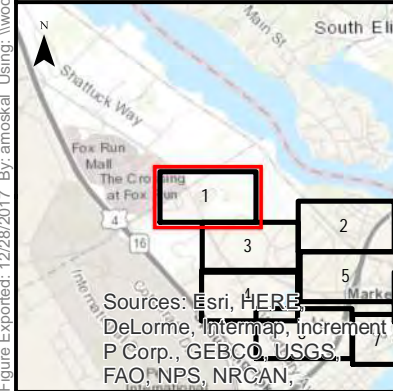
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Feet

City of Portsmouth, NH 2017 SSES	
FIGURE 4-2: Manhole Rehabilitation Key Plan	
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**CITY OF PORTSMOUTH NH, 2017 SSES**

**Figure 4-2: Recommended Manhole Rehabilitation**  
*MAP 1 of 24*

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**SCALE: 1" = 200'**

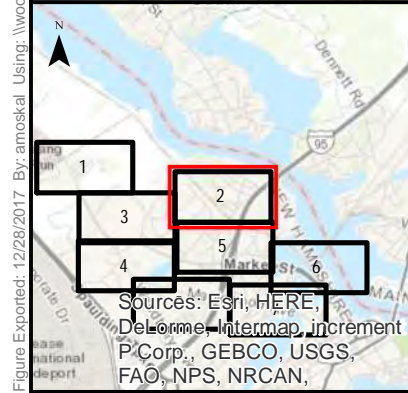
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### Legend

Manhole Rehabilitation	Sanitary Sewer System Features	Geographical Features
Infiltration	Metering Basin	City/Town Boundary
Infiltration & Structural/O&M	Sewer Manhole	
Structural/O&M	Gravity Sewer Pipe	
Monitor		
Locate Manhole		

### CITY OF PORTSMOUTH NH, 2017 SSES

#### Figure 4-2: Recommended Manhole Rehabilitation

MAP 2 of 24

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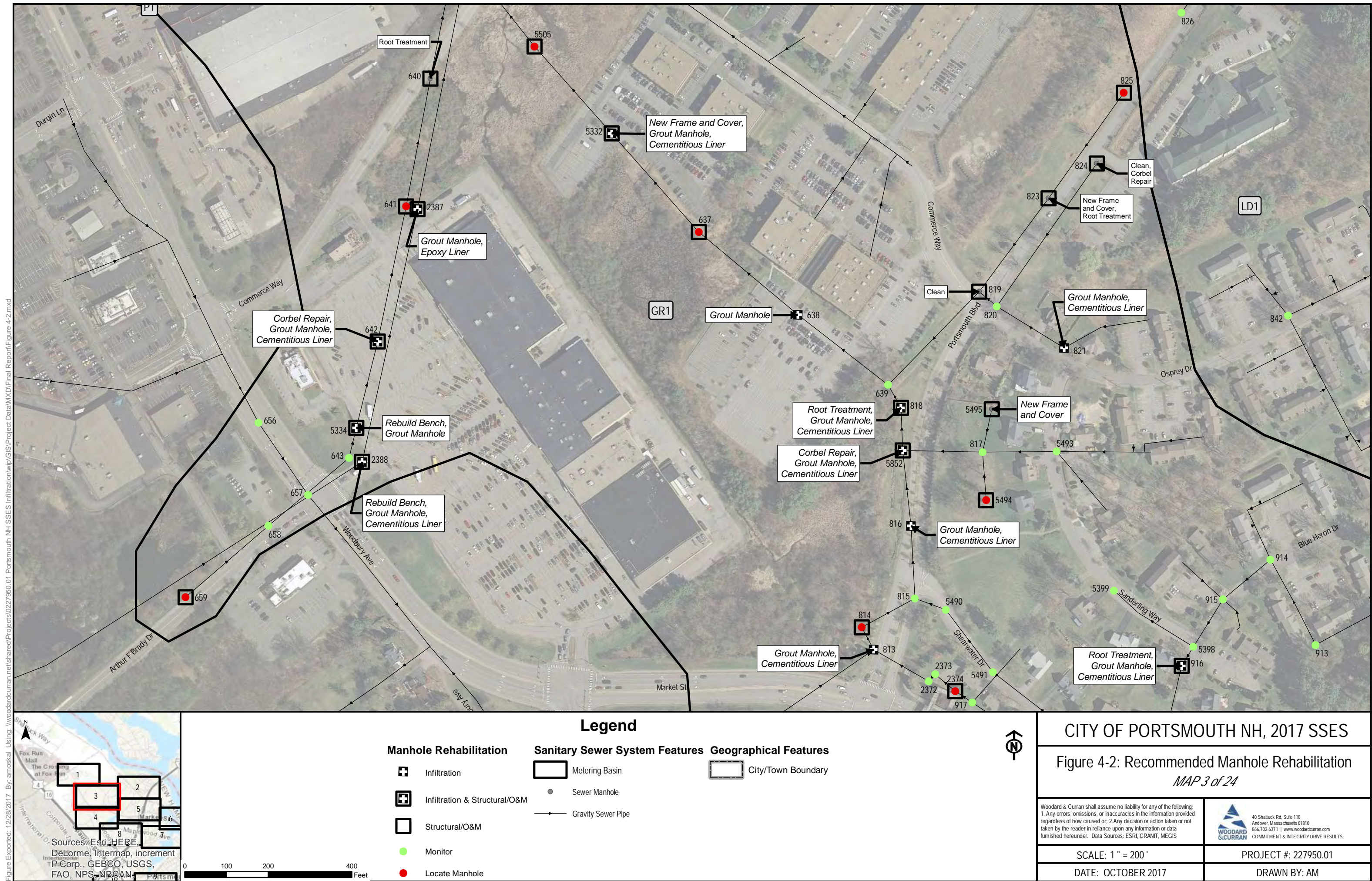
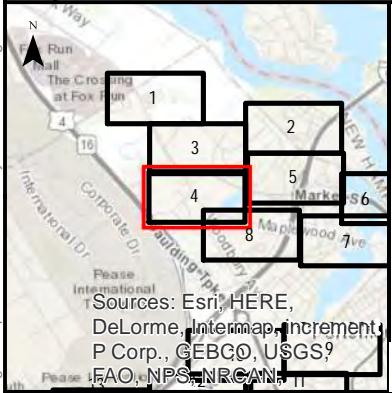




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### Legend

Manhole Rehabilitation	Sanitary Sewer System Features	Geographical Features
Infiltration	Metering Basin	City/Town Boundary
Infiltration & Structural/O&M	Sewer Manhole	
Structural/O&M	Gravity Sewer Pipe	
Monitor		
Locate Manhole		

## CITY OF PORTSMOUTH NH, 2017 SSES

### Figure 4-2: Recommended Manhole Rehabilitation

MAP 4 of 24

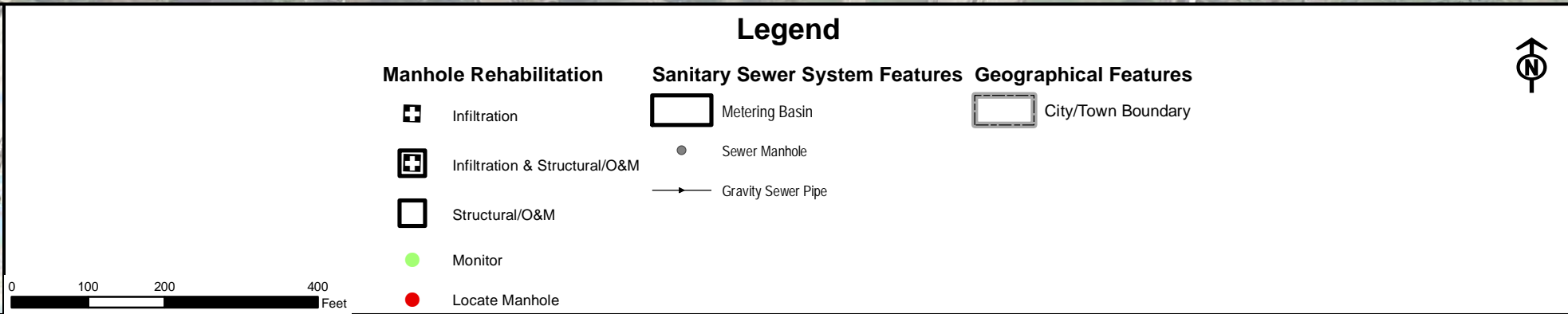
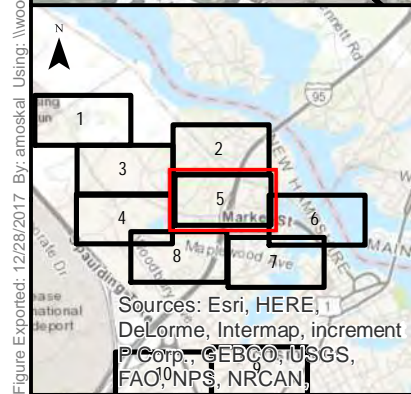
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**CITY OF PORTSMOUTH NH, 2017 SSES**

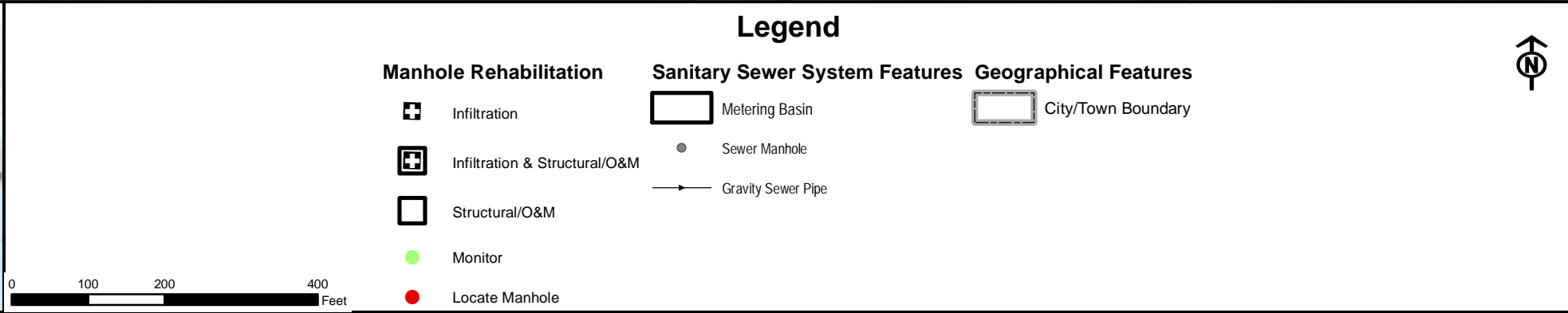
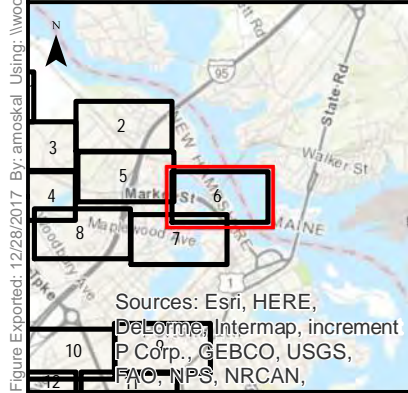
**Figure 4-2: Recommended Manhole Rehabilitation**  
*MAP 5 of 24*

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**CITY OF PORTSMOUTH NH, 2017 SSES**

**Figure 4-2: Recommended Manhole Rehabilitation**  
*MAP 6 of 24*

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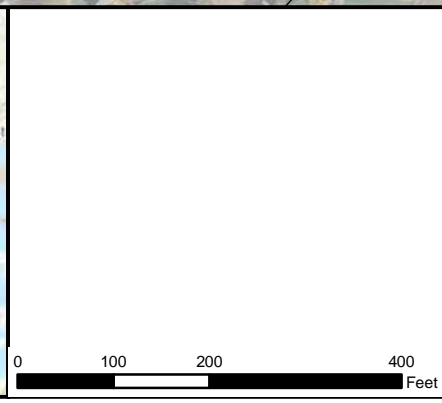
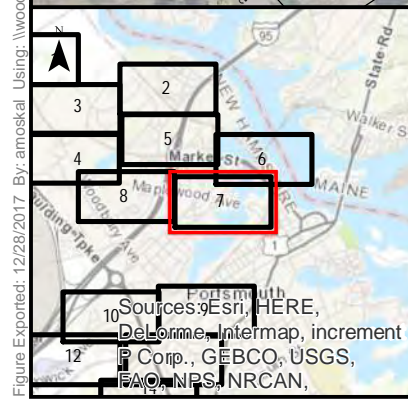
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### Legend

#### Manhole Rehabilitation

- Infiltration
- Infiltration & Structural/O&M
- Structural/O&M
- Monitor
- Locate Manhole

#### Sanitary Sewer System Features

- Metering Basin
- Sewer Manhole
- Gravity Sewer Pipe

#### Geographical Features

- City/Town Boundary

### CITY OF PORTSMOUTH NH, 2017 SSES

#### Figure 4-2: Recommended Manhole Rehabilitation

MAP 7 of 24

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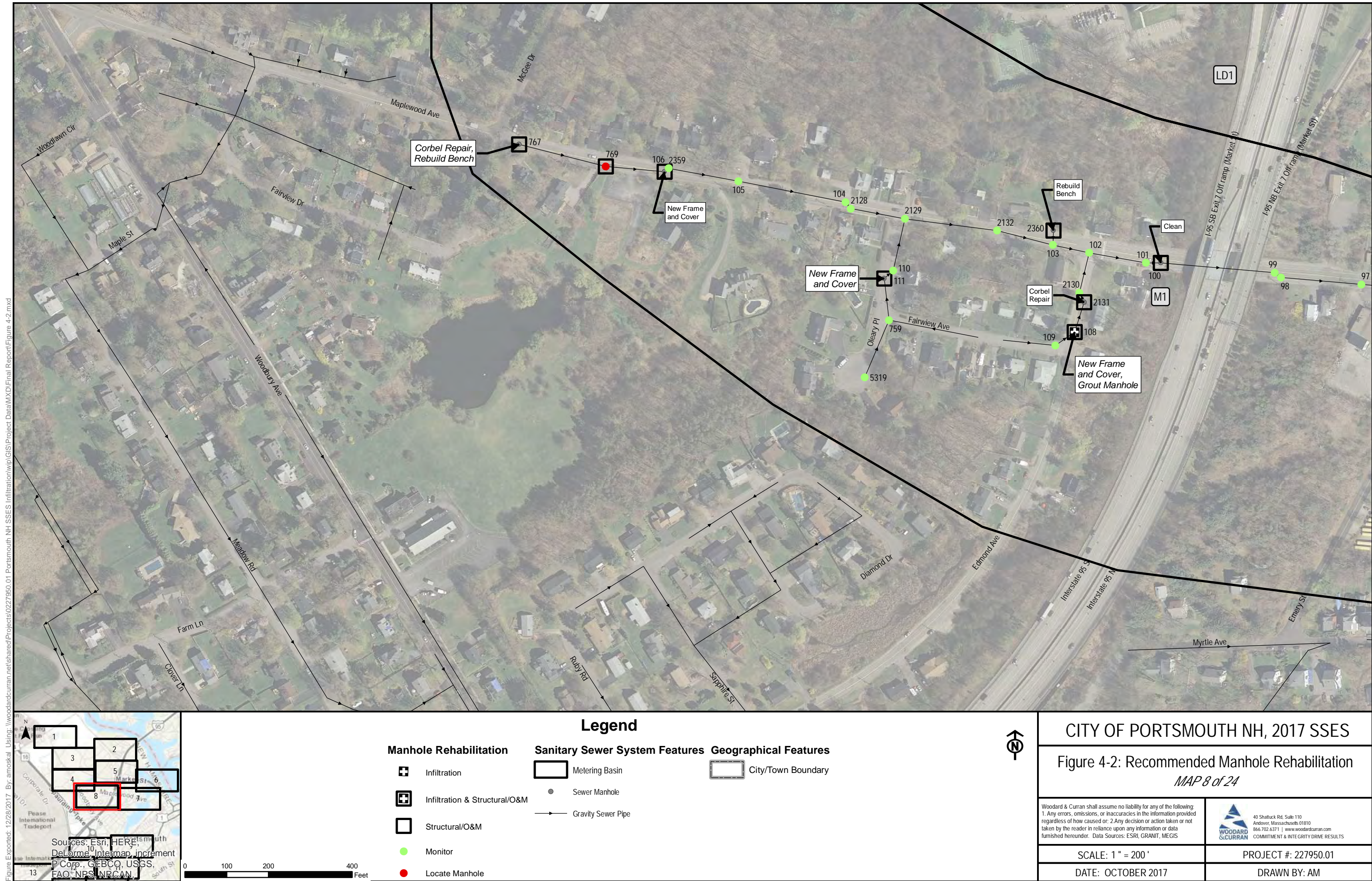
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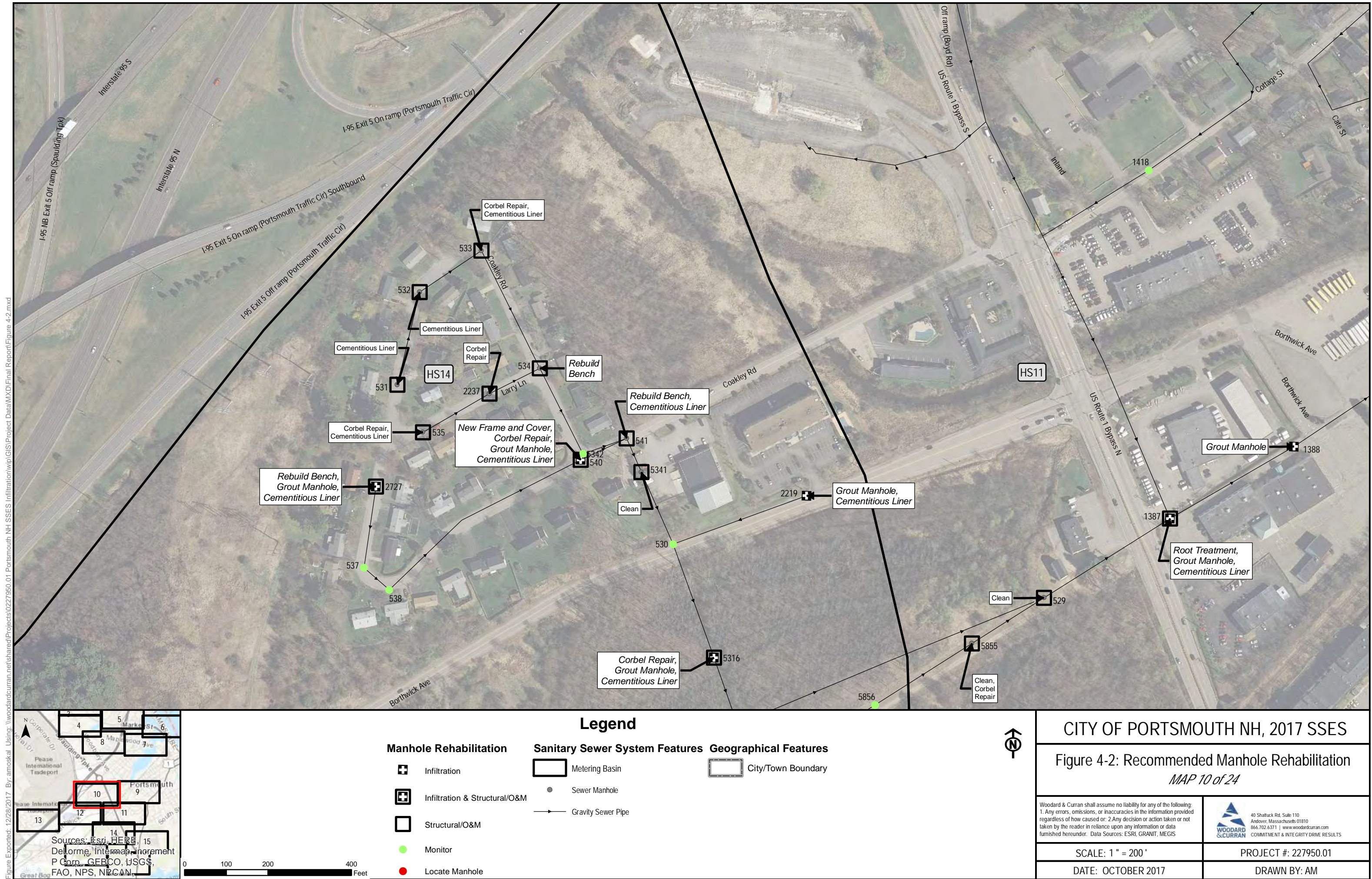
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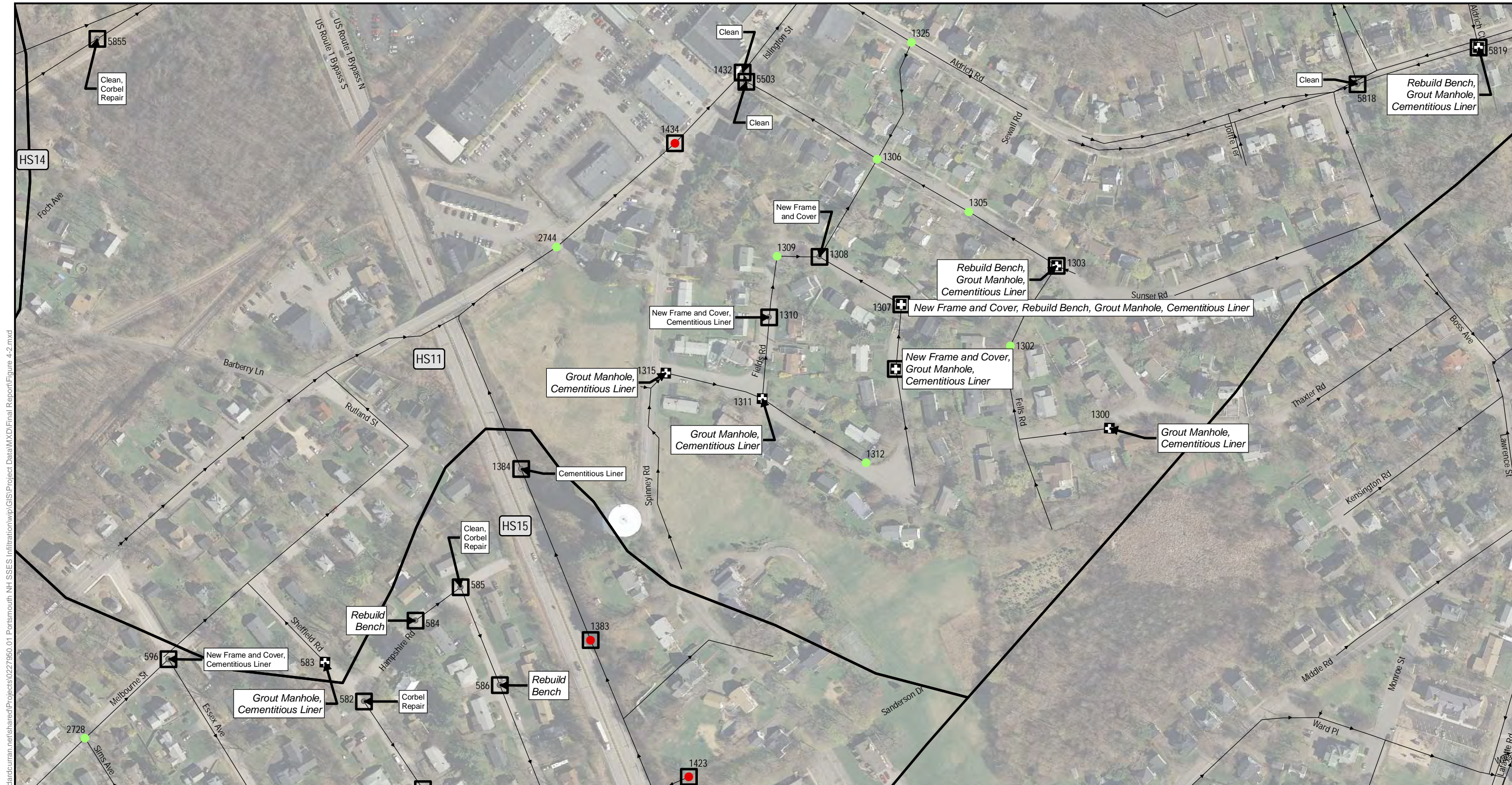
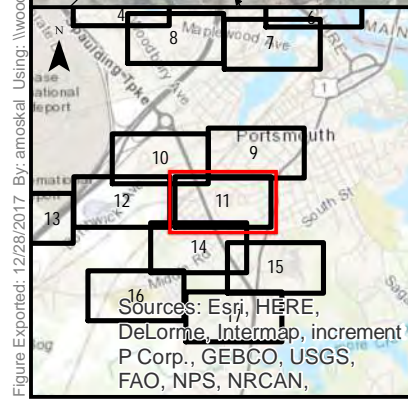


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### Legend

#### Manhole Rehabilitation

- Infiltration
- Infiltration & Structural/O&M
- Structural/O&M
- Monitor
- Locate Manhole

#### Sanitary Sewer System Features

- Metering Basin
- Sewer Manhole
- Gravity Sewer Pipe

#### Geographical Features

- City/Town Boundary

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## CITY OF PORTSMOUTH NH, 2017 SSES

### Figure 4-2: Recommended Manhole Rehabilitation

MAP 11 of 24

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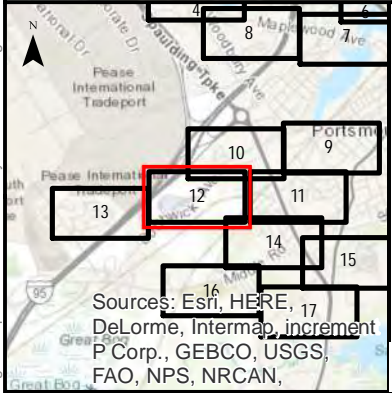
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### Legend

#### Manhole Rehabilitation

- Infiltration
- Infiltration & Structural/O&M
- Structural/O&M
- Monitor
- Locate Manhole

#### Sanitary Sewer System Features

- Metering Basin
- Sewer Manhole
- Gravity Sewer Pipe

#### Geographical Features

- City/Town Boundary

### CITY OF PORTSMOUTH NH, 2017 SSES

#### Figure 4-2: Recommended Manhole Rehabilitation

MAP 12 of 24

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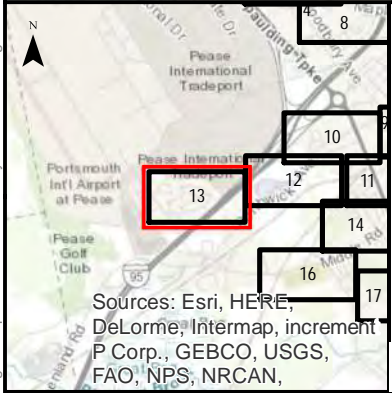
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### Legend

Manhole Rehabilitation	Sanitary Sewer System Features	Geographical Features
Infiltration	Metering Basin	City/Town Boundary
Infiltration & Structural/O&M	Sewer Manhole	
Structural/O&M	Gravity Sewer Pipe	
Monitor		
Locate Manhole		

### CITY OF PORTSMOUTH NH, 2017 SSES

Figure 4-2: Recommended Manhole Rehabilitation  
*MAP 13 of 24*

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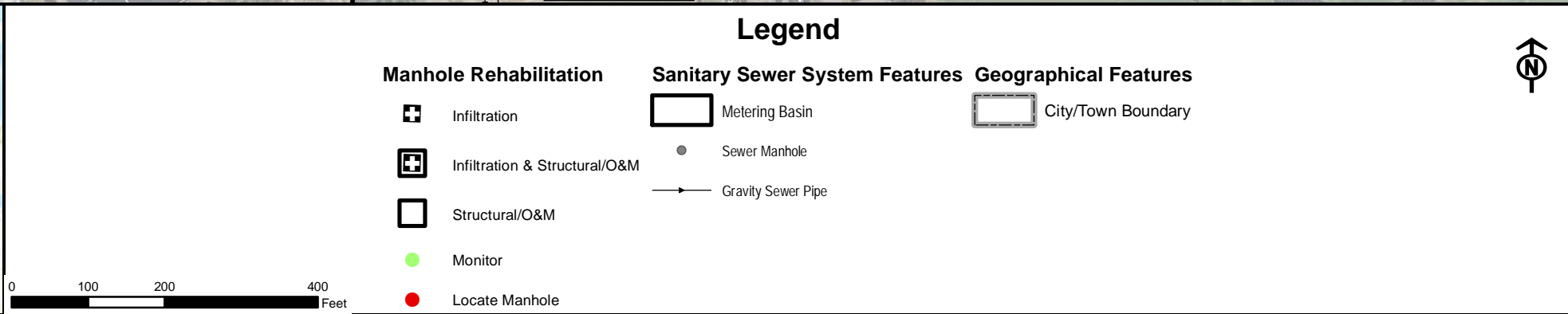
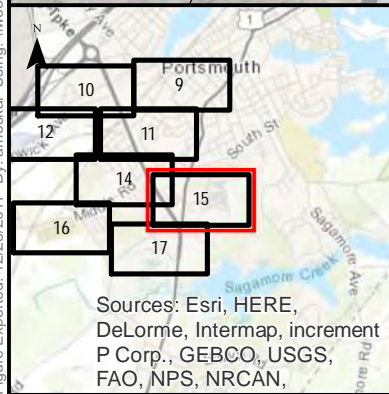
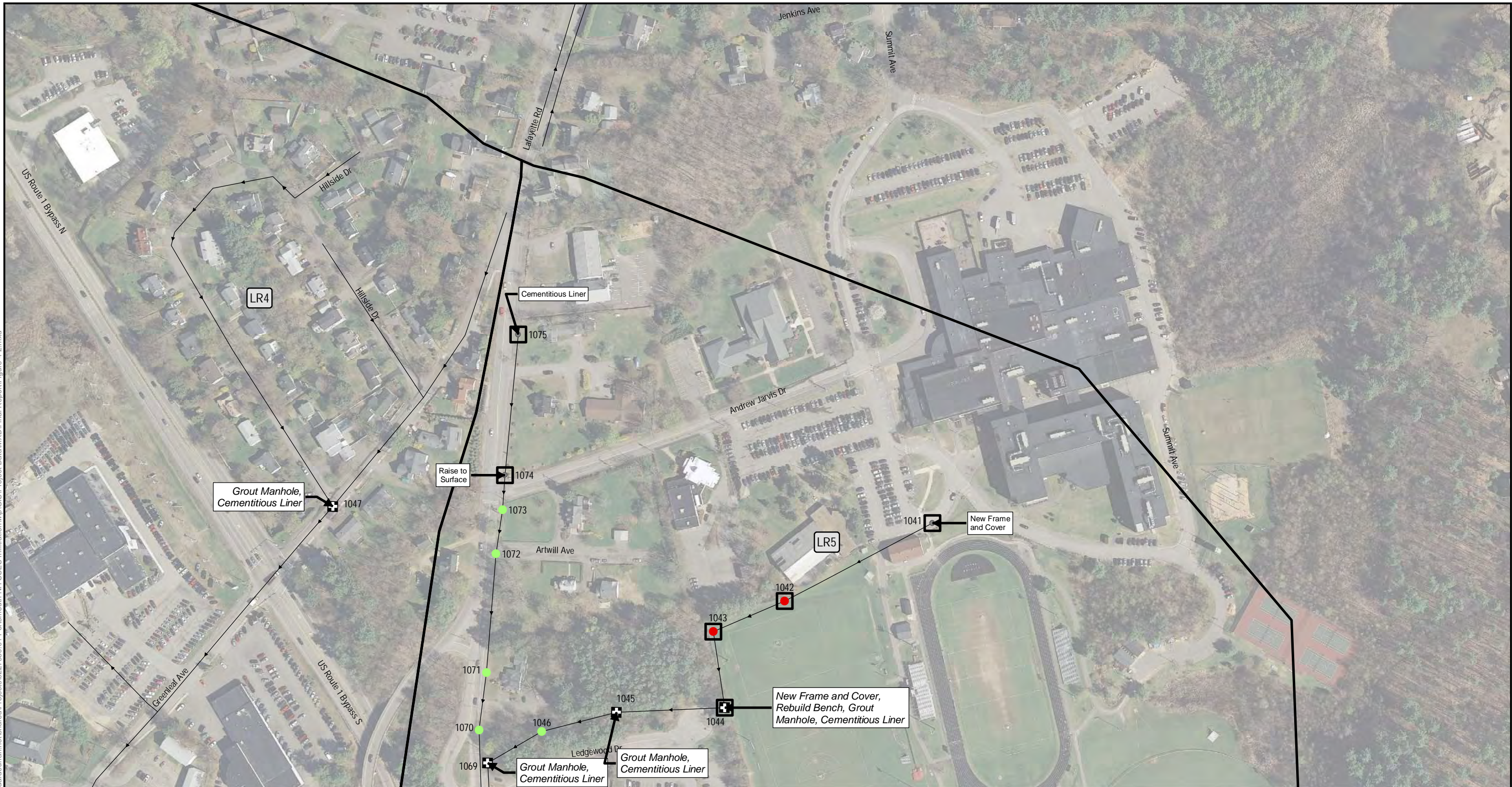
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## CITY OF PORTSMOUTH NH, 2017 SSES

Figure 4-2: Recommended Manhole Rehabilitation  
*MAP 15 of 24*

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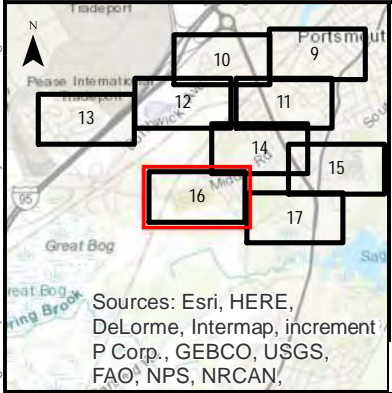
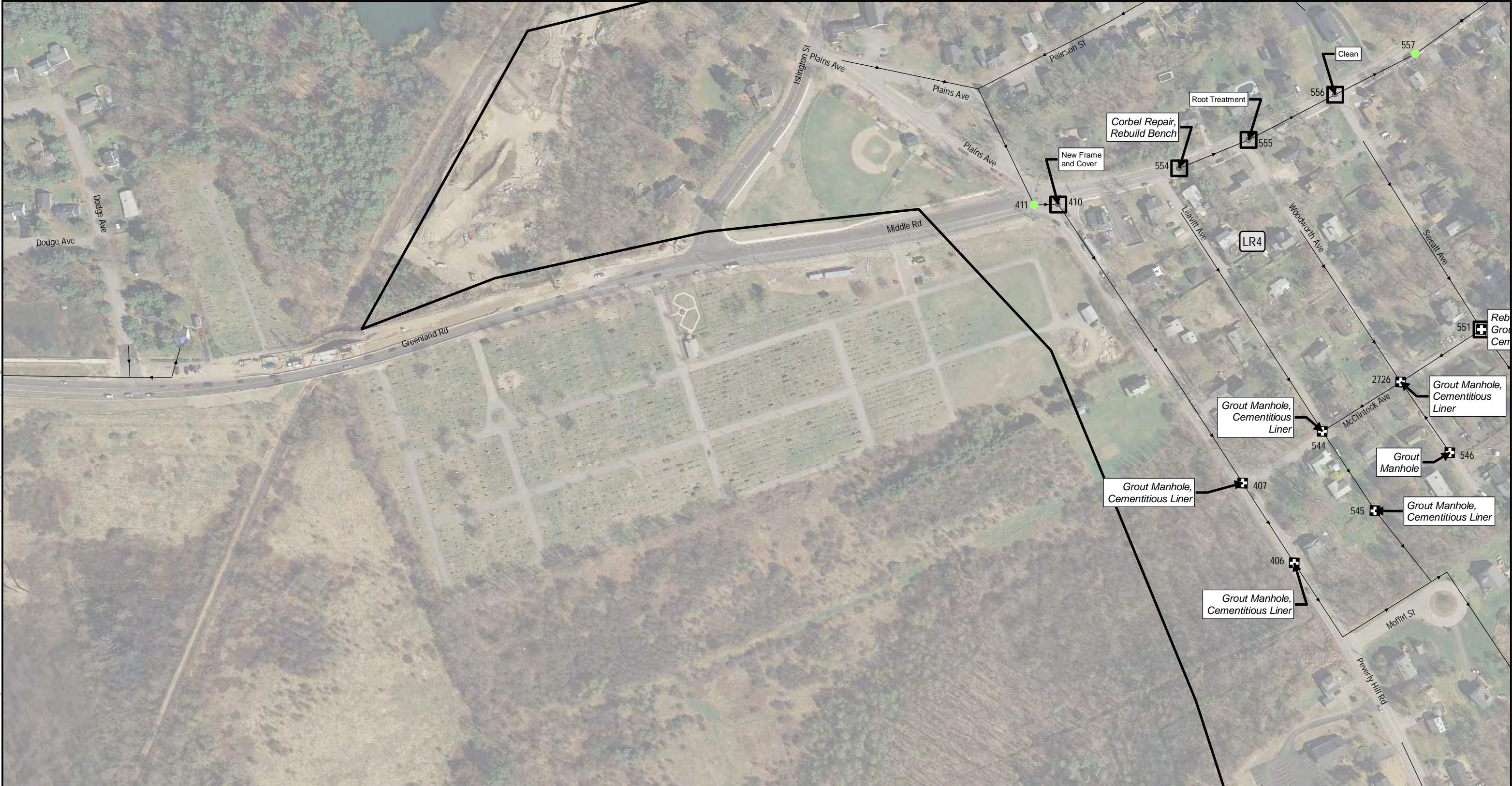
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### Legend

#### Manhole Rehabilitation

- Infiltration
- Infiltration & Structural/O&M
- Structural/O&M
- Monitor
- Locate Manhole

#### Sanitary Sewer System Features

- Metering Basin
- Sewer Manhole
- Gravity Sewer Pipe

#### Geographical Features

- City/Town Boundary

## CITY OF PORTSMOUTH NH, 2017 SSES

### Figure 4-2: Recommended Manhole Rehabilitation

*MAP 16 of 24*

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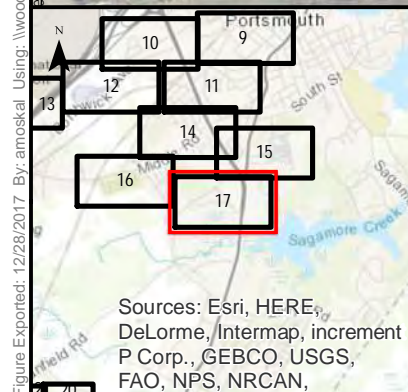
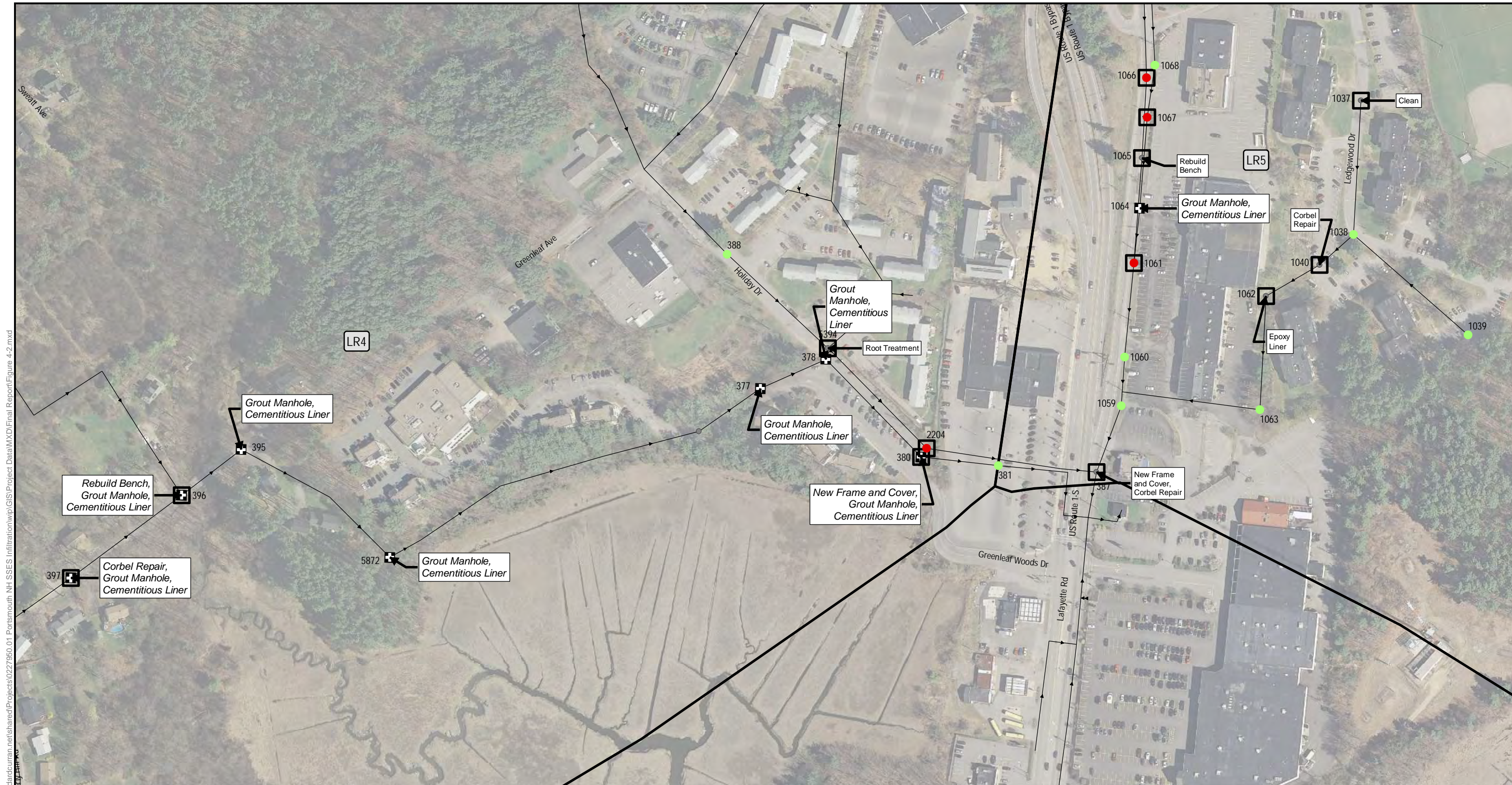
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**Legend**

Manhole Rehabilitation	Sanitary Sewer System Features	Geographical Features
Infiltration	Metering Basin	City/Town Boundary
Infiltration & Structural/O&M	Sewer Manhole	
Structural/O&M	Gravity Sewer Pipe	
Monitor		
Locate Manhole		

**CITY OF PORTSMOUTH NH, 2017 SSES**

**Figure 4-2: Recommended Manhole Rehabilitation**

*MAP 17 of 24*

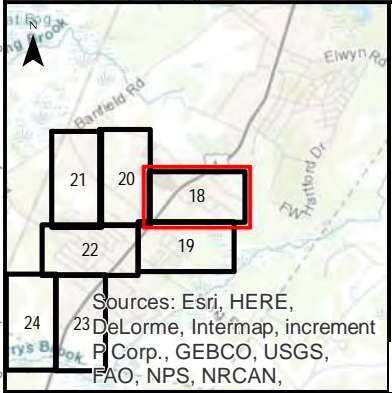
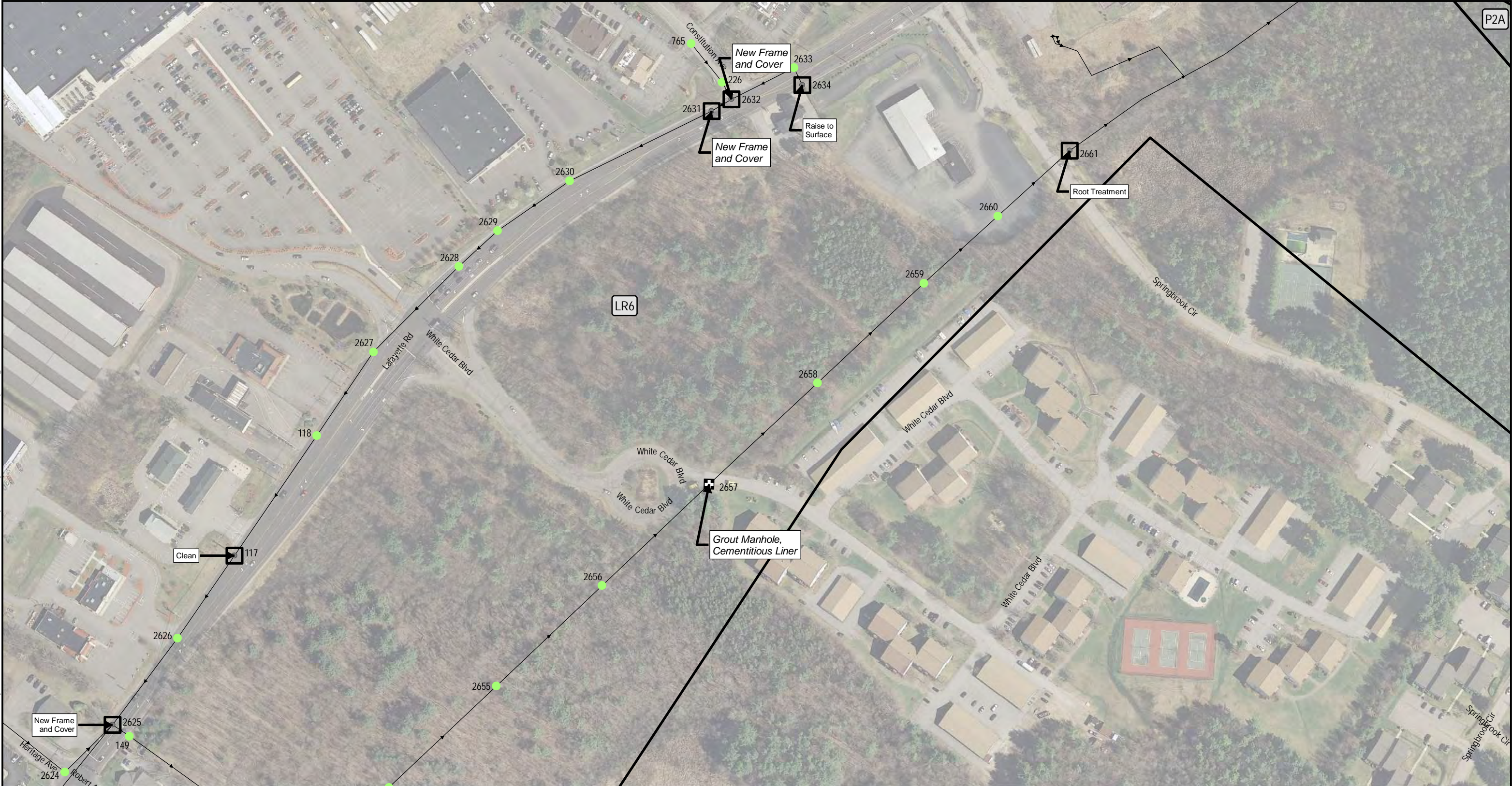
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### Legend

#### Manhole Rehabilitation

- Infiltration
- Infiltration & Structural/O&M
- Structural/O&M
- Monitor
- Locate Manhole

#### Sanitary Sewer System Features

- Metering Basin
- Sewer Manhole
- Gravity Sewer Pipe

#### Geographical Features

- City/Town Boundary

## CITY OF PORTSMOUTH NH, 2017 SSES

### Figure 4-2: Recommended Manhole Rehabilitation

MAP 18 of 24

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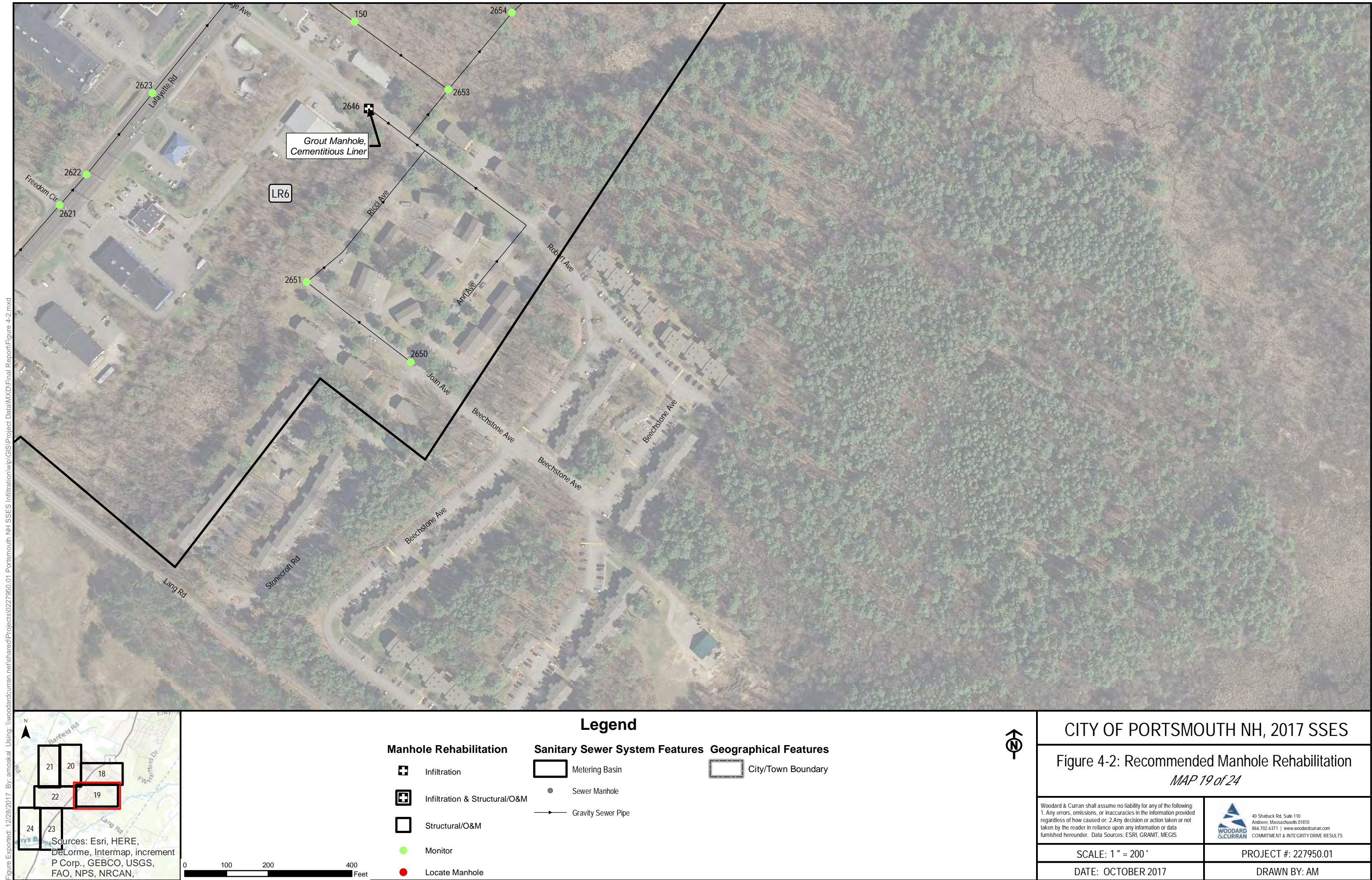
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## CITY OF PORTSMOUTH NH, 2017 SSES

Figure 4-2: Recommended Manhole Rehabilitation  
*MAP 19 of 24*

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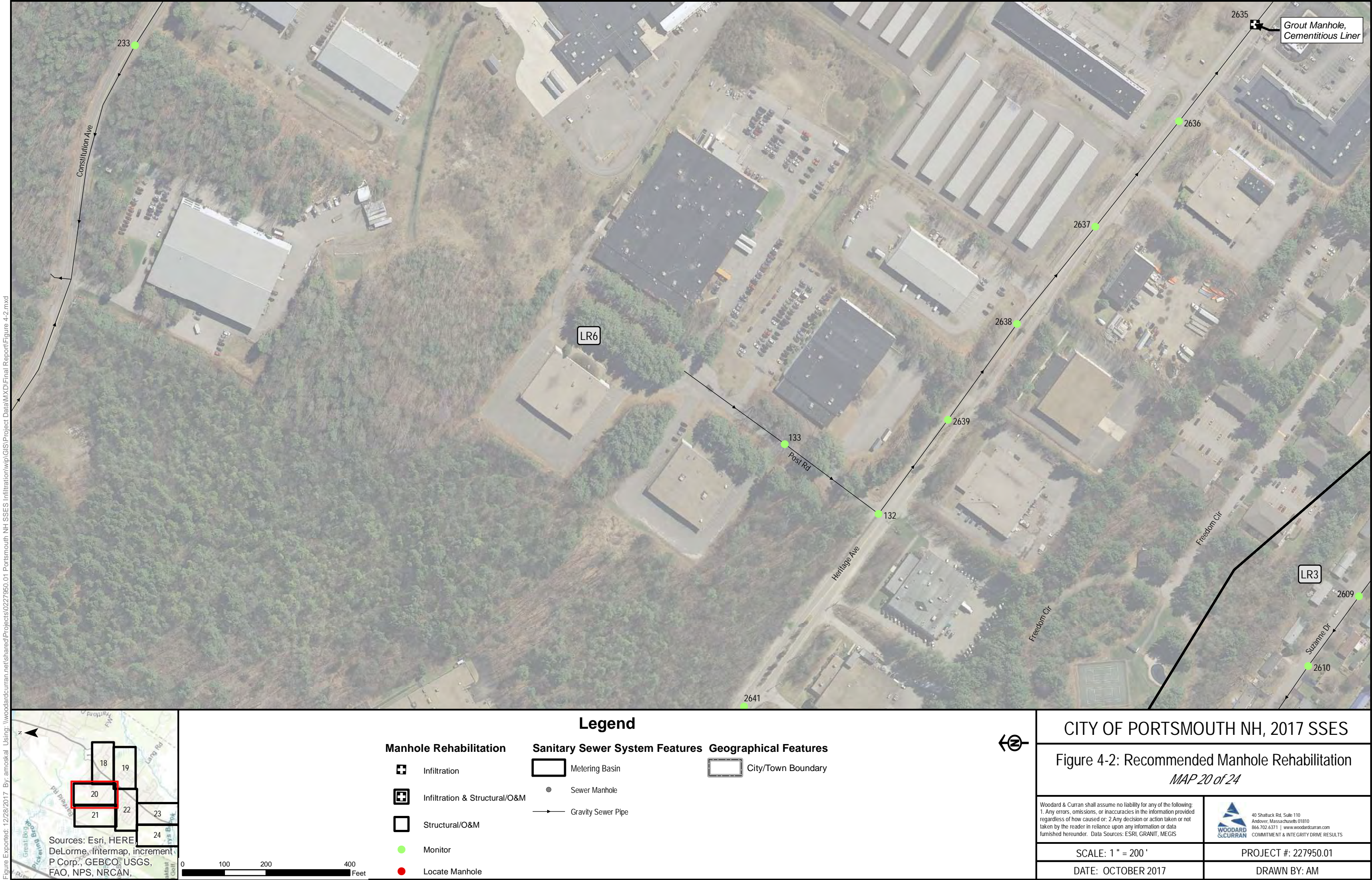
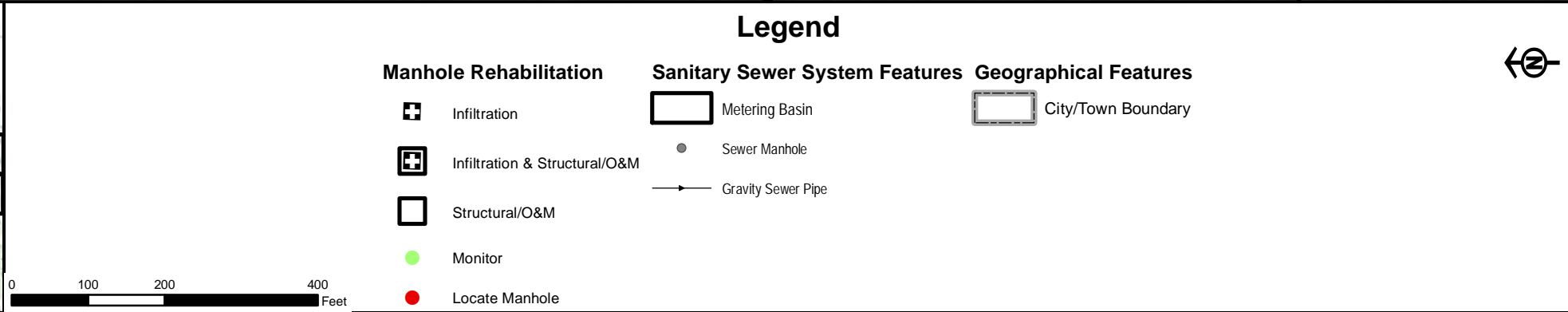
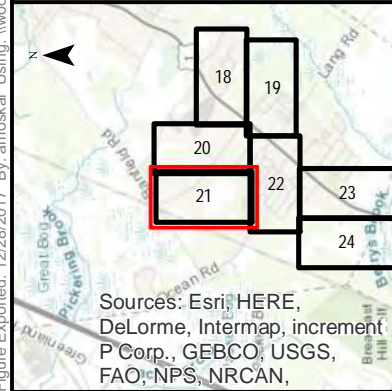




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CITY OF PORTSMOUTH NH, 2017 SSES

Figure 4-2: Recommended Manhole Rehabilitation

MAP 21 of 24

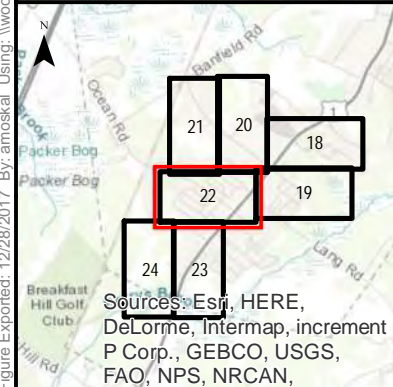
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**Legend**

Manhole Rehabilitation	Sanitary Sewer System Features	Geographical Features
Infiltration	Metering Basin	City/Town Boundary
Infiltration & Structural/O&M	Sewer Manhole	
Structural/O&M	Gravity Sewer Pipe	
Monitor		
Locate Manhole		

0 100 200 400 Feet

North Arrow

**CITY OF PORTSMOUTH NH, 2017 SSES**

**Figure 4-2: Recommended Manhole Rehabilitation**

*MAP 22 of 24*

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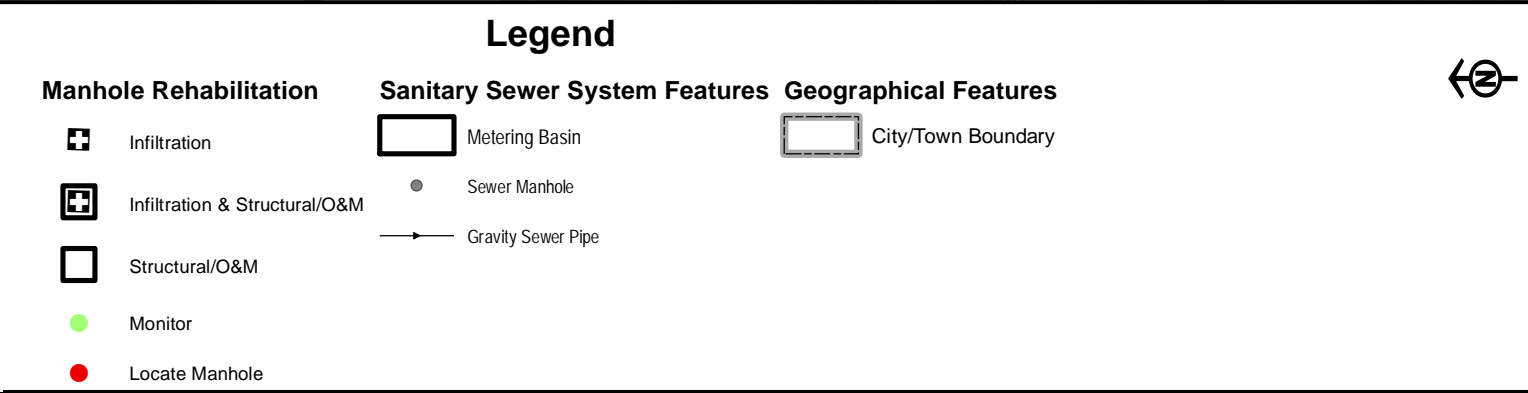
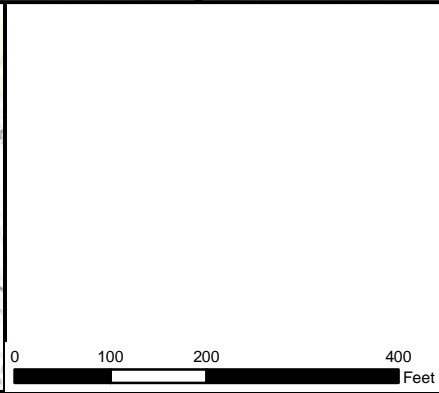
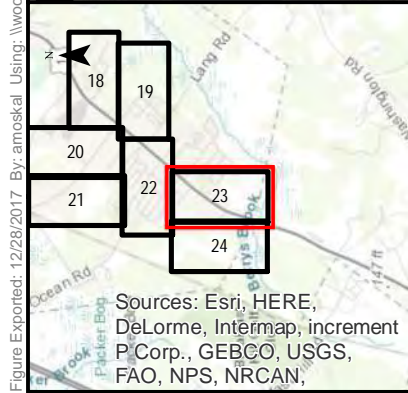
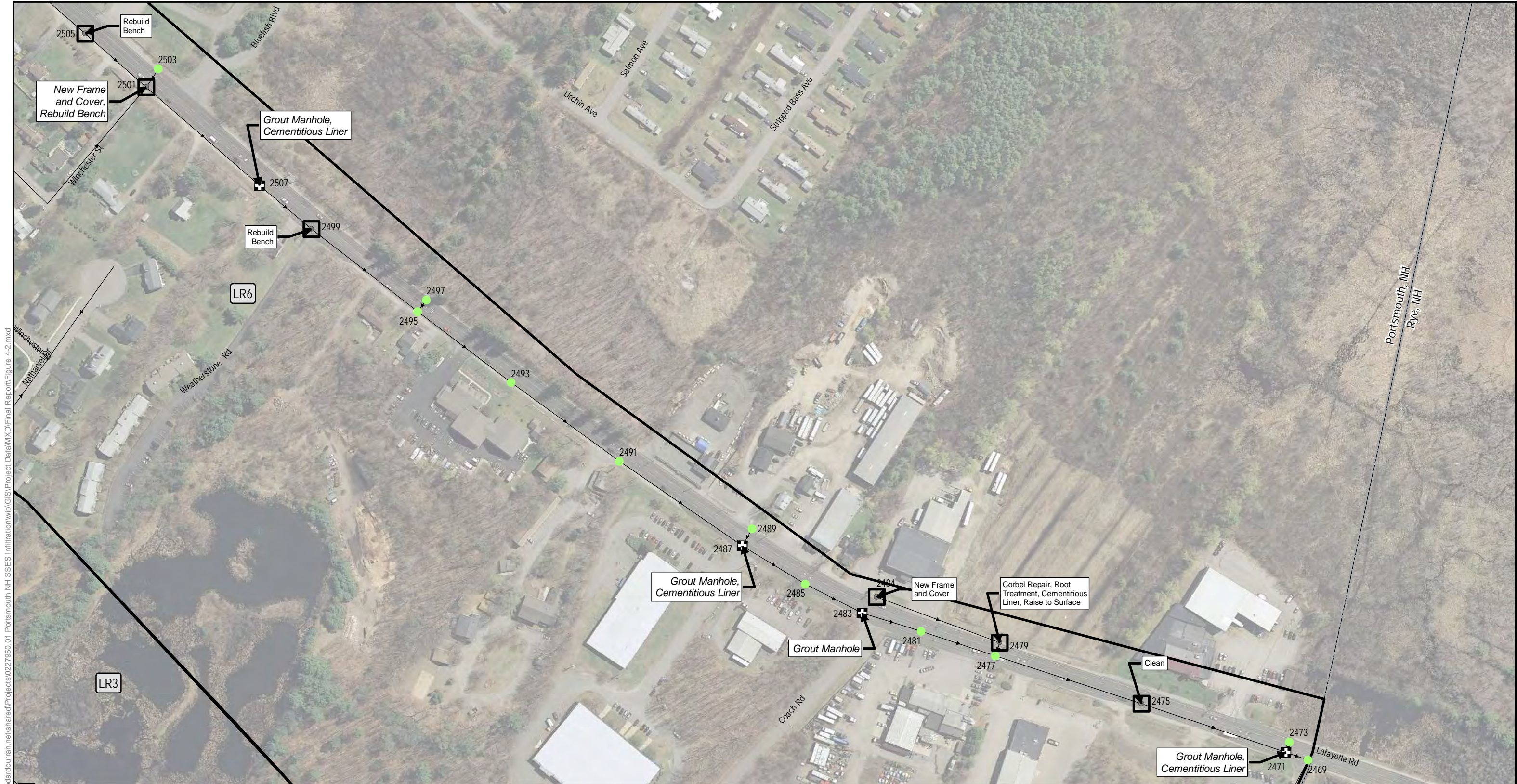
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**CITY OF PORTSMOUTH NH, 2017 SSES**

Figure 4-2: Recommended Manhole Rehabilitation  
*MAP 23 of 24*

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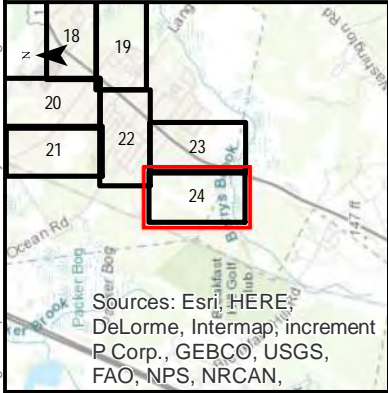
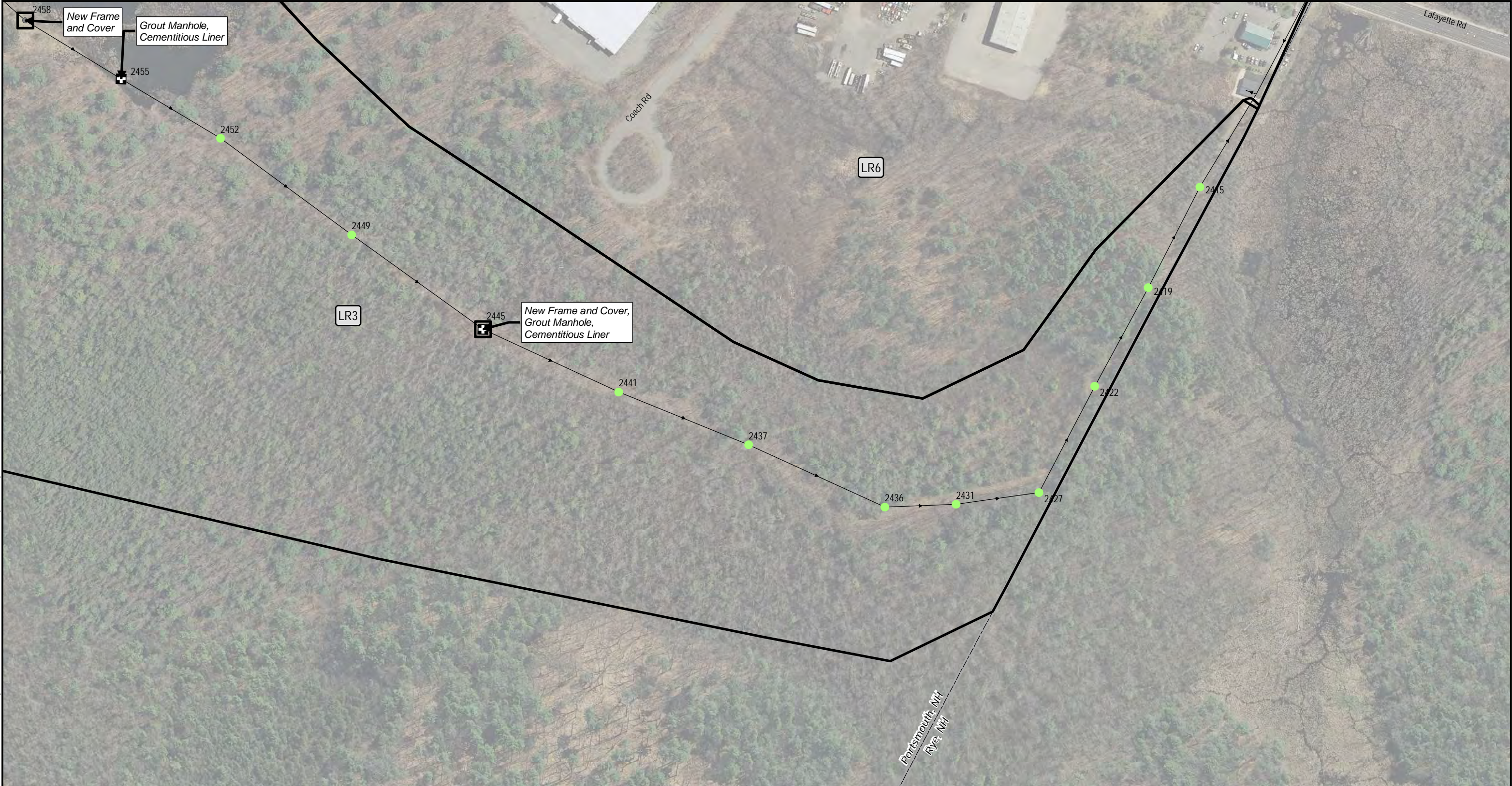
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### Legend

#### Manhole Rehabilitation

- Infiltration
- Infiltration & Structural/O&M
- Structural/O&M
- Monitor
- Locate Manhole

#### Sanitary Sewer System Features

- Metering Basin
- Sewer Manhole
- Gravity Sewer Pipe

#### Geographical Features

- City/Town Boundary

## CITY OF PORTSMOUTH NH, 2017 SSES

### Figure 4-2: Recommended Manhole Rehabilitation

*MAP 24 of 24*

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## APPENDIX C: MANHOLE INSPECTIONS AND FLOW ISOLATION DATA (PROVIDED ELECTRONICALLY)



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## APPENDIX D: CCTV DATA (PROVIDED ELECTRONICALLY)



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APPENDIX E: WOODARD & CURRAN TECHNICAL  
MEMORANDUM (TASK 4), REVIEW OF EXISTING  
CITY CCTV DATA, JULY 2017





**CITY OF PORTSMOUTH, NEW HAMPSHIRE**

**SANITARY SEWER COLLECTION SYSTEM INFILTRATION STUDY**

**DPW CCTV INSPECTION RESULTS**

**TECHNICAL MEMORANDUM**

**Subject:** Review of City CCTV Data

**Date:** July 17, 2017

**BACKGROUND**

As part of the City's Infiltration and Inflow (I/I) program, the City of Portsmouth performs Closed Circuit Television (CCTV) inspection of gravity sewers throughout the City. These inspection videos were provided to Woodard & Curran for review as part of the Phase 2 Sanitary Sewer Evaluation Survey (SSES) program. Footage of approximately 14,500 linear feet of sanitary sewer pipeline inspection was reviewed to determine the presence of I/I as well as structural defects within the sanitary sewage collection system.

Pursuant to Task 4.0 of the SSES Scope of Work, Woodard & Curran reviewed existing data collected by City crews on manhole to manhole segments of at least 1,000 linear feet that had been investigated during high groundwater conditions. This is typically during the months of March-June following the winter snowmelt. Furthermore, to ensure the relevance of the footage only videos taken after 2010 were utilized in this review.

**PROGRAM DEVELOPMENT**

The defects, recommended studies, and rehabilitation methods listed in the following tables include several types of work to investigate and/or repair defects. Addressing these defects will assist the City in reducing I/I flows in the sewer system. Removing I/I from the collection system will benefit the City in ways that include but are not limited to: improved collection system performance, reduced treatment and transport costs, assistance in maintaining wastewater discharge at the mandated limits, extending the service life of its sewer assets, and reducing operational costs.

Review of CCTV footage was performed using the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) condition scoring. The PACP scoring is a nationally recognized condition grading system utilized to rank structural and operational/maintenance defects. The video provided to Woodard & Curran by the City was graded in PACP format by City staff. Woodard & Curran supplemented the grading performed by the City of Portsmouth by grading the peak structural and maintenance defects of each pipe. The overall scoring was used to reflect the higher of the two peak scores and develop rehabilitation recommendations. **Table 1** presents a summary of CCTV observations noting defects found and estimated infiltration rate observed.





Using the PACP condition grade and type(s) of defects, recommendations for rehabilitation were made using the 0-5 scale where 0 typically indicates no action required and 5 indicates a priority repair should be made.

Based on the review of the CCTV inspections, recommendations were developed to address any defects found in each pipe segment. The recommended repair method was selected based on the type of defect found and the severity of the defect, as well as the overall condition of the pipe segment. A summary of the types of repairs recommended is presented below. Recommended repair method for each defect can be found in **Table 2**.

**CCTV:** Pressure water wash is recommended for pipe segments exhibiting significant debris and build-up, and/or pipe segments that could not be fully inspected during the initial SSES fieldwork. Segments recommended for heavy clean are also to be CCTV inspected to identify potential deficiencies.

**CCTV Lateral:** Closed circuit television inspection is recommended for service laterals that display clear water flowing consistently as this may be evidence of groundwater intruding into the collection system through a deficiency in the lateral.

**Clean, Inspect, Test and Seal (CITS):** Testing and sealing joints is recommended in pipe segments that are without observable structural deficiencies but exhibit active leaks, separated joints or circumferential cracks that could allow infiltration, and/or lie in areas of high groundwater influence.

**Cut Protruding Service:** Protruding services not only reduce the cross-sectional area of the pipe and impede the hydraulic conditions at that location but limit the ability to inspect the pipe with a CCTV camera. Such a defect is recommended to be cut from within the pipe to rectify flow.

**Root Treatment:** Chemical root treatment is recommended in pipe segments that exhibit roots growing through joints and/or defects and often includes segments where the majority of the pipe cross section is restricted by root ball growths.

**Short Liner:** A varying length cured-in-place-pipe (CIPP) liner is recommended in pipe reaches where identified leaks, cracks, or other defects occur sporadically in pipe segments that are otherwise in sound condition. Short liners include extra strength for pipe segments to provide structural support. The length of the short liner will be based on the size of the individual deficiency observed.

**Cured-In-Place-Pipe (CIPP) Liner:** A manhole-to-manhole structural CIPP liner is recommended in pipe segments where leaking joints, cracks, or other structural defects are recurring throughout the majority of the pipe segment. A CIPP liner creates a pipe within the existing pipe that reinstates the structural integrity of the pipe and removes infiltration.

**Open Cut Repair, Dig and Replace:** An open cut repair is recommended in pipe segments that are damaged beyond repair by means of trenchless rehabilitation.

**Grout Manhole:** Grouting is recommended in manholes where infiltration is observed through cracks and/or other defects in the structure.

**Continue to Monitor:** In pipe segments where defects are non-existent or minor in significance and no immediate rehabilitation is recommended, continued monitoring is the best practice.





**TABLE 1: CCTV OBSERVATIONS**

Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Video Date	Dia. (in.) Material	Observations	Infiltration Rate (gpm)
GR1	GOSLING RD PS	820	819	55	2 Osprey Drive	4/10/17	8"VCP	Infiltration Stains Throughout Pipe, Roots Fine Joint Throughout Pipe	0.3
GR1	GOSLING RD PS	819	639	335	99 Portsmouth Boulevard	4/10/17	8"VCP	Hole Void Visible at 101' DS, Infiltration Gusher at 34' and 101' DS	4.0
GR1	GOSLING RD PS	EOP	821	218	5 Osprey Drive	4/12/17	6"VCP	Fracture and Infiltration Gusher at Unknown Distance in Pipe, assumed to be 1-3' US	0.5
GR1	GOSLING RD PS	2372	813	152	Portsmouth Boulevard	4/1/14	10"VCP	Infiltration Dropper at 134' US, Heavy Debris at 124' US	0.4
GR1	GOSLING RD PS	813	814	60	Portsmouth Boulevard	4/1/14	10"VCP	Infiltration Stains in Pipe and MH 814, Cracks at 27' and 30' DS	0.1
LD1	LESLIE DRIVE PS	1021	1020	44	200 Chase Drive	1/22/15	8"AC	No significant defects observed	
LD1	LESLIE DRIVE PS	1020	1019	243	200 Chase Drive	1/22/15	8"AC	No significant defects observed	
LD1	LESLIE DRIVE PS	1019	1018	215	200 Chase Drive	1/23/15	8"AC	No significant defects observed	
LD1	LESLIE DRIVE PS	1018	1017	226	200 b Chase Street	1/23/15	8"AC	No significant defects observed	
LD1	LESLIE DRIVE PS	2375	1014	255	Michael Succi Drive	8/25/16	14"AC	Patch Repair at 46' US	
LD1	LESLIE DRIVE PS	1014	1015	198	Michael Succi Drive	8/25/16	14"AC	Roots at DS Manhole Invert	
LD1	LESLIE DRIVE PS	1015	1016	200	Michael Succi Drive	8/31/16	14"AC	Counter not utilized during survey. Hole Soil Visible and Roots in Joints at Unknown Distances	
LD1	LESLIE DRIVE PS	1016	1017	209	1 Michael Succi Drive	8/25/16	14"AC	PVC Spot Repair at 36' US, Infiltration Stains from 89'-143' US, Roots in Joint at US MH Connection	
LD1	LESLIE DRIVE PS	1017	985	191	Michael Succi Drive	8/25/16	14"AC	No significant defects observed	
LD1	LESLIE DRIVE PS	985	2365	103	Michael Succi Drive & Market Street	8/25/16	15"CI	No significant defects observed	
LR5	MECHANIC ST PS	1092	1091	528	Broad Street	5/14/14	8"VCP	Roots Medium Joint Throughout, Broken Pipe at 63' DS, Fractures Throughout Pipe	
LR6	LAFAYETTE RD PS	2630	2629	189	2458 Lafayette Road	3/30/15	8"AC	Deformed Pipe at 0' DS, Intruding Lateral at 156' DS	
LR6	LAFAYETTE RD PS	2631	2630	341	2458 Lafayette Road	3/30/15	8"AC	Surface Spalling Throughout Pipe	
LR6	LAFAYETTE RD PS	2629	2628	113	2460 Lafayette Road	3/30/15	8"AC	No significant defects observed	
LR6	LAFAYETTE RD PS	2628	2627	260	2460 Lafayette Road	3/26/15	12"AC	Infiltration Runner at 1' DS from Fractured Joint	0.3
LR6	LAFAYETTE RD PS	2627	118	218	2466 Lafayette Road	3/26/15	12"AC	Surface Spalling from 88'-95' DS, Intruding Lateral at 94' DS	1.0
LR6	LAFAYETTE RD PS	118	117	314	2468 Lafayette Road	3/26/15	12"AC	Surface Spalling, Infiltration Stains from 38-48' DS, Cavity in pipe at 148' DS	1.0
LR6	LAFAYETTE RD PS	117	2626	216	2470 Lafayette Road	3/30/15	12"AC	No significant defects observed	





Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Video Date	Dia. (in.) Material	Observations	Infiltration Rate (gpm)
LR6	LAFAYETTE RD PS	2626	2625	234	2800 Lafayette Road	3/30/15	12"AC	Cracks at 5' and 79' DS, Infiltration Runner at 143' DS	0.3
LR6	LAFAYETTE RD PS	2635	2624	200	Heritage Ave & Lafayette	3/30/15	12"AC	No significant defects observed	
LR6	LAFAYETTE RD PS	2636	2635	294	55 Heritage Avenue	3/30/15	12"AC	No significant defects observed	
LR6	LAFAYETTE RD PS	2638	2637	298	85 Heritage Avenue	3/30/15	12"AC	Broken Lateral Hole Void Visible at 286' US	
LR6	LAFAYETTE RD PS	2639	2638	282	112 Heritage Avenue	3/24/15	12"AC	Poor Survey Quality (Steam)	
LR6	LAFAYETTE RD PS	132	2639	280	145 Heritage Avenue	3/24/15	12"AC	No significant defects observed	
M1	DEER ST PS	111	110	28	134 Fairview Avenue	5/20/11	8"PVC	Separated Joint at 1.5' US, Clear Water Coming from Lateral at 4.5' US	0.3
M1	DEER ST PS	110	2129	127	139 Fairview Avenue	5/20/11	8"PVC	No significant defects observed	
M1	DEER ST PS	100	99	274	I-95 & Maplewood Avenue	5/23/11	10"PVC	No significant defects observed	
M1	DEER ST PS	99	98	19	678 Maplewood Avenue	5/23/11	10"PVC	No significant defects observed	
M1	DEER ST PS	98	97	193	678 Maplewood Avenue	5/23/11	10"PVC	No significant defects observed	
M1	DEER ST PS	102	101	138	768 Maplewood Avenue	5/20/11	10"PVC	Medium grease deposits throughout pipe	
M1	DEER ST PS	103	102	89	791 Maplewood Avenue	5/20/11	8"PVC	No significant defects observed	
M1	DEER ST PS	2128	2129	132	828 Maplewood Avenue	5/20/11	8"PVC	Infiltration Gusher at DS Manhole Connection	0.8
M1	DEER ST PS	2129	2132	223	860 Maplewood Avenue	5/20/11	8"PVC	Infiltration Dripper at 160' DS	0.1
M1	DEER ST PS	105	104	261	940 Maplewood Avenue	5/19/11	8"PVC	Grease Deposits at 250' DS, Clear Water Coming from Lateral at 192' DS	0.3
M1	DEER ST PS	2359	105	169	979 Maplewood Avenue	5/19/11	8"PVC	Clear Water Coming from Lateral at 33' US	0.3
P2A	WOODLANDS 1 PS	2423	2428	342	270 F.W. Hartford Drive	5/5/14	8"PVC	Infiltration Dripper at 100' DS, Sag in Pipe at 140' DS	0.1
P3	WEST RD PS	2188	2187	154	60 West Road	5/11/12	8"PVC	No significant defects observed	0.8
P3	WEST RD PS	2187	2186	424	100 West Road	5/11/12	8"PVC	Sag in pipe at 23' DS, Hole Void Visible at 82' DS, Heavy Grease Deposits at 276' DS	
P3	WEST RD PS	2186	2185	291	140 West Road	5/11/12	8"PVC	Separated Joint at 49' DS, Heavy Debris from 180'-187' DS	
P3	WEST RD PS	2185	2184	199	155 West Road	5/10/12	8"PVC	Deformed Pipe at 37' US, Offset Joint at 140' US. Survey Abandoned at 132' US	
P3	WEST RD PS	2184	2183	230	170 West Road	5/10/12	8"PVC	No significant defects observed	
P3	WEST RD PS	2183	2182	268	195 West Road	5/9/12	8"PVC	Separated joint at 174' DS, Pipe Sag at 179' DS	
P3	WEST RD PS	2182	2177	349	200 West Road	5/3/16	8"PVC	Infiltration Dripper (Unknown Location)	0.1
P3	WEST RD PS	2177	2176	249	240 West Road	5/9/12	8"PVC	Infiltration Runner at 144' US, Pipe Sag at 159' US	0.8
P3	WEST RD PS	2176	2175	243	270 West Road	12/21/15	8"PVC	Broken Pipe at MH 2175	





Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Video Date	Dia. (in.) Material	Observations	Infiltration Rate (gpm)
P3	WEST RD PS	2174	5558	314	300 West Road	5/8/12	8"PVC	Debris in Pipe from 5-14' DS, Downstream Manhole Cover Leaking	
P3	WEST RD PS	5558	2175	332	300 West Road	12/17/15	8"PVC	Debris in Pipe at 65' DS	

## CCTV PROGRAM RESULTS

**Table 2** presents the defect score and recommended Rehabilitation method developed from the review of the CCTV data. Assets listed in Table 1 that are included in one of the Pilot Area Metering Basins (P1, P2, P2A, or P3) were not included in the following table as they are being investigated as part of the larger SSES CCTV inspections and will have recommendations in the final SSES report. For pipes listed in **Table 1** that were found to have no significant defects, it is recommended that the city continue to monitor these pipes to verify that no defects develop as the pipes continue to age.

Completion of the recommended program can reduce infiltration into the sewer system by an estimated 14,000 gpd. In addition to the reduction in wastewater loading, the City should see improved sewer operation following correction of defects such as root intrusion and debris.

Attached to this memorandum is a set of figures displaying the recommended rehabilitation for each pipe segment listed in **Table 2**. For pipes with more than one recommended rehab activity, multiple colors are overlaid on the same pipe segment.

**TABLE 2: DEFECT SCORE AND RECOMMENDED REHABILITATION**

Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Dia. (in.) Material	Defect Score			Recommended Rehabilitation	Estimated Repair Cost (\$)
							Structural	O&M	Overall		
GR1	GOSLING RD PS	820	819	55	2 Osprey Drive	8" VCP	0	3	3	Root treatment, CITS	1,300
GR1	GOSLING RD PS	819	639	335	99 Portsmouth Boulevard	8" VCP	5	5	5	Open Cut Replace Entire Pipe	164,000
GR1	GOSLING RD PS	EOP	821	218	5 Osprey Drive	6" VCP	2	5	5	Possible 6' Short Liner at Beginning of Pipe	3,000
GR1	GOSLING RD PS	2372	813	152	Portsmouth Boulevard	10" VCP	0	5	5	CITS	2,600
GR1	GOSLING RD PS	813	814	60	Portsmouth Boulevard	10" VCP	2	3	3	Heavy Clean, 6' Short Liner at 27'-30' DS, CITS, Grout Manhole 814	5,500
LD1	LESLIE DRIVE PS	1015	1016	200	Michael Succi Drive	14" AC	5	3	5	Possible 6' Short Liner Once Hole is Located	3,000
LD1	LESLIE DRIVE PS	1016	1017	209	1 Michael Succi Drive	14" AC	3	2	3	CITS	600
LR5	MECHANIC ST PS	1092	1091	528	Broad Street	8" VCP	5	4	5	Root Treatment, MH-MH CIPP	36,200
LR6	LAFAYETTE RD PS	2630	2629	189	2458 Lafayette Road	8" AC	4	2	4	Cut Protruding Service at 156' DS	600
LR6	LAFAYETTE RD PS	2628	2627	260	2460 Lafayette Road	12" AC	0	4	4	CITS, 6' Short Liner at 1' DS	5,100





Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Dia. (in.) Material	Defect Score			Recommended Rehabilitation	Estimated Repair Cost (\$)
							Structural	O&M	Overall		
LR6	LAFAYETTE RD PS	2627	118	218	2466 Lafayette Road	12" AC	2	3	3	Cut Protruding Service at 94' DS	600
LR6	LAFAYETTE RD PS	118	117	314	2468 Lafayette Road	12" AC	2	2	2	6' Short Liner at 148' DS	3,000
LR6	LAFAYETTE RD PS	2626	2625	234	2800 Lafayette Road	12" AC	2	4	4	CITS, 6' Short Liners at 5' and 79' DS	7,900
M1	DEER ST PS	111	110	28	134 Fairview Avenue	8" PVC	2	0	2	Lateral Sealing 4.5' US	300
M1	DEER ST PS	2128	2129	132	828 Maplewood Avenue	8" PVC	0	5	5	Grout Manhole 2129	1,100
M1	DEER ST PS	2129	2132	223	860 Maplewood Avenue	8" PVC	0	2	2	CITS	1,800
M1	DEER ST PS	105	104	261	940 Maplewood Avenue	8" PVC	0	3	3	Heavy Cleaning and Lateral Sealing 192' DS	1,800
M1	DEER ST PS	2359	105	169	979 Maplewood Avenue	8" PVC	0	4	4	Lateral Sealing 33' US	300
<b>Total</b>											<b>239,000</b>

## RECOMMENDED REHABILITATION PROGRAM

The City's wishes to reduce infiltration and inflow in the sanitary sewer collection system, and is developing an implementable action plan to address known defects. While it would be ideal to rehabilitate every collection system defect or I/I source uncovered during the CCTV review, it may be necessary to prioritize repairs based on available funds to perform the work. In general, we recommend a phased sewer system rehabilitation program focused on addressing the most severe defects encountered during the investigations while maintaining a database of the remaining defects for future rehabilitation consideration.

The total program cost not including engineering is estimated at \$239,000. Prices were generated using unit price costs from projects of similar size and scope. Unit price costs referenced from previous projects were inflated 3% from the previous year's value and given a 5% contingency.

Rehabilitation of the 99 Portsmouth Boulevard (MH 819 – MH 639) defect will require open cut excavation to repair a mainline with multiple holes, fractures, and points of observed infiltration. Repair by trenchless means does not seem feasible as there is evidence that the pipe structure is beginning to deform and is experiencing loads that could cause a complete collapse. The existing pipe is beneath a drainage swale and has a sloped ground surface above. To mitigate soil movement during construction, permanent sheeting should be installed uphill of the excavated trench. To protect and repair the drainage swale during construction, stormwater best management practices (BMP's) should be utilized wherever suitable.

**Table 3** presents a summary of defects by infiltration from the defect, defect rating, and cost to rehabilitate. It is recommended that the City address the defects by defect rating as funds become available. Defects with a 4 or 5 defect rating are the most serious and should be addressed first. This table summarizes the work which could be included in a sewer rehabilitation contract to address structural and infiltration-related defects noted during the inspections.





**TABLE 3: DEFECTS BY RATING**

Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Dia. (in.) Material	Defect Rating	Infiltration Rate (gpd)	Recommended Rehabilitation	Estimated Repair Cost
GR1	GOSLING RD PS	819	639	335	99 Portsmouth Boulevard	8" VCP	5	5,760	Open Cut Replace Entire Pipe	164,000
M1	DEER ST PS	2128	2129	132	828 Maplewood Avenue	8" PVC	5	1,152	Grout Manhole 2129	1,100
GR1	GOSLING RD PS	EOP	821	218	5 Osprey Drive	6" VCP	5	720	Possible 6' Short Liner at Beginning of Pipe	3,000
GR1	GOSLING RD PS	2372	813	152	Portsmouth Boulevard	10" VCP	5	576	CITS	2,600
LD1	LESLIE DRIVE PS	1015	1016	200	Michael Succi Drive	14" AC	5	0	Possible 6' Short Liner Once Hole is Located	3,000
LR5	MECHANIC ST PS	1092	1091	528	Broad Street	8" VCP	5	0	Root Treatment, MH-MH CIPP	36,200
<b>Defect Rating 5 Subtotal</b>										<b>\$ 209,900</b>
LR6	LAFAYETTE RD PS	2628	2627	260	2460 Lafayette Road	12" AC	4	432	CITS, 6' Short Liner at 1' DS	5,100
LR6	LAFAYETTE RD PS	2626	2625	234	2800 Lafayette Road	12" AC	4	432	CITS, 6' Short Liners at 5' and 79' DS	7,900
M1	DEER ST PS	2359	105	169	979 Maplewood Avenue	8" PVC	4	432	Lateral Sealing 33' US	300
LR6	LAFAYETTE RD PS	2630	2629	189	2458 Lafayette Road	8" AC	4	0	Cut Protruding Service at 156' DS	600
<b>Defect Rating 4 Subtotal</b>										<b>\$ 13,900</b>
GR1	GOSLING RD PS	820	819	55	2 Osprey Drive	8" VCP	3	432	Root treatment, CITS	1,300
LR6	LAFAYETTE RD PS	2627	118	218	2466 Lafayette Road	12" AC	3	1,440	Cut Protruding Service at 94' DS	600
M1	DEER ST PS	105	104	261	940 Maplewood Avenue	8" PVC	3	432	Heavy Cleaning and Lateral Sealing 192' DS	1,800
GR1	GOSLING RD PS	813	814	60	Portsmouth Boulevard	10" VCP	3	144	Heavy Clean, 6' Short Liner at 27'-30' DS, CITS, Grout Manhole 814	5,500
LD1	LESLIE DRIVE PS	1016	1017	209	1 Michael Succi Drive	14" AC	3	0	CITS	600
<b>Defect Rating 3 Subtotal</b>										<b>\$ 9,800</b>
LR6	LAFAYETTE RD PS	118	117	314	2468 Lafayette Road	12" AC	2	1,440	6' Short Liner at 148' DS	3,000
M1	DEER ST PS	111	110	28	134 Fairview Avenue	8" PVC	2	432	Lateral Sealing 4.5' US	300
M1	DEER ST PS	2129	2132	223	860 Maplewood Avenue	8" PVC	2	144	CITS	1,800
<b>Defect Rating 2 Subtotal</b>										<b>\$ 5,100</b>





**Table 4** summarizes the cost and estimated removable infiltration by defect rating. Defects with a rating of 5 have the highest cost but also result in the most infiltration removed. The total cost of the rating 5 rehabilitation is driven by the high cost to excavate and replace sewer segment 819-639 on Portsmouth Boulevard which is 78% of the total cost for all defect 5 rehabilitation, but accounts for 41% of the total estimated removable infiltration. Other defects which can be repaired in situ have lower rehabilitation costs.

**TABLE 4: SUMMARY BY DEFECT RATING**

Defect Rating	Cost	Estimated Removable I/I (gpd)
5	\$ 209,900	8,208
4	\$ 13,900	1,296
3	\$ 9,800	2,448
2	\$ 5,100	2,016
1	\$ -	0
Total	\$ 239,000	13,968

## FURTHER INVESTIGATIONS

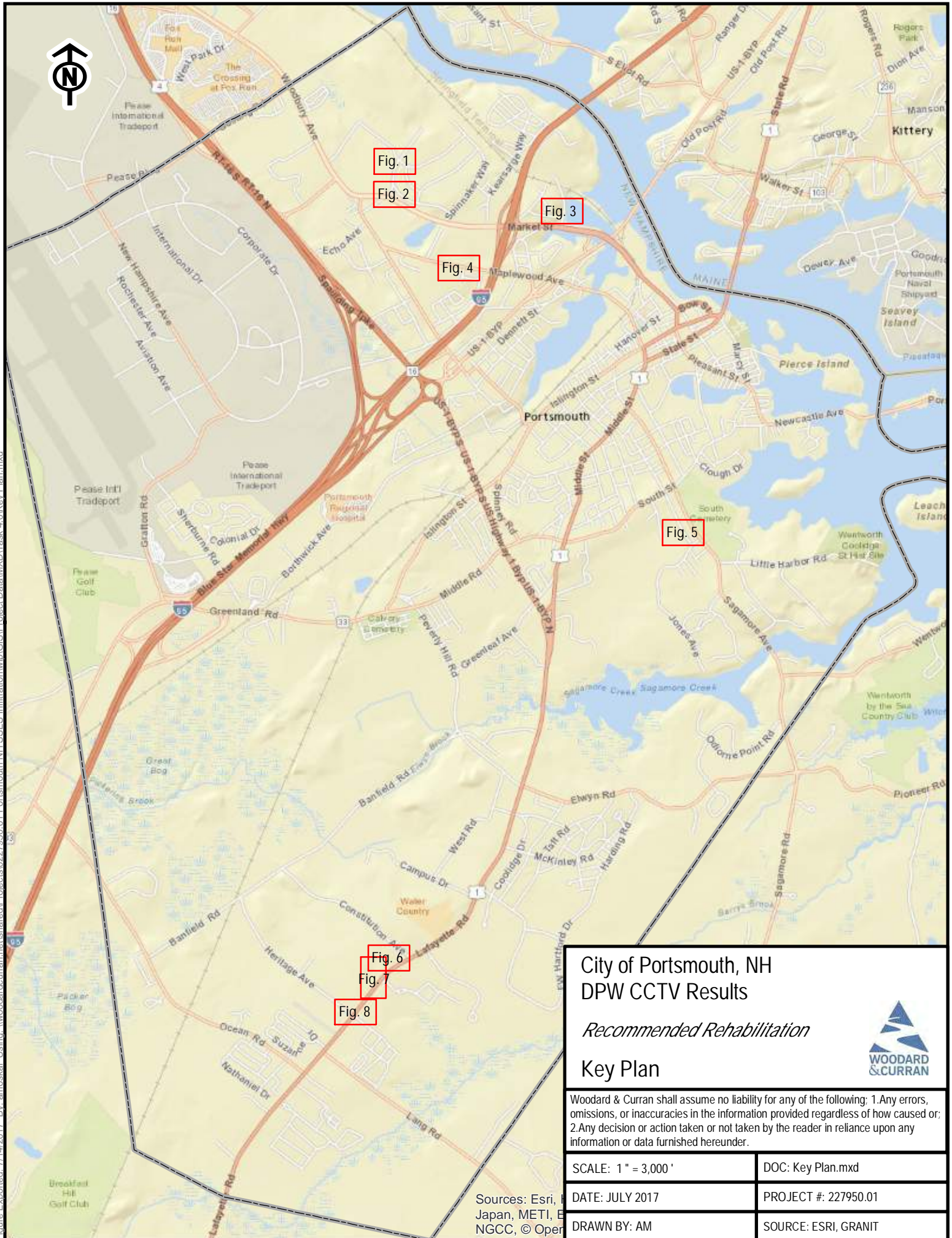
We recommend that the City continue to investigate its collection system to identify and address system defects before they become emergencies as well as to build an electronic database of system conditions. During our review of City CCTV data, some pipe segments revealed clear water running from laterals that should be investigated by lateral inspection during high groundwater periods. Inspections that were incomplete can be inspected by reversal or other means as time and resources are available. Woodard & Curran recommends that the City continue their efforts in monitoring the overall sewer system. A list of specific areas for additional investigation is included in **Table 5**.

**TABLE 5: FUTURE INVESTIGATIONS**

Metering Basin	Pump Station Basin	From MH	To MH	LF	Location	Dia. (in.) Material	Description	Estimated Cost (\$)
GR1	GOSLING RD PS	EOP	821	218	5 Osprey Drive	6" VCP	CCTV to Complete Investigation	1,200
GR1	GOSLING RD PS	2372	813	152	Portsmouth Boulevard	10" VCP	CCTV to Complete Investigation	800
LD1	LESLIE DRIVE PS	1015	1016	200	Michael Succi Drive	14" AC	CCTV to Complete Investigation	1,100
LR5	MECHANIC ST PS	1092	1091	528	Broad Street	8" VCP	CCTV to Complete Investigation	2,800
M1	DEER ST PS	111	110	28	134 Fairview Avenue	8" PVC	CCTV Lateral at 4.5' US	200
M1	DEER ST PS	105	104	261	940 Maplewood Avenue	8" PVC	CCTV Lateral at 192' DS	200
M1	DEER ST PS	2359	105	169	979 Maplewood Avenue	8" PVC	CCTV Lateral at 33' US	200
<b>Total</b>								<b>\$ 6,500</b>



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# City of Portsmouth, NH DPW CCTV Results *Recommended Rehabilitation* Key Plan



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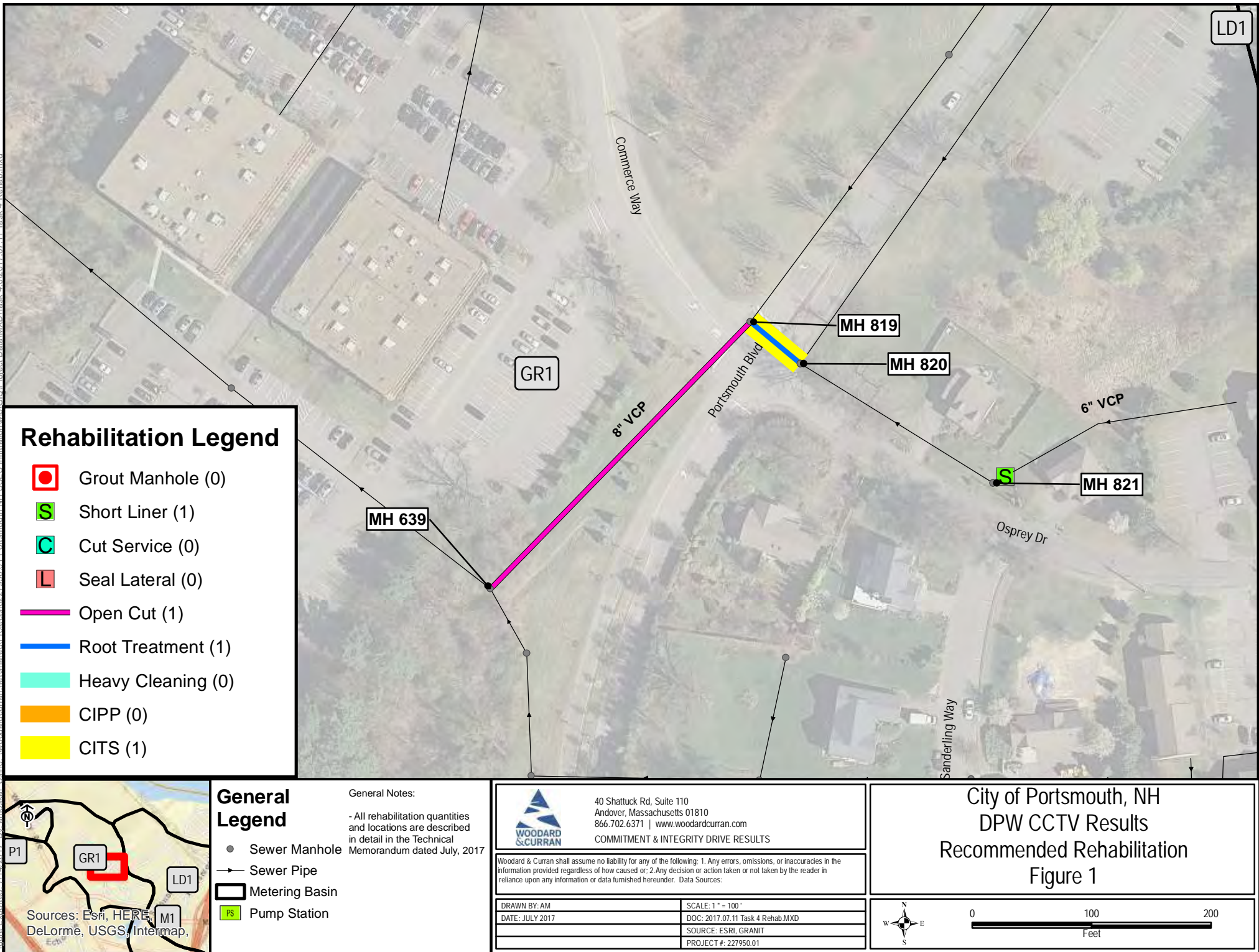
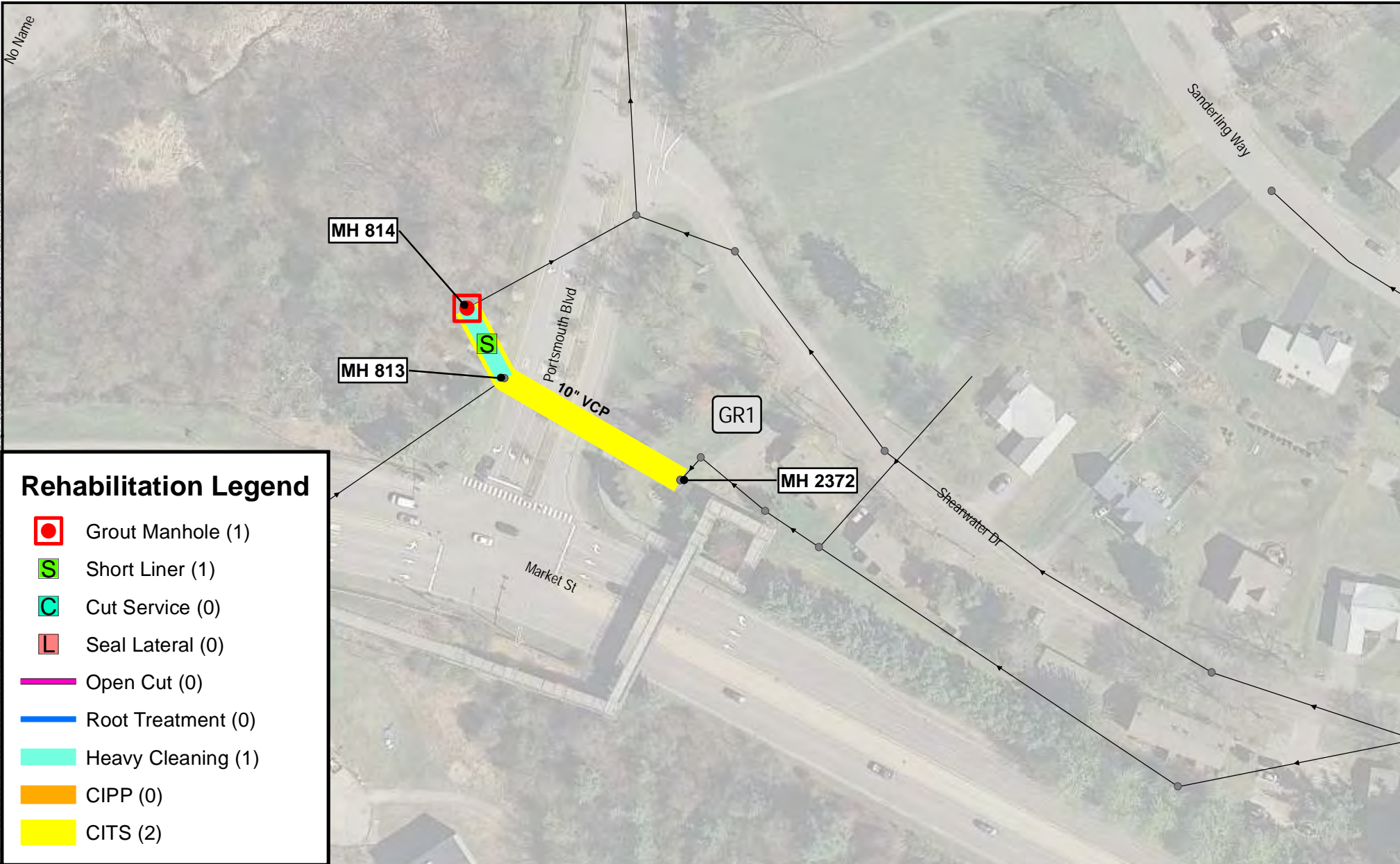




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### Rehabilitation Legend

- Grout Manhole (1)
- Short Liner (1)
- Cut Service (0)
- Seal Lateral (0)
- Open Cut (0)
- Root Treatment (0)
- Heavy Cleaning (1)
- CIPP (0)
- CITS (2)



### General Legend

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- Pump Station

General Notes:  
- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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## City of Portsmouth, NH

## DPW CCTV Results

## Recommended Rehabilitation

### Figure 2



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### Rehabilitation Legend

- Grout Manhole (0)
- Short Liner (1)
- Cut Service (0)
- Seal Lateral (0)
- Open Cut (0)
- Root Treatment (0)
- Heavy Cleaning (0)
- CIPP (0)
- CITS (1)



### General Legend

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- Pump Station

General Notes:

- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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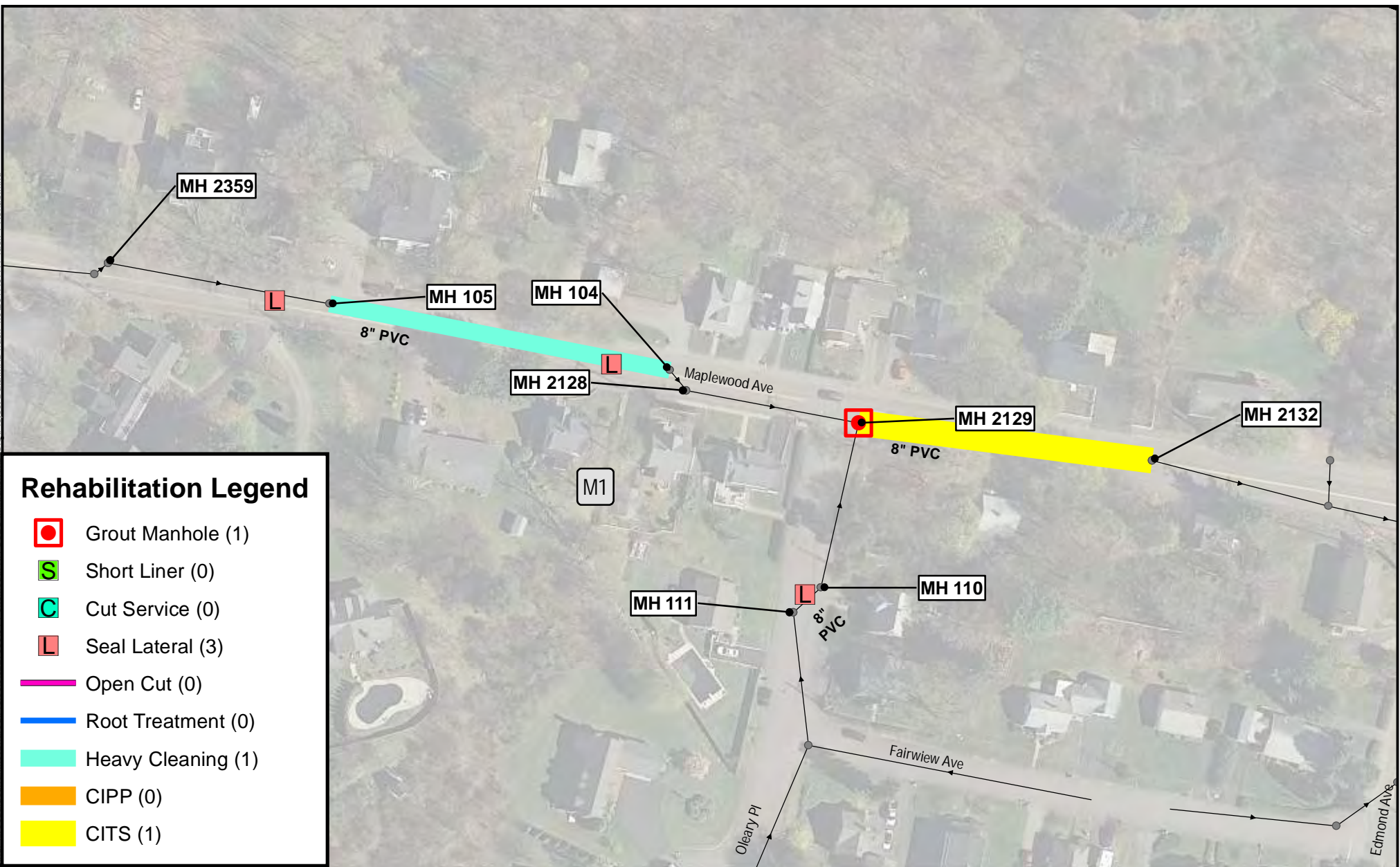
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## City of Portsmouth, NH DPW CCTV Results Recommended Rehabilitation Figure 3



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**General Legend**

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- Pump Station

**General Notes:**

- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

City of Portsmouth, NH  
DPW CCTV Results  
Recommended Rehabilitation  
Figure 4

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### Rehabilitation Legend

- Grout Manhole (0)
- Short Liner (0)
- Cut Service (0)
- Seal Lateral (0)
- Open Cut (0)
- Root Treatment (1)
- Heavy Cleaning (0)
- CIPP (1)
- CITS (0)



### General Legend

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- Pump Station

General Notes:

- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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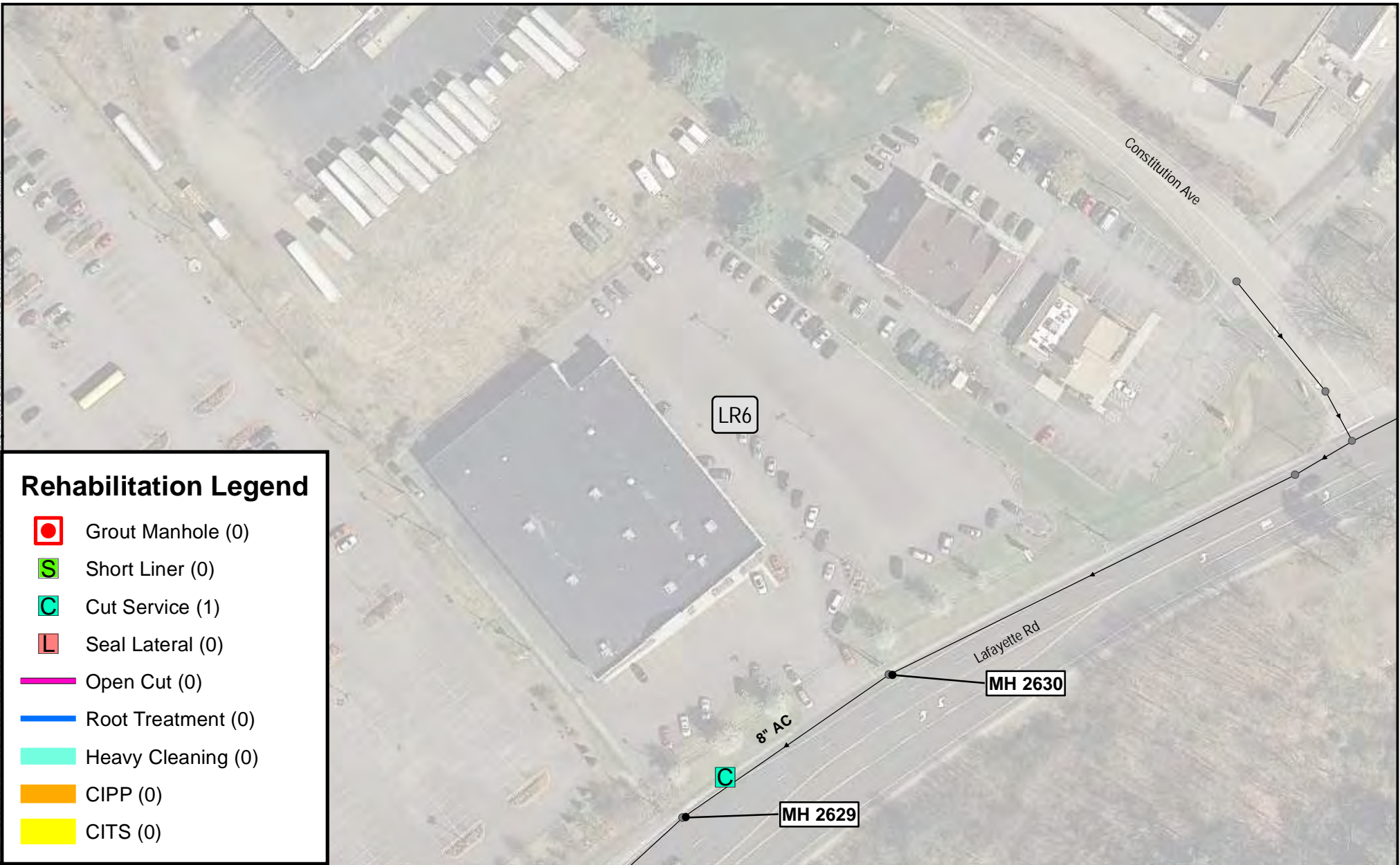
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DRAWN BY: AM	SCALE: 1" = 100'
DATE: JULY 2017	DOC: 2017.07.11 Task 4 Rehab.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

### City of Portsmouth, NH DPW CCTV Results Recommended Rehabilitation Figure 5



Figure Exposed: 7/14/2017 By: amoskel Using: WoodardCurran.mxd Project: 227950.01 Portsmouth NH SSES Infiltration w/ GIS Project Data.MXD Task: 4.02017.07.11 Task 4 Rehab.mxd



### Rehabilitation Legend

- Grout Manhole (0)
- S Short Liner (0)
- C Cut Service (1)
- L Seal Lateral (0)
- Open Cut (0)
- Root Treatment (0)
- Heavy Cleaning (0)
- CIPP (0)
- CITS (0)



### General Legend

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- PS Pump Station

General Notes:

- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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COMMITMENT & INTEGRITY DRIVE RESULTS

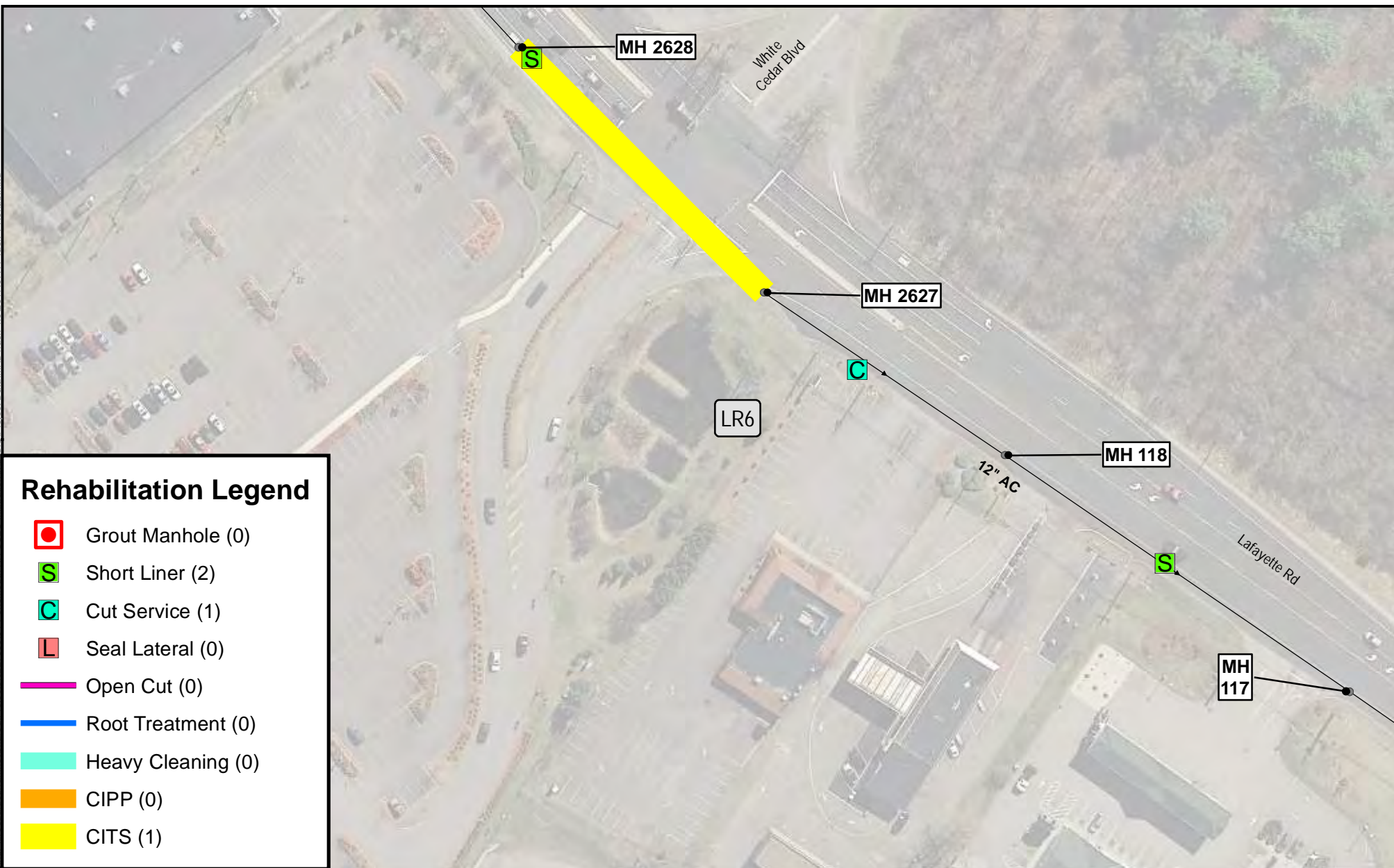
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DRAWN BY: AM	SCALE: 1" = 100'
DATE: JULY 2017	DOC: 2017.07.11 Task 4 Rehab.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

## City of Portsmouth, NH DPW CCTV Results Recommended Rehabilitation Figure 6

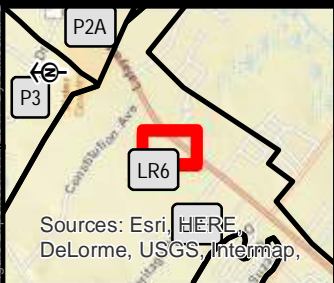


Figure Exposed: 7/14/2017 By: amoskai Using: Woodardcurran.mxd Project: 227950.01 Portsmouth NH SSES Infiltration w/ GIS Project Data.MXD Task: 4.02017.07.11 Task 4 Rehab.mxd



### Rehabilitation Legend

- Grout Manhole (0)
- Short Liner (2)
- Cut Service (1)
- Seal Lateral (0)
- Open Cut (0)
- Root Treatment (0)
- Heavy Cleaning (0)
- CIPP (0)
- CITS (1)



### General Legend

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- Pump Station

General Notes:  
- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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DATE: JULY 2017	DOC: 2017.07.11 Task 4 Rehab.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

## City of Portsmouth, NH

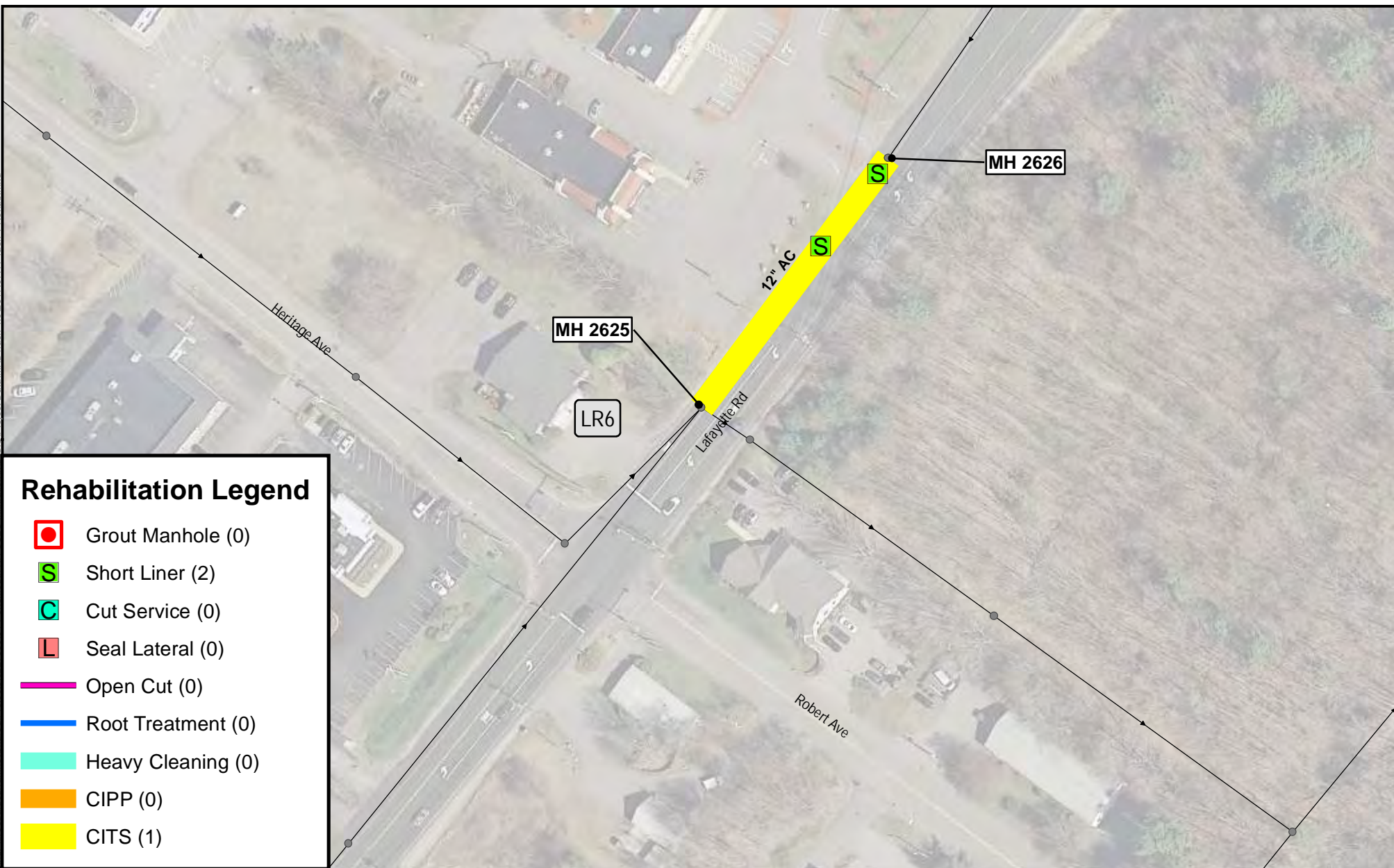
## DPW CCTV Results

## Recommended Rehabilitation

### Figure 7



Figure Exposed: 7/14/2017 By: amoskel Using: WoodardCurran.mxd Project: 227950.01 Portsmouth NH SSES Infiltration w/ GIS Project Data.MXD Task: 4.02017.07.11 Task 4 Rehab.mxd



### Rehabilitation Legend

- Grout Manhole (0)
- Short Liner (2)
- Cut Service (0)
- Seal Lateral (0)
- Open Cut (0)
- Root Treatment (0)
- Heavy Cleaning (0)
- CIPP (0)
- CITS (1)



### General Legend

- Sewer Manhole
- Sewer Pipe
- Metering Basin
- Pump Station

General Notes:

- All rehabilitation quantities and locations are described in detail in the Technical Memorandum dated July, 2017

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DATE: JULY 2017	DOC: 2017.07.11 Task 4 Rehab.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

## City of Portsmouth, NH DPW CCTV Results Recommended Rehabilitation Figure 8



APPENDIX F: UNDERWOOD ENGINEERS PILOT AREA  
TECHNICAL MEMORANDUM DATED SEPTEMBER  
2017 (PROVIDED ELECTRONICALLY)



APPENDIX G: UNDERWOOD ENGINEERS PILOT AREA  
TECHNICAL MEMORANDUM DATED AUGUST 2019  
(PROVIDED ELECTRONICALLY)



---

## APPENDIX H: SEWER MAP REVISIONS



# 1



84 Daniel Plummer Road  
Goffstown, NH 03045  
(603) 656-9799

JOB PORTSMOUTH, NHSHEET NO. 10

OF

CALCULATED BY RN

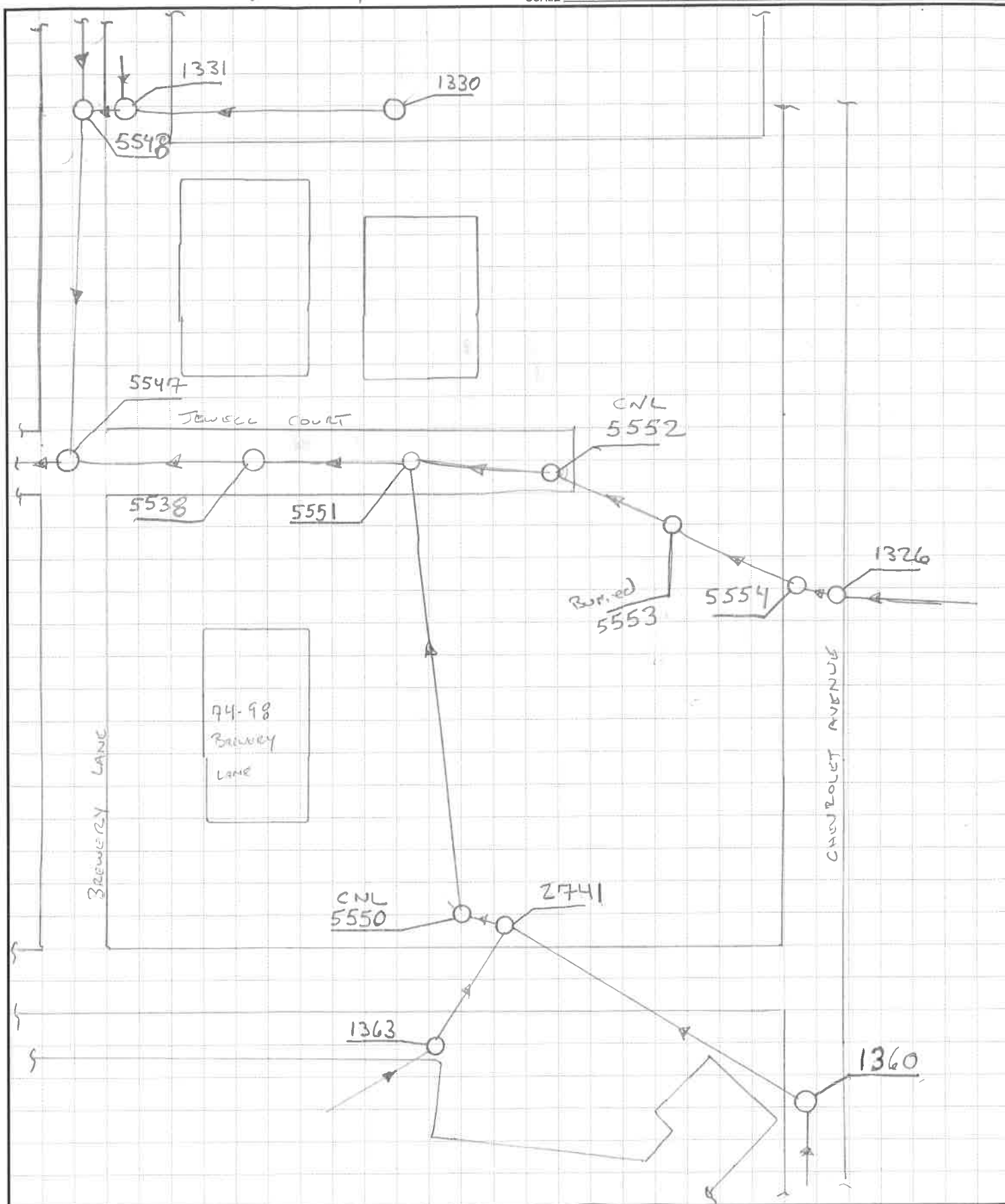
DATE

CHECKED BY

DATE

SCALE NOT TO SCALE

HS11





# 2



84 Daniel Plummer Road  
Goffstown, NH 03045  
(603) 656-9799

HS 11

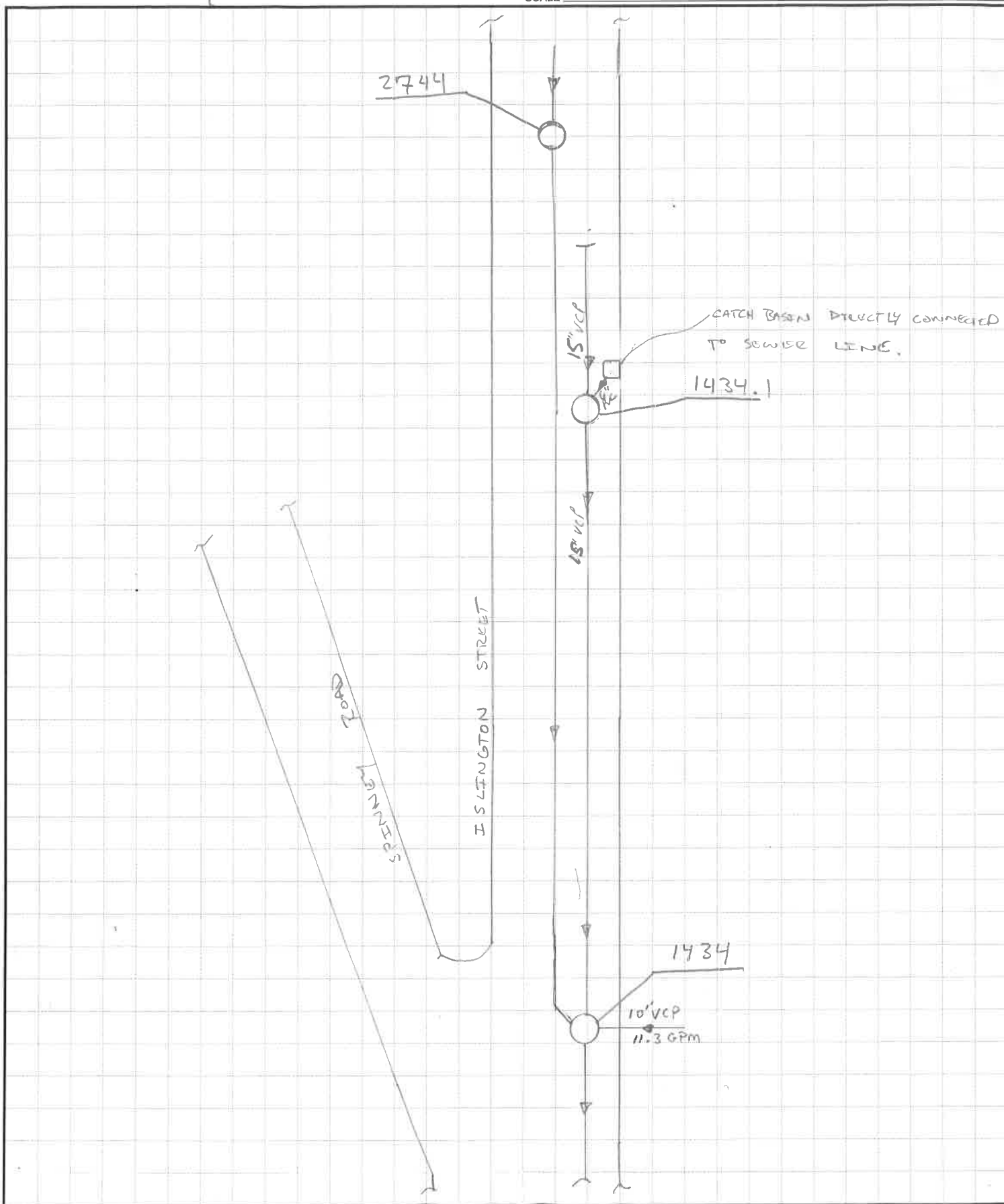
JOB PORTSMOUTH, NH FLOW ISOLATION

SHEET NO. 10 OF       

CALCULATED BY RV DATE       

CHECKED BY RV DATE       

SCALE NOT TO SCALE





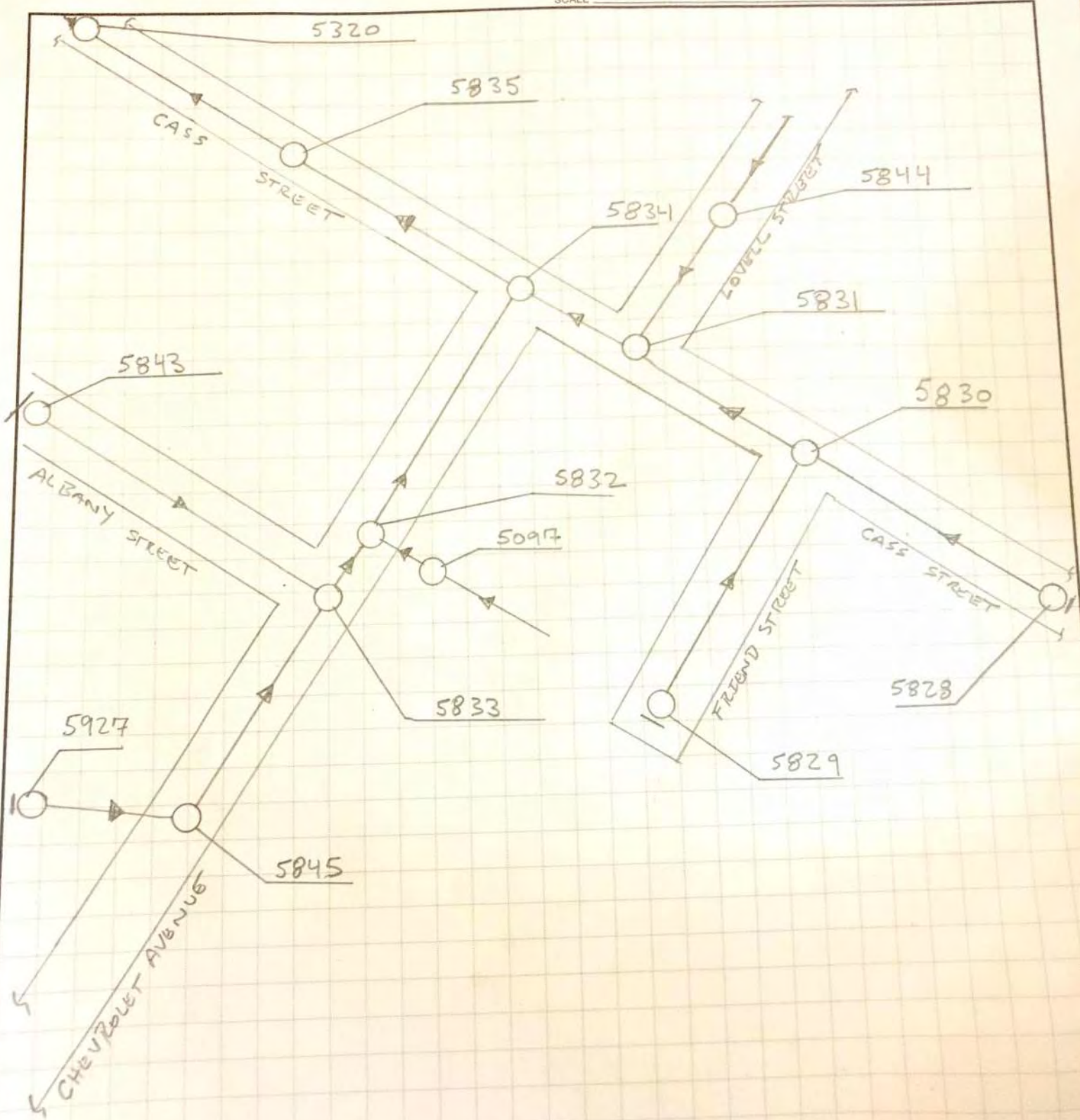
SKETCH#3 REVISED



84 Daniel Plummer Road  
Goffstown, NH 03045  
(603) 656-9799

AREA H S41 Sheet 8/10

JOB PORTSMOUTH, NH  
SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_  
CALCULATED BY \_\_\_\_\_ DATE \_\_\_\_\_  
CHECKED BY RV DATE \_\_\_\_\_  
SCALE NOT TO SCALE





#4



84 Daniel Plummer Road  
Goffstown, NH 03045  
(603) 656-9799

JOB Pocassetbury, NH

SHEET NO. 8

OF

CALCULATED BY RV

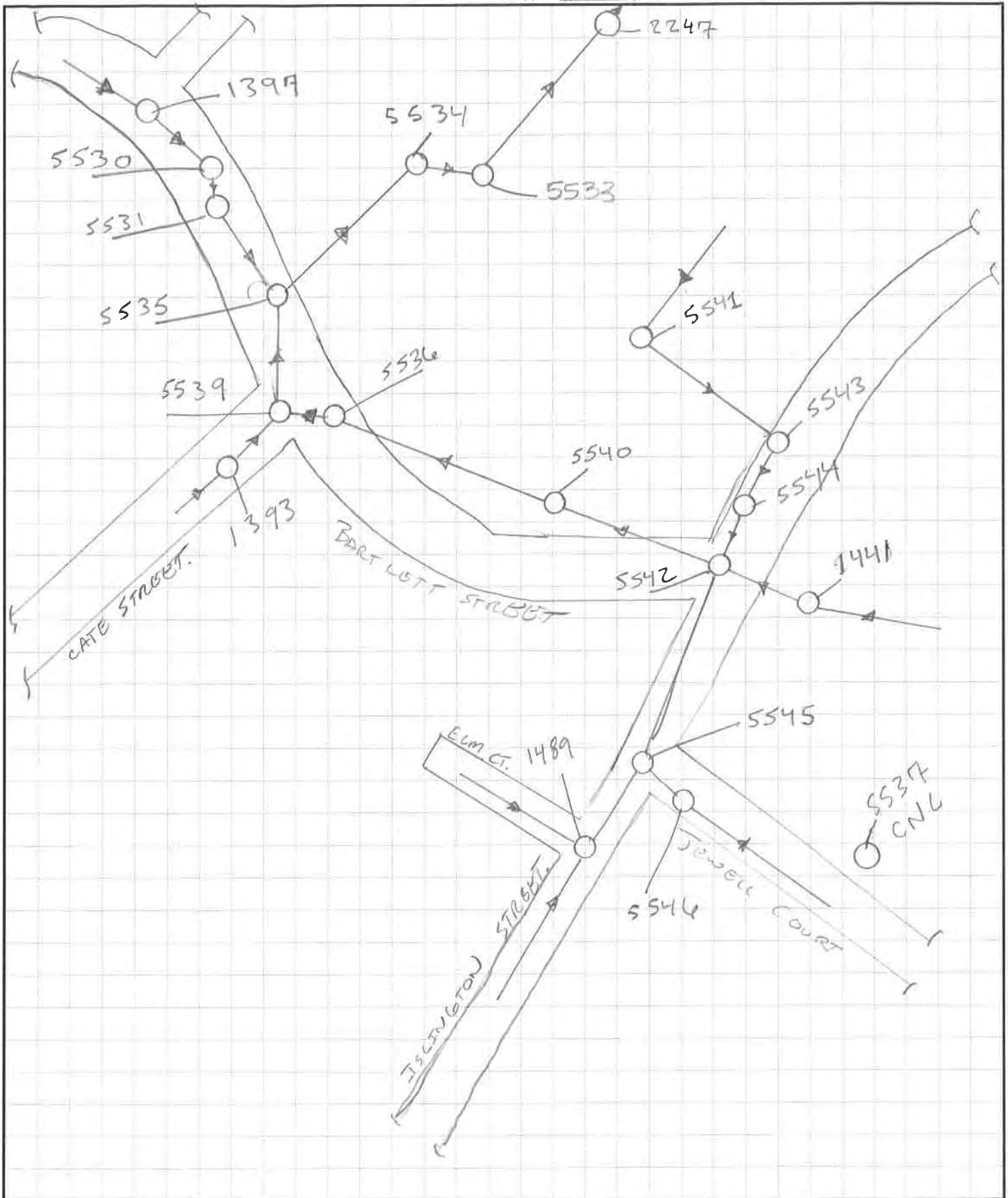
DATE

CHECKED BY

DATE

SCALE NOT TO SCALE

HS 11







84 Daniel Plummer Road  
Goffstown, NH 03045  
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JOB PORTSMOUTH NH  
SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_  
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#5

AREA LR 5 Sheet 15

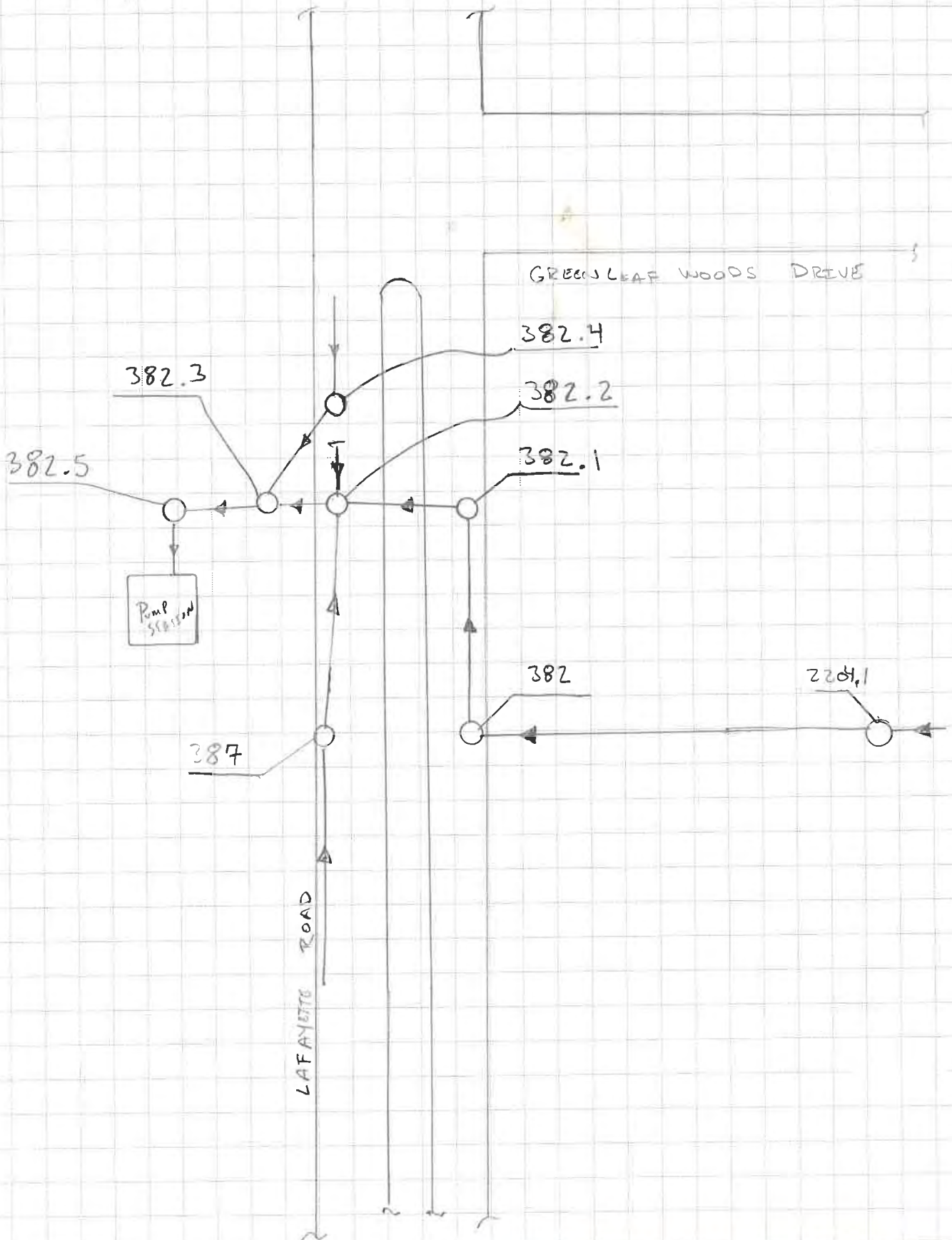
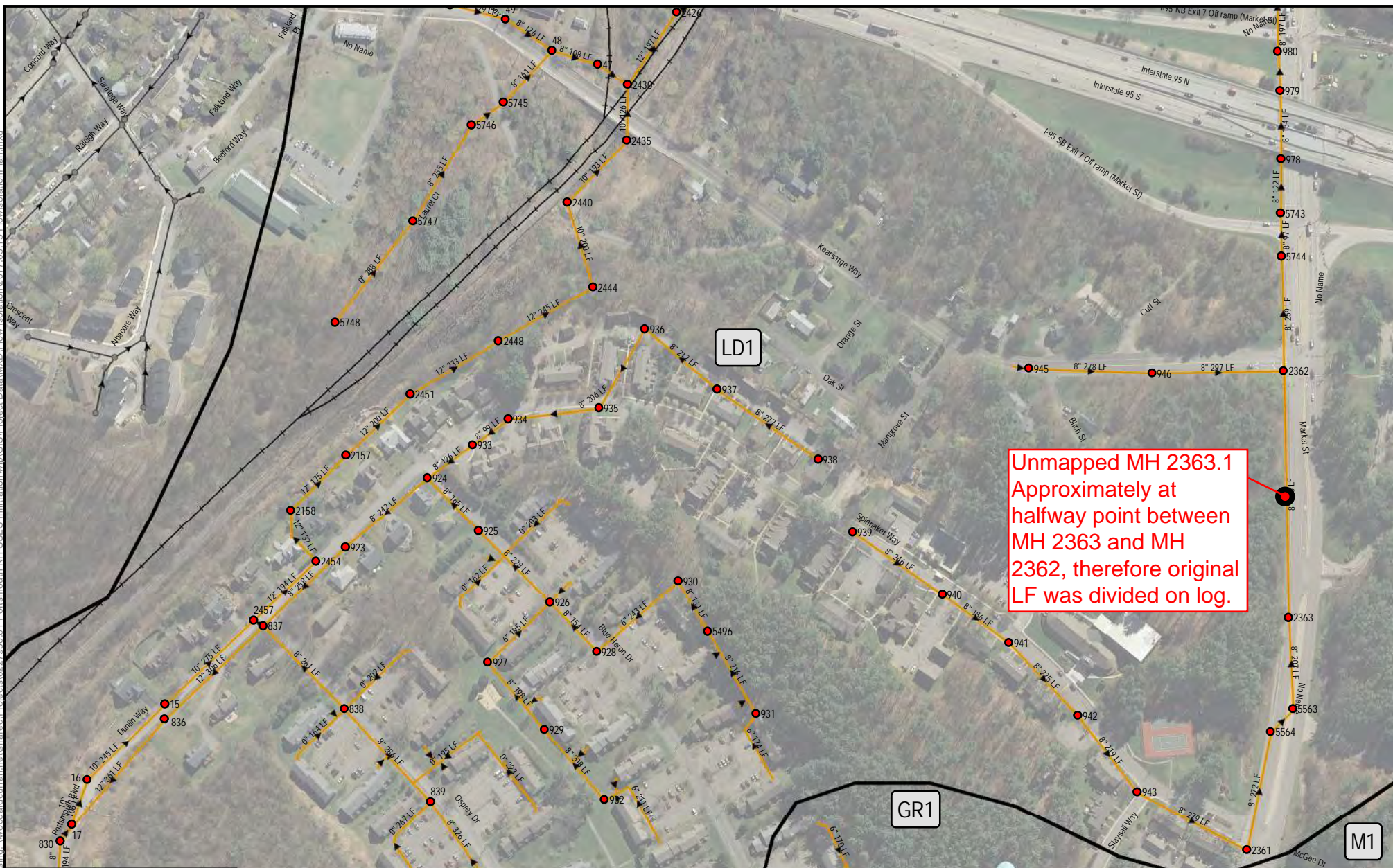




Figure Exported: 5/15/2017 By: amosk Using: WoodardCurran.net\shared\Projects\02-227950.01 Portsmouth NH SSFS Infiltration.wpd\GIS\Project Data\MXD\Flow Isolation\2017.05.15 Flow Isolation Plan.mxd



Unmapped MH 2363.1  
Approximately at  
halfway point between  
MH 2363 and MH  
2362, therefore original  
LF was divided on log.



### Legend

- Flow Isolation Manholes
- Flow Isolation Pipe (City)
- Flow Isolation Pipe (Private)
- SewerManhole
- Sewer Pipe
- Sewer Basin
- Pump Station
- Railroad Tracks



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DATE: MAY 2017	DOC: 2017.05.15 FlowIsolationPlan.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

## City of Portsmouth, NH Flow Isolation Figure 4 of 28

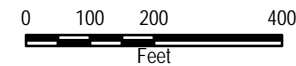




Figure Exported: 5/15/2017 By: amosel Using: \\woodardcurran.net\shared\Projects\02-227950.01 Portsmouth NH SSFS Infiltration.wpd\GIS\Project Data\MXD\Flow Isolation\2017.05.15 Flow Isolation Plan.mxd



### Legend

- Flow Isolation Manholes
- Flow Isolation Pipe (City)
- Flow Isolation Pipe (Private)
- Sewer Manhole
- Sewer Pipe
- Sewer Basin
- PS Pump Station
- Railroad Tracks

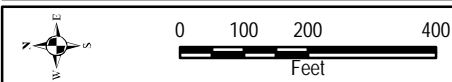


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DATE: MAY 2017	DOC: 2017.05.15 FlowIsolationPlan.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

## City of Portsmouth, NH Flow Isolation Figure 5 of 28





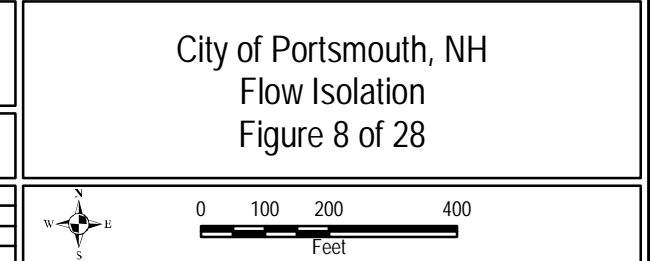
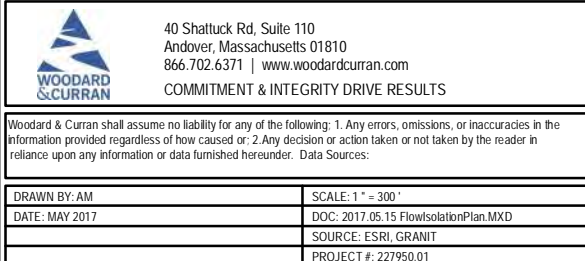
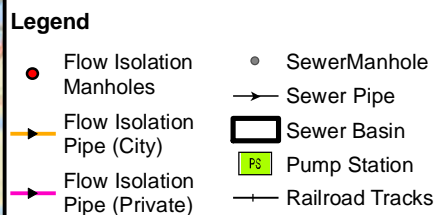
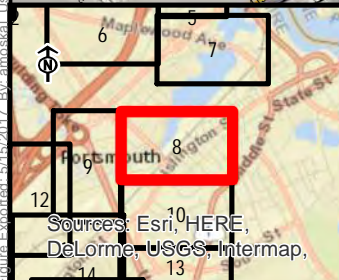
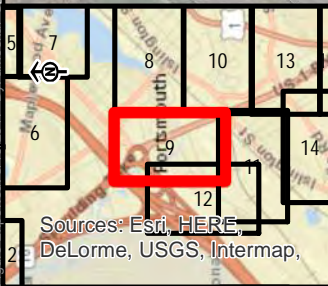
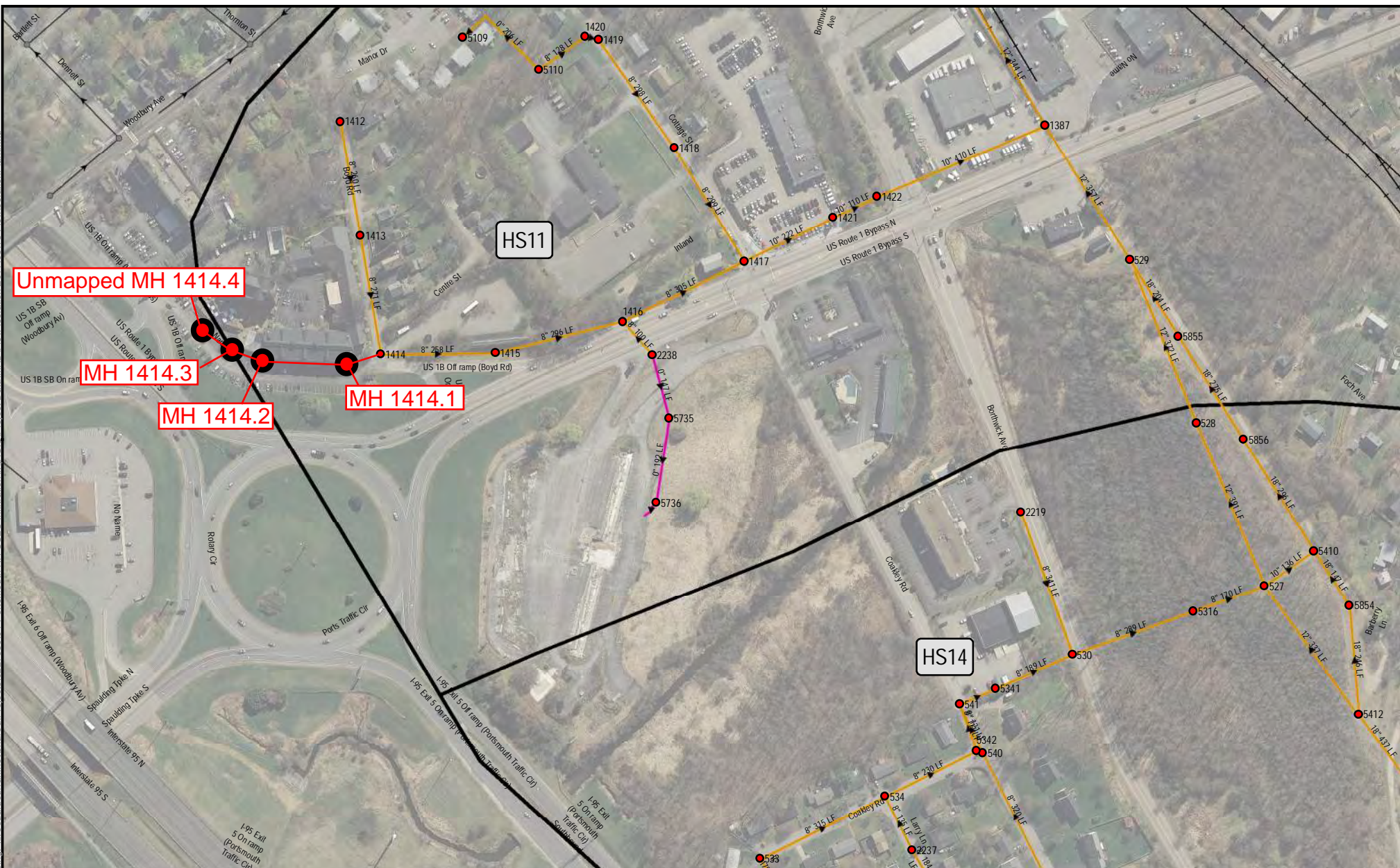





Figure Exported: 5/15/2017 By: amoskel Using: \\woodardcurran.net\shared\Projects\02-227950-01 Portsmouth NH SSFS Infiltration.wpd\GIS\Project Data\MXD\Flow Isolation\2017.05.15 FlowIsolationPlan.mxd




- Legend**
- Flow Isolation Manholes
  - Flow Isolation Pipe (City)
  - Flow Isolation Pipe (Private)
  - SewerManhole
  - Sewer Pipe
  - Sewer Basin
  - Pump Station
  - Railroad Tracks

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DATE: MAY 2017	DOC: 2017.05.15 FlowIsolationPlan.MXD
	SOURCE: ESRI, GRANIT
	PROJECT #: 227950.01

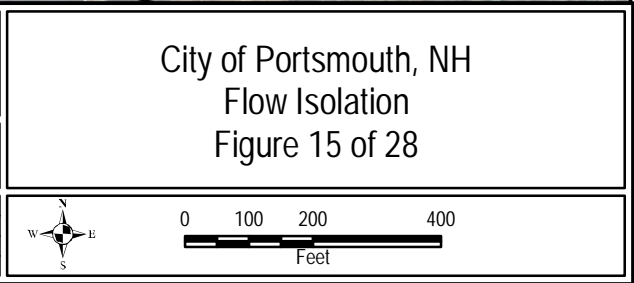
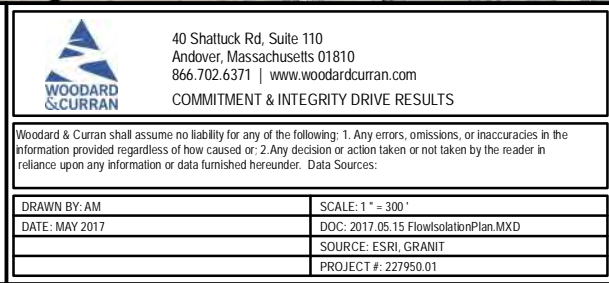
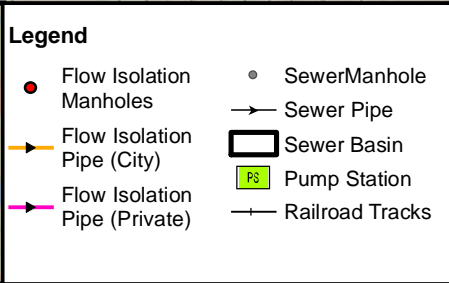
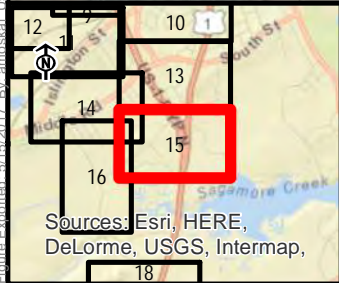
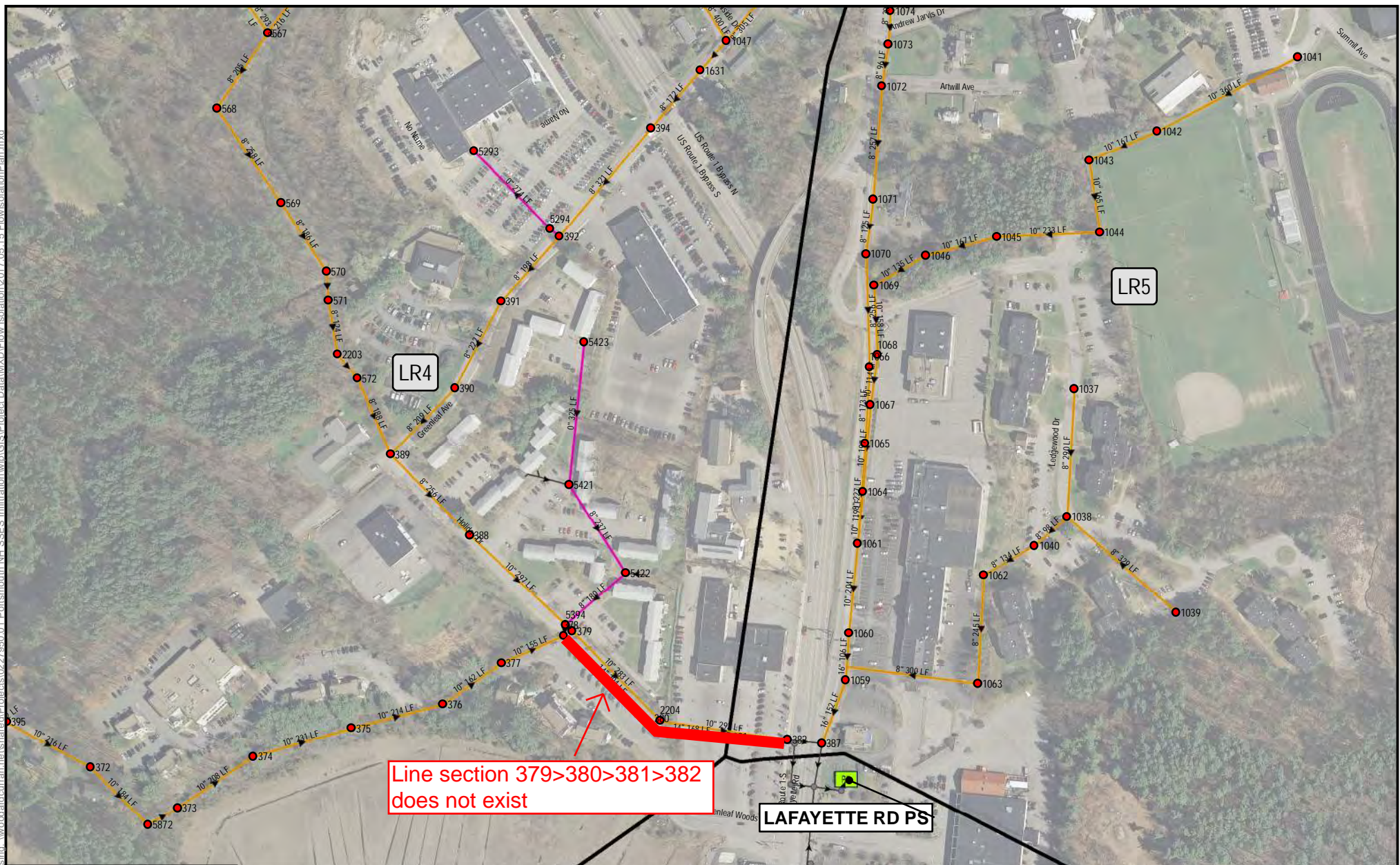
City of Portsmouth, NH  
Flow Isolation  
Figure 9 of 28

 0 100 200 400  
Feet











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## APPENDIX I: SMOKE TESTING RESULTS



Sub-System: B1

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
	Could not locate MH 482 - footages combined. Smoke from ground, possibly buried cleanout - direct connection	80	0.3	0304	3	10/09/18
Greenland Road	Heavy smoke from catch basin#2908 - direct connection	3600	0.9	0303	2	10/09/18
700 Greenland Road	Smoke from cleanout 1" below grade, broken cover - direct connection	24	0.3	0328	1	10/09/18



Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
	Sag in line under bypass	0	0			09/25/18
59 Cass Street	Smoke from roof leader - direct connection. MH 5839.2 unnamed on map - see revised map.	432	0.9	4474	11	09/24/18
Cottage Street	Smoke from catch basin#2179 - direct connection (MH 5109.1 is unmapped manhole - see revised map)	9600	0.9	0289	13	09/25/18
Fields Road	Light smoke from catch basin#1164 - indirect connection	0	0	0281	6	09/24/18
Islington Street	Light smoke from catch basin#1858 - indirect connection	0	0	0278	2	09/24/18
Islington Street	Smoke from catch basin#481 - direct connection	9000	0.9	0277	1	09/24/18
Islington Street	Smoke from catch basin#62 - direct connection	60000	0.9	0274	1	09/24/18
Islington Street	Smoke from catch basin#482 - indirect connection	0	0	0275	1	09/24/18
Islington Street	Light smoke from catch basin#5321 - indirect connection. MH 2221.1 unnamed on map - see revised map.	0	0	0286	10	09/24/18
Islington Street	Light smoke from catch basin#86 - indirect connection. MH 2221.3 unnamed on map - see revised map	0	0	0285	8	09/24/18
Islington Street	Light smoke from catch basin#2387 - indirect connection. MH 5538.4 unnamed on map - see revised map	0	0	4467	8	09/24/18
Islington Street	Footage scaled. Heavy smoke from catch basin#935 - direct connection	400	0.9	4466	5	09/24/18
953 Islington Street	Smoke from driveway drain - direct connection. MH 1305.3 unnamed on map - see revised map.	2100	0.9	4465	5	09/24/18
Morning Street	Heavy smoke from catch basin#833 - direct connection	4400	0.9	0290	14	09/25/18
Morning Street	Light smoke from catch basin#1905 - indirect connection	0	0	0291	14	09/25/18
Route 1 R.O.W.	Light smoke from hole next to MH 1387 - direct connection	8	0.3	0288	12	09/25/18
Route 1 R.O.W.	Smoke from catch basin#1239 - direct connection	400	0.9	4468	9	09/24/18
Route 1 R.O.W.	Smoke from catch basin#1240 - direct connection	400	0.9	4469	9	09/24/18



Sub-System: HS11

Portsmouth, NH

Page: 2

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
Route 1 R.O.W. - Frank Jones Center	Heavy smoke from catch basin - direct connection	2800	0.9	0287	12	09/25/18
50 Sunset Road	Heavy smoke from driveway drain - direct connection	3125	0.9	0284	7	09/24/18
Thaxter Road	Light smoke from catch basin#1182 - indirect connection	0	0	0279	3	09/24/18
Thaxter Road	Light smoke from catch basin#1162 - indirect connection. MH 1305.2 unnamed on map - see revised map.	0	0	0280	4	09/24/18
82 Woodbury Avenue	Smoke from catch basin#7218 - direct connection	2400	0.9	0292	15	09/25/18



Sub-System: HS15

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
Middle Road	Heavy smoke from catch basin#493 - direct connection	3960	0.9	0273	1	09/21/18



Sub-System: LD1

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
	MH 65.1 unnamed on map - see revised map. Smoke from broken concrete outside of MH 65.1 - direct connection	80	0.3	0325	2	10/01/18
Beechwood Street	Light smoke from catch basin#3734 - indirect connection	0	0	0324	1	10/01/18
29 Brigham Lane	Smoke from cleanout 1" below grade, missing cover - direct connection	24	0.3	0294	3	10/01/18
Market Street	Smoke from sidewalk/curb - direct connection	30	0.3	0295	5	10/01/18
Market Street	Smoke from ground near sidewalk - direct connection	48	0.3	0326	4	10/01/18
Market Street	Light smoke from curb - direct connection	32	0.9	0327	4	10/01/18
Portsmouth Boulevard	Smoke from cleanout 1" below grade, missing cover - direct connection (Line abandoned)	750	0.3	0299	7	10/01/18
Spinnaker Way	Light smoke from catch basin#444 - indirect connection	0	0	0297	6	10/01/18



Sub-System: LR1

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
6 Elwyn Road	Heavy smoke from yard drain behind home -direct connection	6250	0.3	0260	6	09/07/18
Elwyn Road R.O.W.	Smoke from rockpile near MH 338 - direct connection	150	0.3	0134	4	09/07/18
Elwyn Road R.O.W.	Smoke from around corbel of MH 343 - direct connection	2	0.9	0255		09/07/18
Sagamore Avenue	MH 5858 is in gutterline	150	0.9		2	09/07/18
Sagamore Avenue R.O.W.	Heavy smoke from ground around MH 5857.1 - direct connection. MH 5857.1 unnamed on map - see revised map.	150	0.3	7088	2	09/07/18
Taft Road	Smoke from catch basin#1507 - direct connection	4950	0.9	0258	5	09/07/18
Taft Road	Light smoke from catch basin#1847 - indirect connection	0	0	0251	3	09/07/18
Taylor Lane	Light smoke from catch basin#1573 - indirect connection	0	0	0250	1	09/07/18



Sub-System: LR2

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
420 Grant Drive	Smoke from cleanout missing cap, at grade - direct connection	15	0.9	0138	1	09/12/18
2021 Lafayette Road	Light smoke from catch basin - indirect connection	0	0	0261	2	09/12/18



Sub-System: LR4

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
380 Greenleaf Avenue	Light smoke from drain pipe - indirect connection	0	0	0270	2	09/20/18
Hillside Drive	Light smoke from catch basin#4071 - direct connection	1650	0.9	0272	3	09/20/18
Leavitt Avenue	3 GPM leak from above outgoing line in MH 543	0	0	0268		09/20/18
10 McClintock Avenue	Smoke from ground - direct connection	150	0.3	0269	1	09/20/18



Sub-System: LR6

Portsmouth, NH

Page: 1

Smoke Testing Summary of Findings By Street Address  
Table 1

Findings Address	Findings	Drainage Area SqFt	Runoff Coeff	Photo No.	Sketch No.	Insp. Date
275 Constitution Avenue	Smoke from loose cleanout cover 6" above grade - direct connection	0	0	0262		09/14/18
225 Heritage Avenue	Smoke from cleanout missing cover, 3" above grade - direct connection	0	0	0265	2	09/14/18
225 Heritage Avenue	Smoke from cleanout missing cover, at grade - direct connection	160	0.3	0264	2	09/14/18
Lafayette Road	MH 2479 is buried - footages combined. Smoke from ground near approximate location of MH 2479 - direct connection	30	0.3	0267	3	09/14/18
2468 Lafayette Road	Smoke from metal plates and cracks - direct connection	800	0.9	0263	1	09/14/18



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:

Sub-System: B1

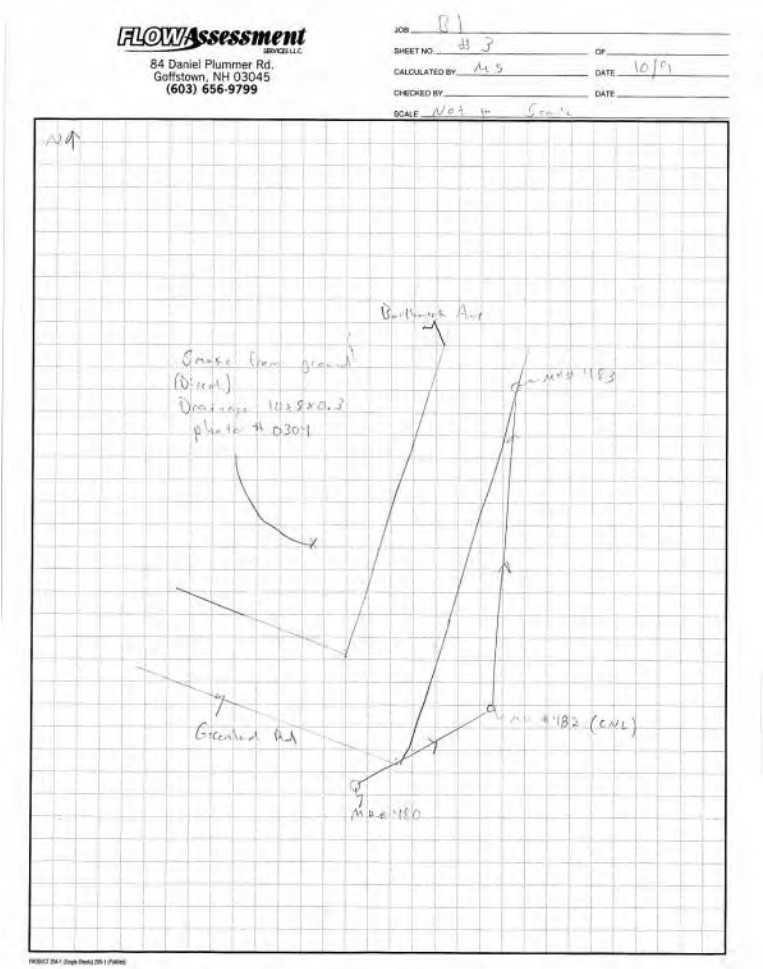
Smoke Testing Log

Project No: 18001  
Date: 10/09/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Could not locate MH 482 - footages combined. Smoke from ground, possibly buried cleanout - direct connection	80	0.3



Image #: 0304.JPG



Sketch #: Subarea B1 Sketch#3.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Greenland Road

Sub-System: B1

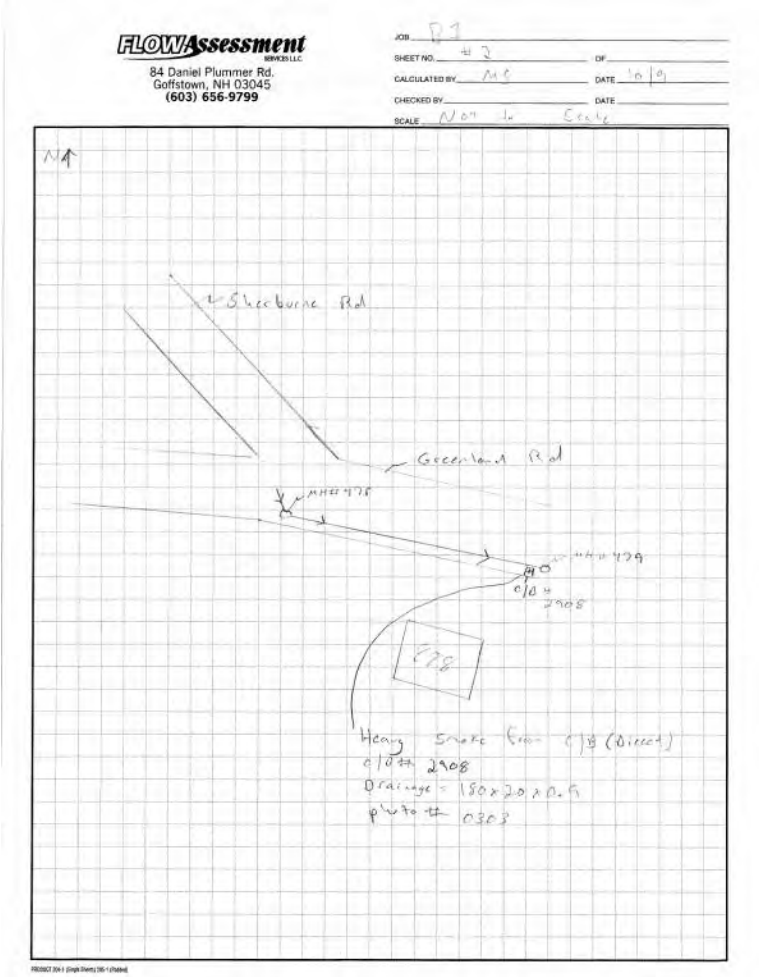
Smoke Testing Log

Project No: 18001  
Date: 10/09/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from catch basin#2908 - direct connection	3600	0.9



Image #: 0303.JPG



Sketch #: Subarea B1 Sketch#2.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
700 Greenland Road

Sub-System: B1

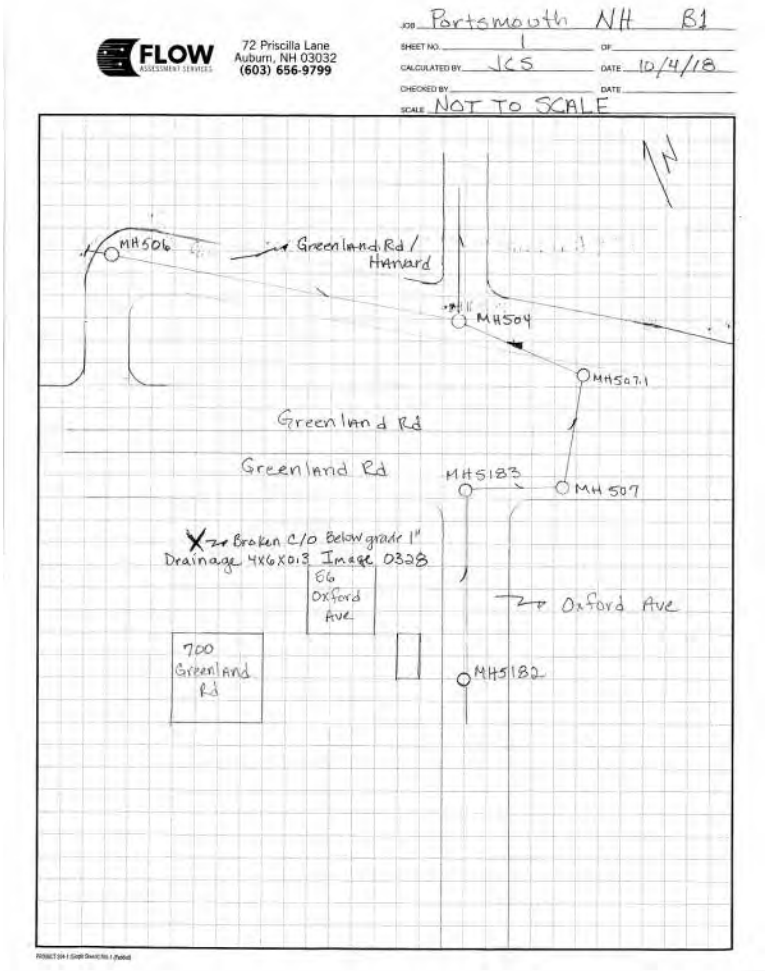
Smoke Testing Log

Project No: 18001  
Date: 10/09/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from cleanout 1" below grade, broken cover - direct connection	24	0.3



Image #: IMG\_0328.JPG



Sketch #: Subarea B1 Sketch#1.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
59 Cass Street

Sub-System: HS11

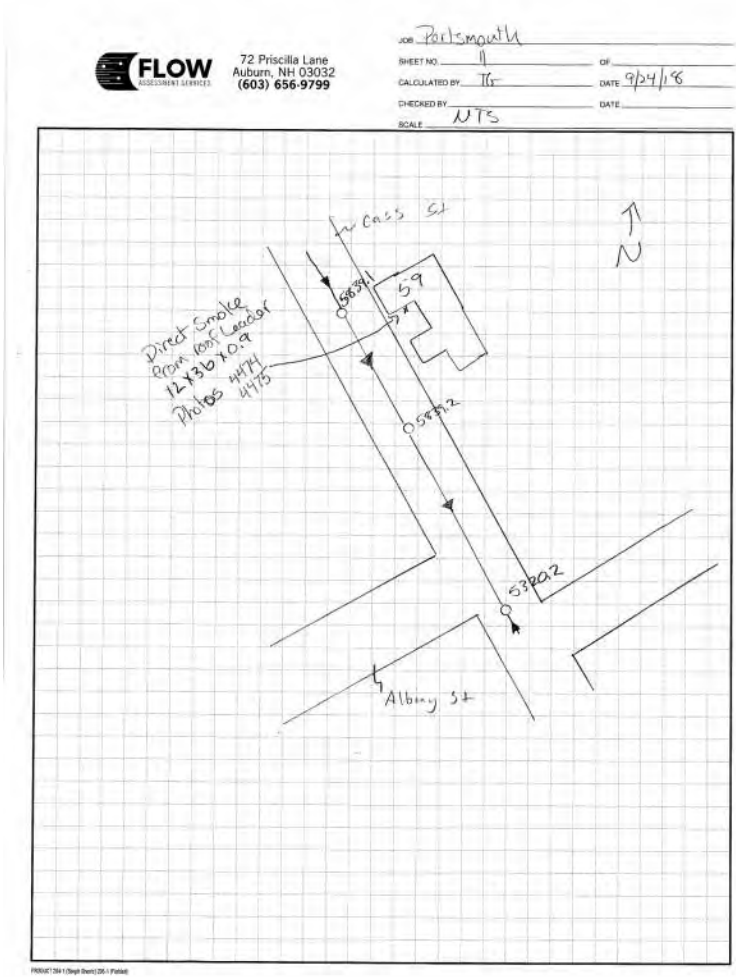
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from roof leader - direct connection	0	0



Image #: DSCF4475.JPG



Sketch #: Subarea HS11 Sketch#11.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
59 Cass Street

Sub-System: HS11

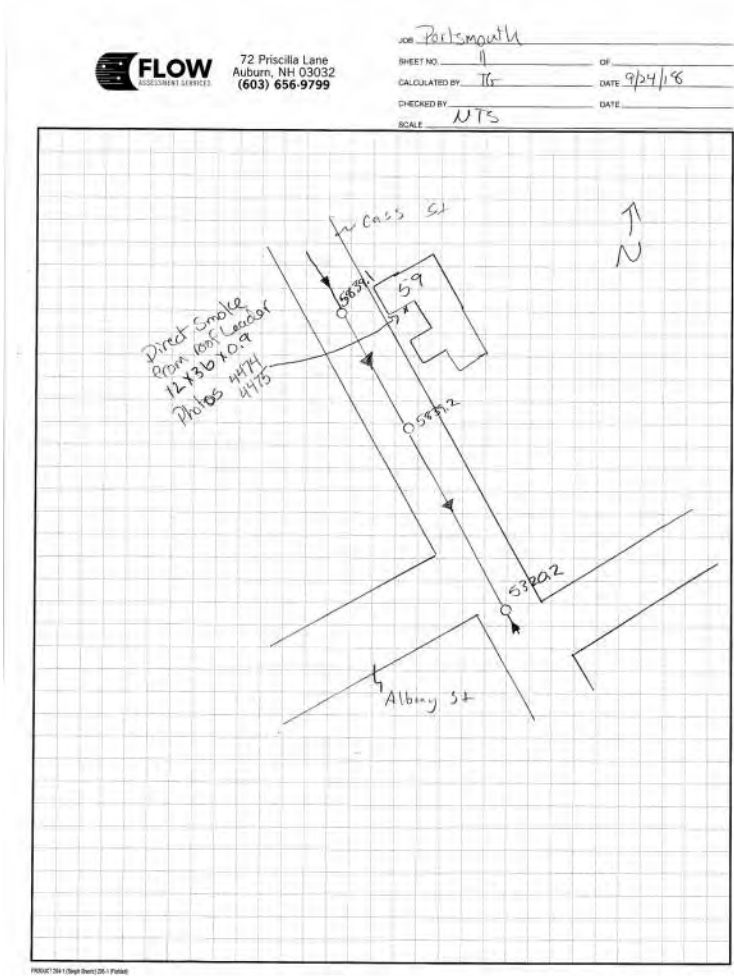
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from roof leader - direct connection. MH 5839.2 unnamed on map - see revised map.	432	0.9



Image #: DSCF4474.JPG



Sketch #: Subarea HS11 Sketch#11.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Cottage Street

Sub-System: HS11

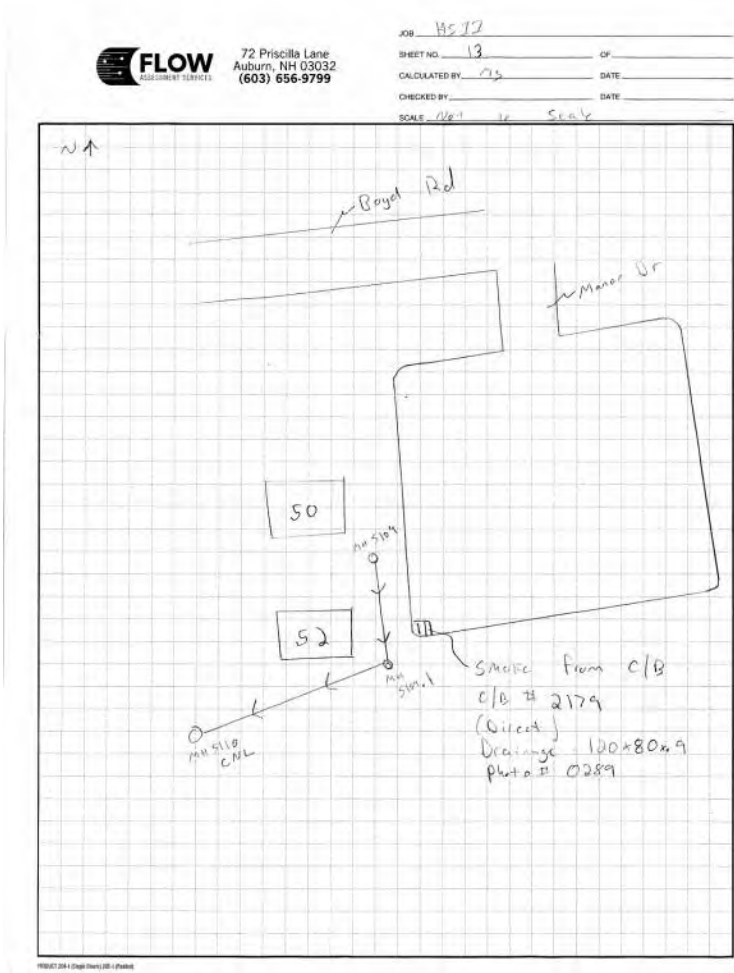
Smoke Testing Log

Project No: 18001  
Date: 09/25/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#2179 - direct connection (MH 5109.1 is unmapped manhole - see revised map)	9600	0.9



Image #: 0289.JPG



Sketch #: Subarea HS11 Sketch#13.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Fields Road

Sub-System: HS11

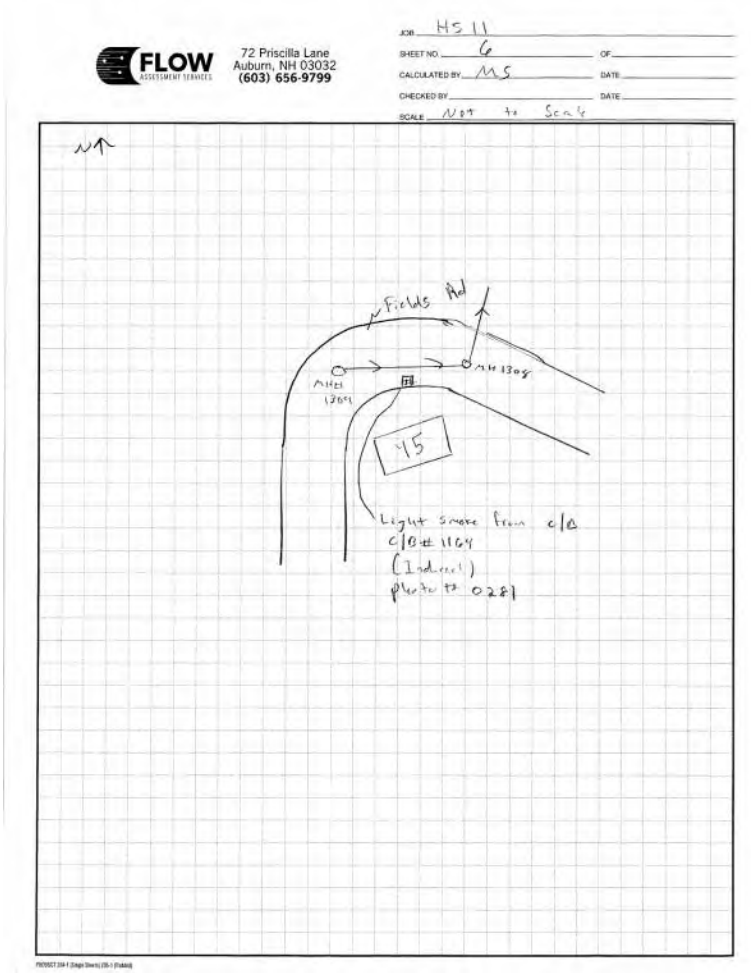
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#1164 - indirect connection	0	0



Image #: 0281.JPG



Sketch #: Subarea HS11 Sketch#6.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Islington Street

Sub-System: HS11

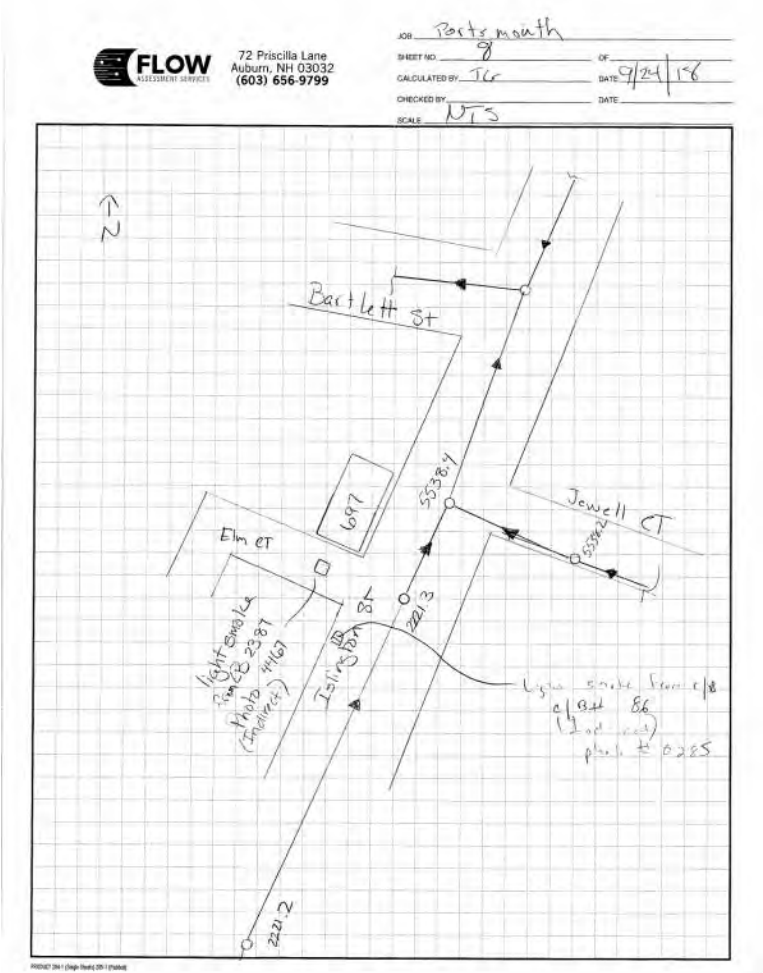
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#86 - indirect connection. MH 2221.3 unnamed on map - see revised map	0	0



Image #: 0285.JPG



Sketch #: Subarea HS11 Sketch#8.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Islington Street

Sub-System: HS11

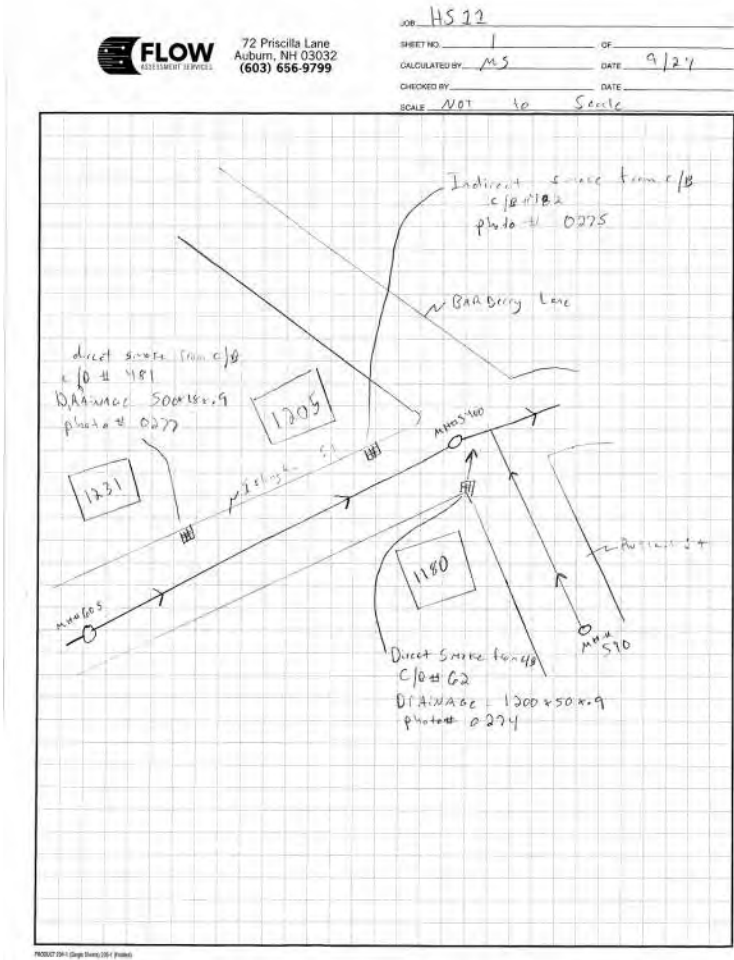
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#481 - direct connection	9000	0.9



Image #: 0277.JPG



Sketch #: Subarea HS11 Sketch#1.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Islington Street

Sub-System: HS11

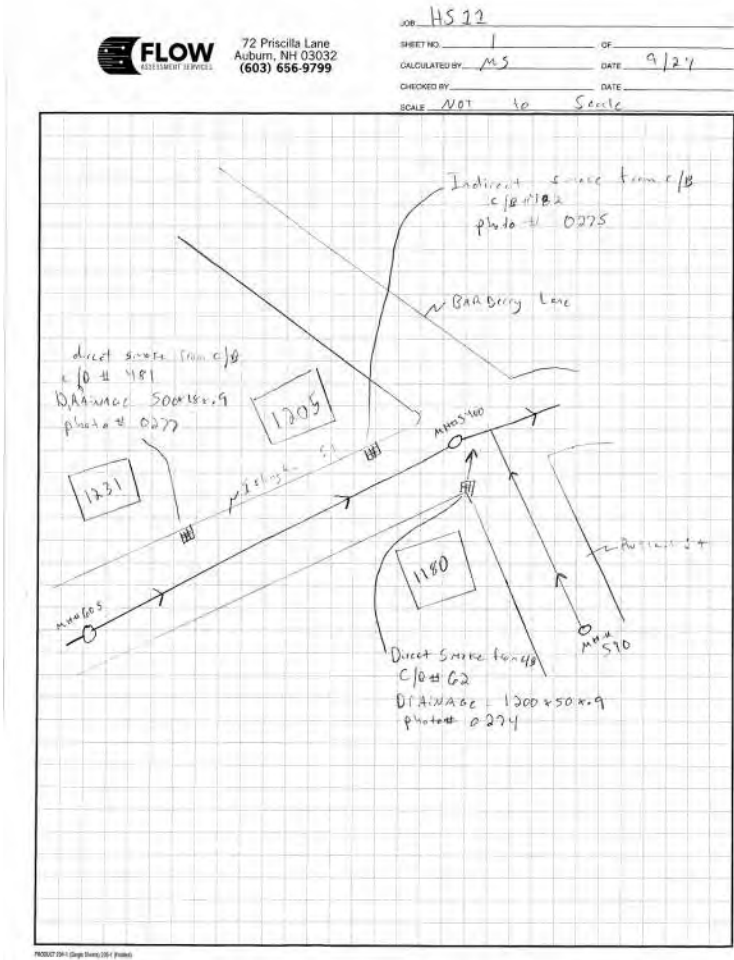
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#62 - direct connection	60000	0.9



Image #: 0274.JPG



Sketch #: Subarea HS11 Sketch#1.tif



# Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH

Finding Location:

Islington Street

Sub-System: HS11

## Smoke Testing Log

Project No: 18001

Date: 09/24/2018

Inspector: MS

### Findings:

Smoke from catch basin#482 - indirect connection

Drainage  
Area SqFt

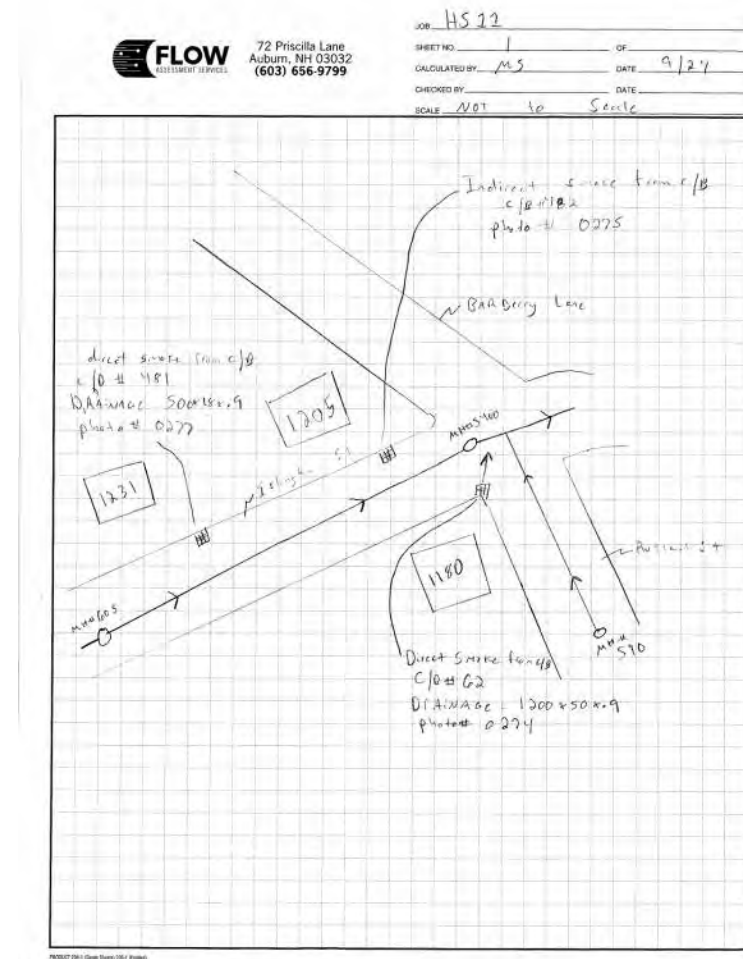
0

Runoff  
Coeff

0



Image #: 0275.JPG



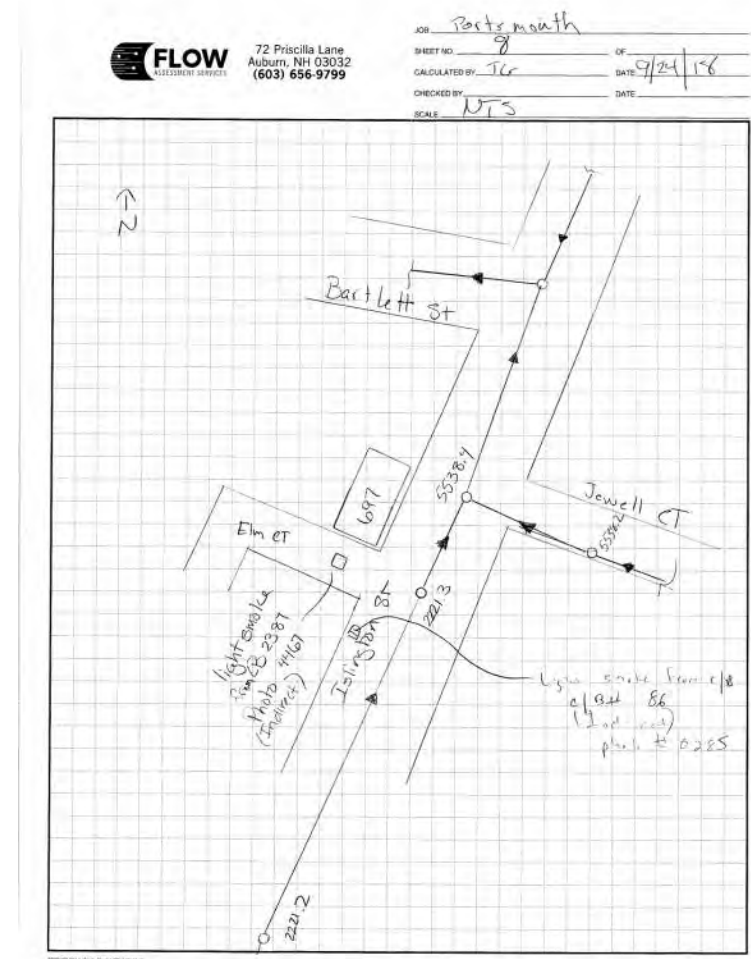
Sketch #: Subarea HS11 Sketch#1.tif

**Municipality:** Portsmouth, NH  
**Finding Location:**  
Islington Street

**Project No:** 18001  
**Date:** 09/24/2018  
**Inspector:** MS

Light smoke from catch basin#2387 - indirect connection. MH 5538.4 unnamed on map - see revised map

0 0



**Sketch #:** Subarea HS11 Sketch#8.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Islington Street

Sub-System: HS11

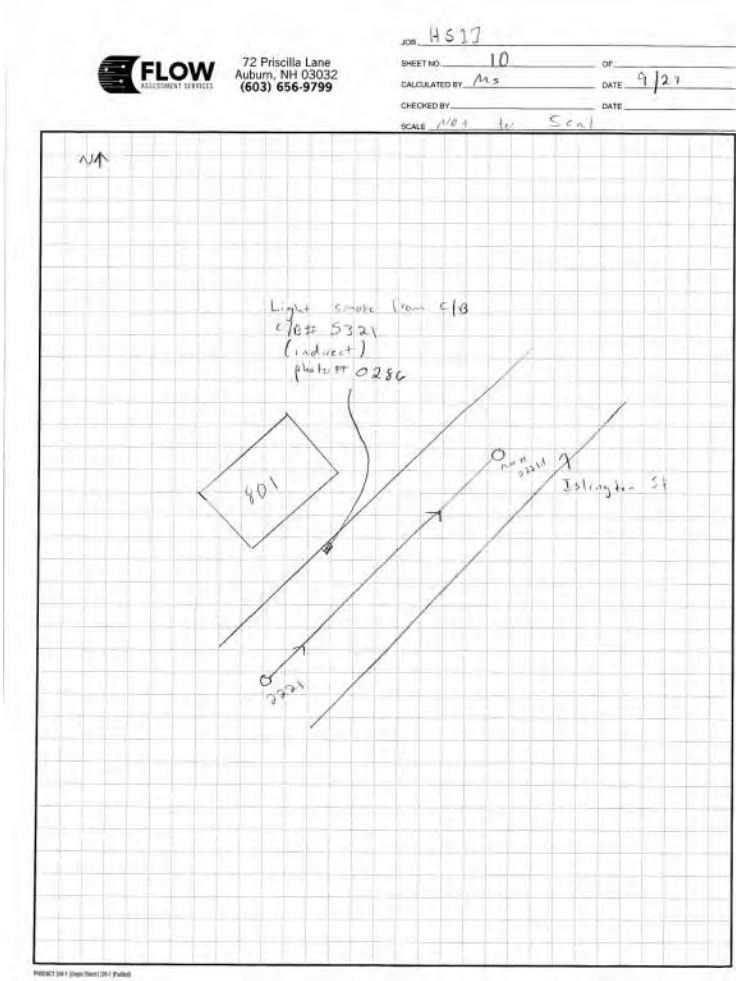
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#5321 - indirect connection. MH 2221.1 unnamed on map - see revised map.	0	0



Image #: 0286.JPG



Sketch #: Subarea HS11 Sketch#10.tif

# Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH

Finding Location:

Islington Street

Sub-System: HS11

## Smoke Testing Log

Project No: 18001

Date: 09/24/2018

Inspector: MS

### Findings:

Footage scaled. Heavy smoke from catch basin#935 - direct connection

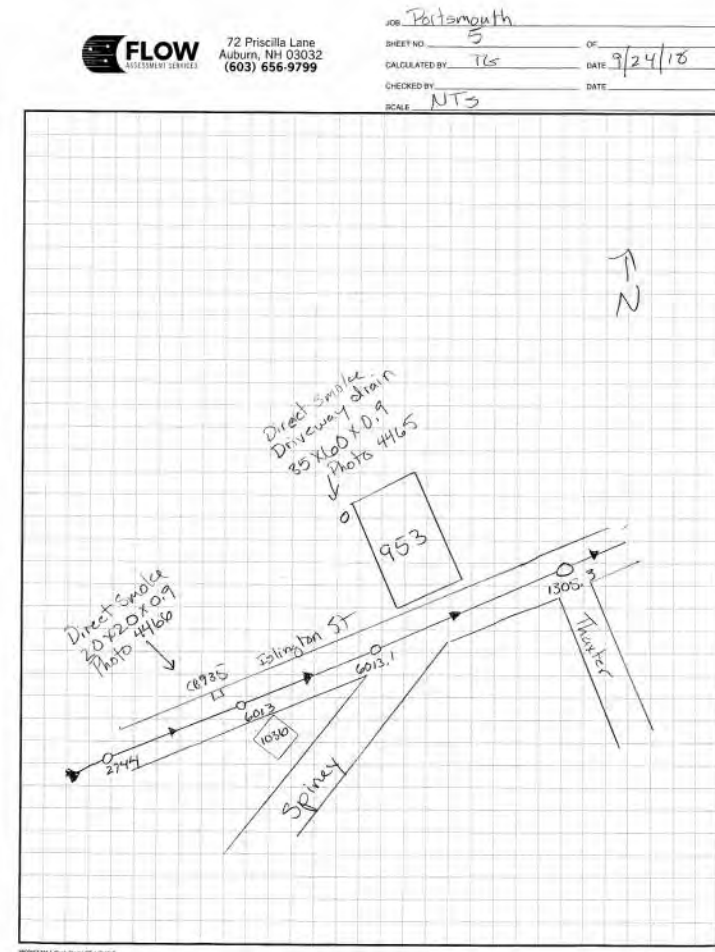
Drainage Area SqFt	Runoff Coeff
-----------------------	-----------------

400

0.9



Image #: DSCF4466.JPG



Sketch #: Subarea HS11 Sketch#5.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Islington Street

Sub-System: HS11

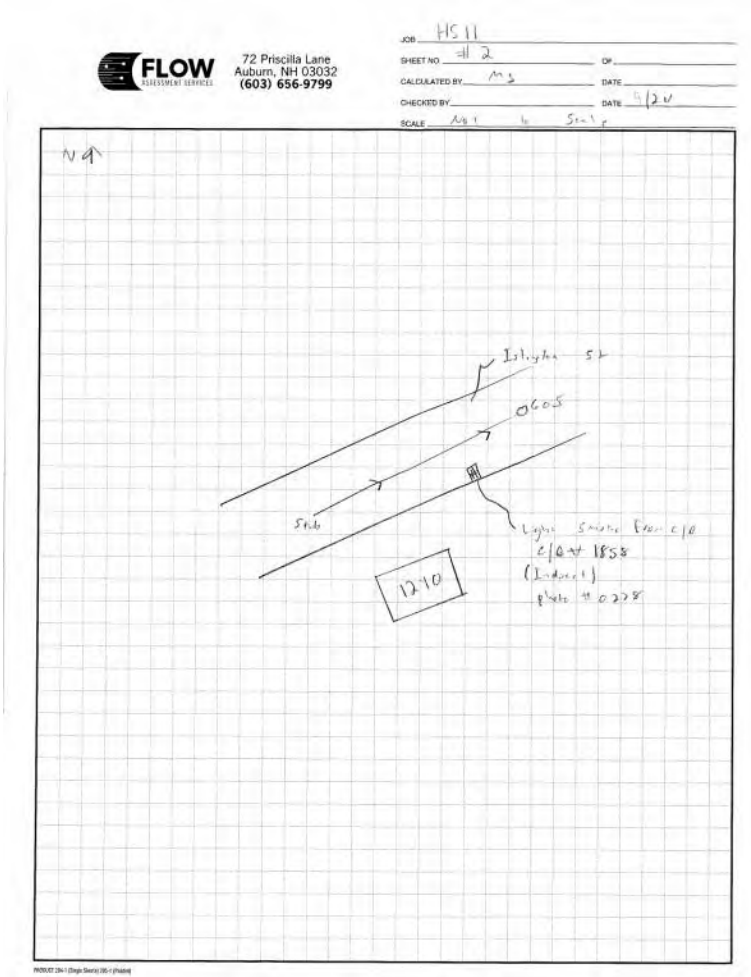
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#1858 - indirect connection	0	0



Image #: 0278.JPG



Sketch #: Subarea HS11 Sketch#2.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
953 Islington Street

Sub-System: HS11

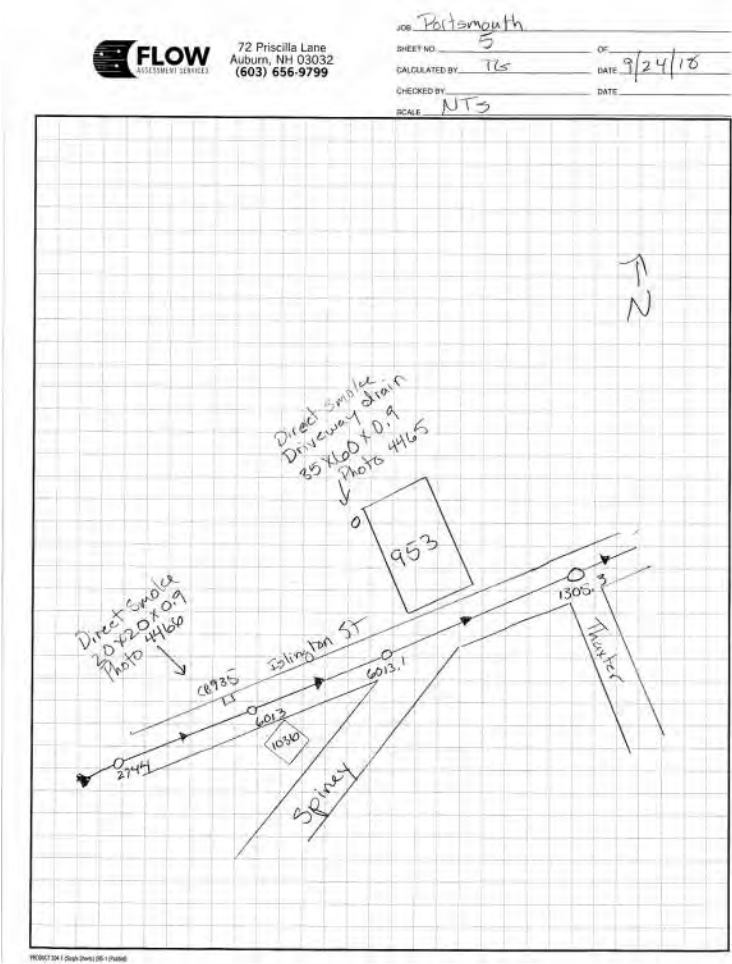
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from driveway drain - direct connection. MH 1305.3 unnamed on map - see revised map.	2100	0.9



Image #: DSCF4465.JPG



Sketch #: Subarea HS11 Sketch#5.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Morning Street

Sub-System: HS11

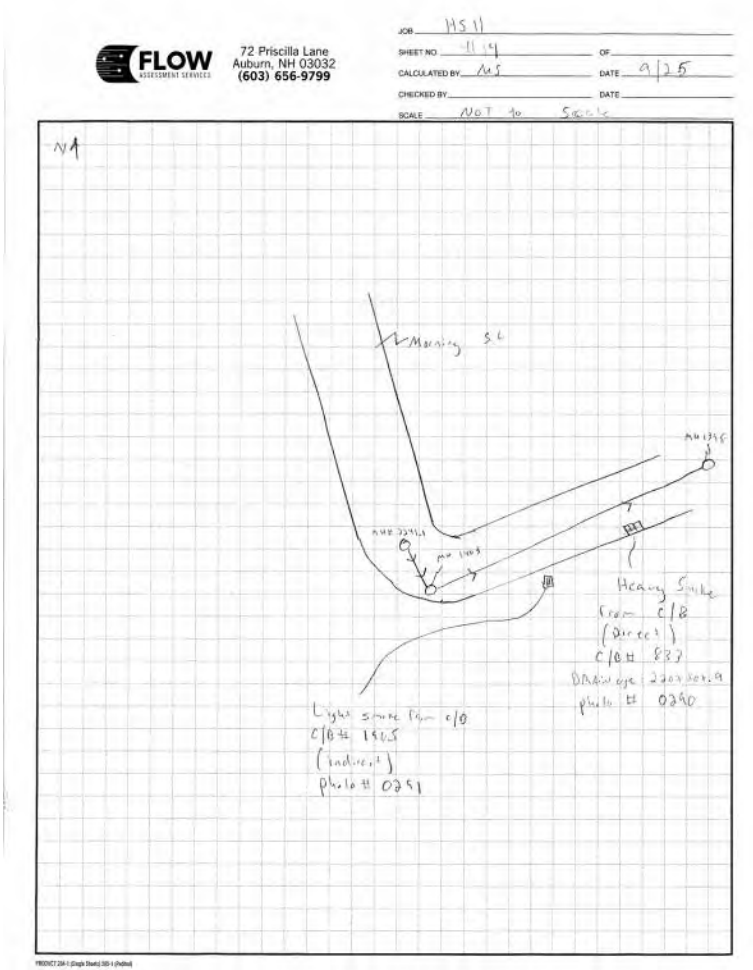
Smoke Testing Log

Project No: 18001  
Date: 09/25/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from catch basin#833 - direct connection	4400	0.9



Image #: 0290.JPG



Sketch #: Subarea HS11 Sketch#14.tif

**Municipality:** Portsmouth, NH  
**Finding Location:**  
Morning Street

**Sub-System:** HS11

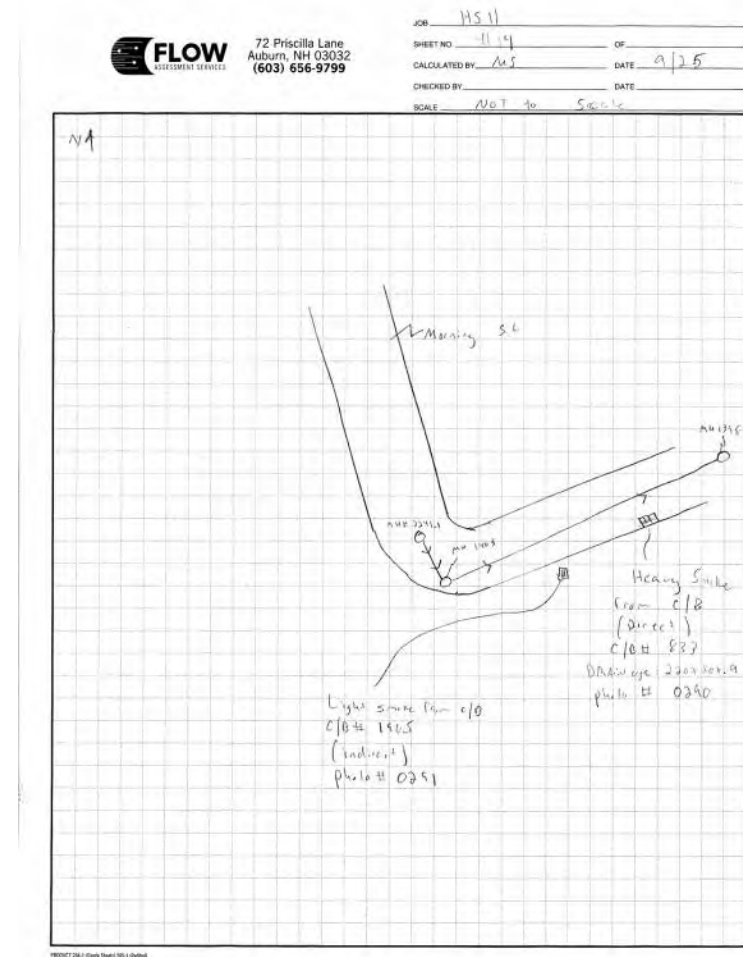
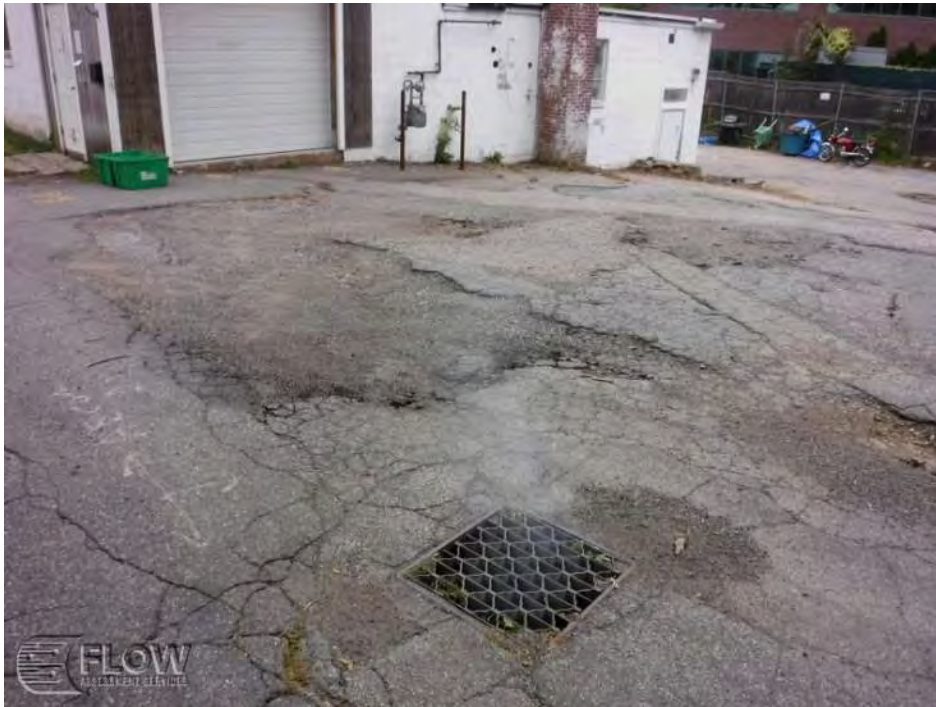
**Date:** 09/25/2018

**Inspector:** MS

Light smoke from catch basin#1905 - indirect connection

Drainage Area SqFt	Runoff Coeff
-----------------------	-----------------

0 0



**Image #:** 0291.JPG

**Sketch #:** Subarea HS11 Sketch#14.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Route 1 R.O.W.

Sub-System: HS11

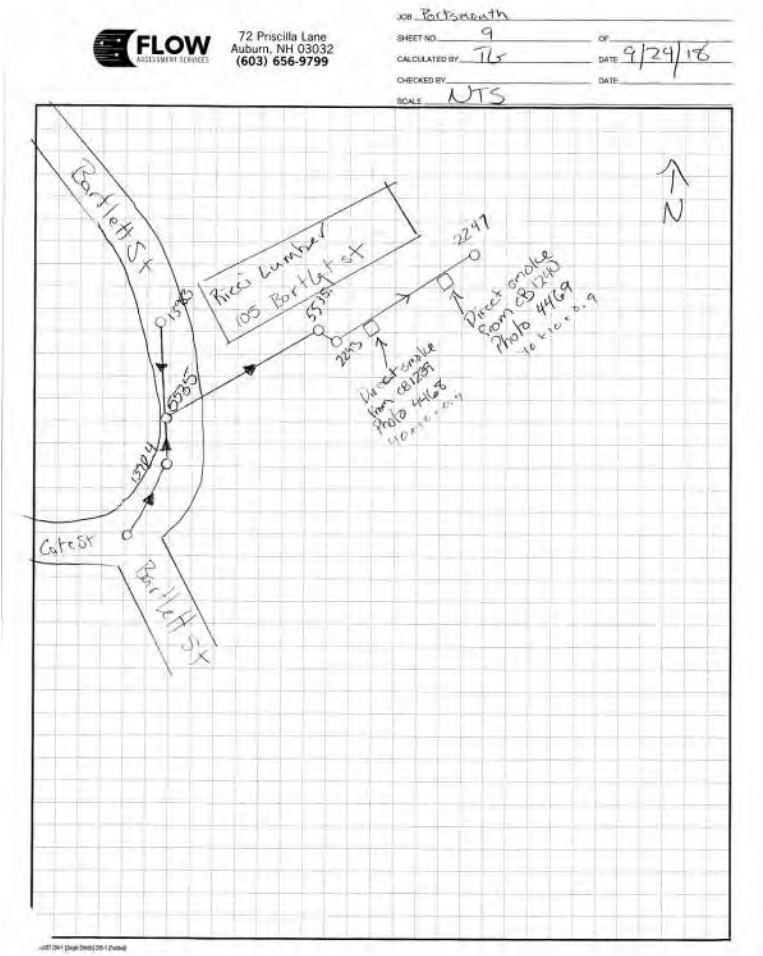
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#1240 - direct connection	400	0.9



Image #: DSCF4469.JPG



Sketch #: Subarea HS11 Sketch#9.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Route 1 R.O.W.

Sub-System: HS11

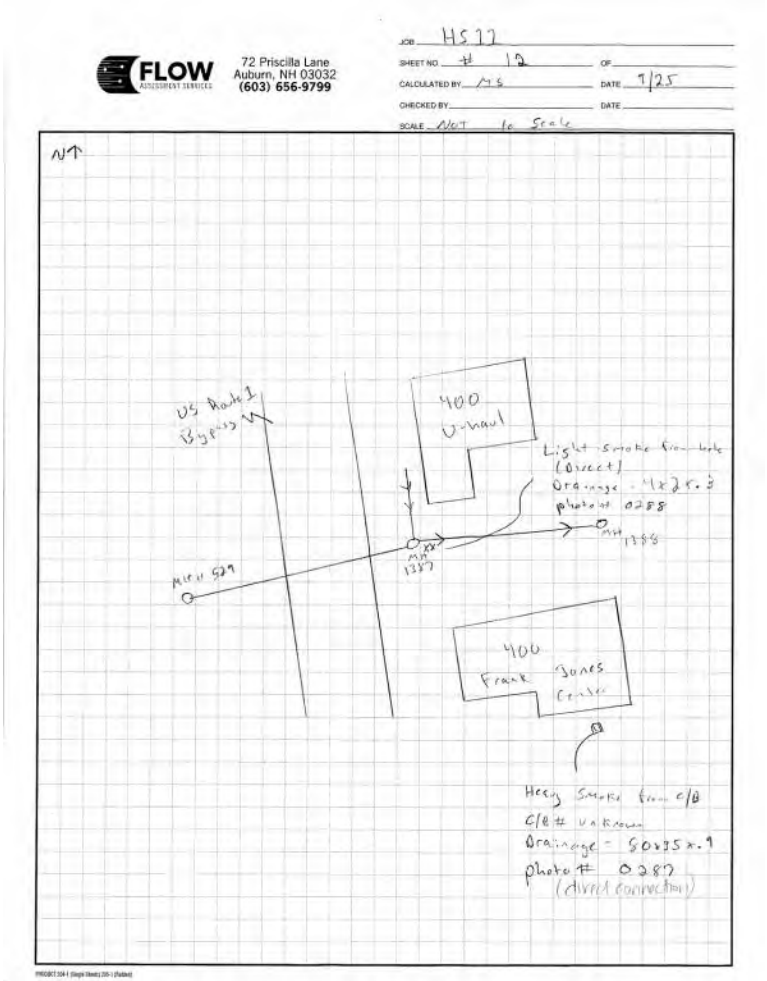
Smoke Testing Log

Project No: 18001  
Date: 09/25/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from hole next to MH 1387 - direct connection	8	0.3



Image #: 0288.JPG



Sketch #: Subarea HS11 Sketch#12.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Route 1 R.O.W.

Sub-System: HS11

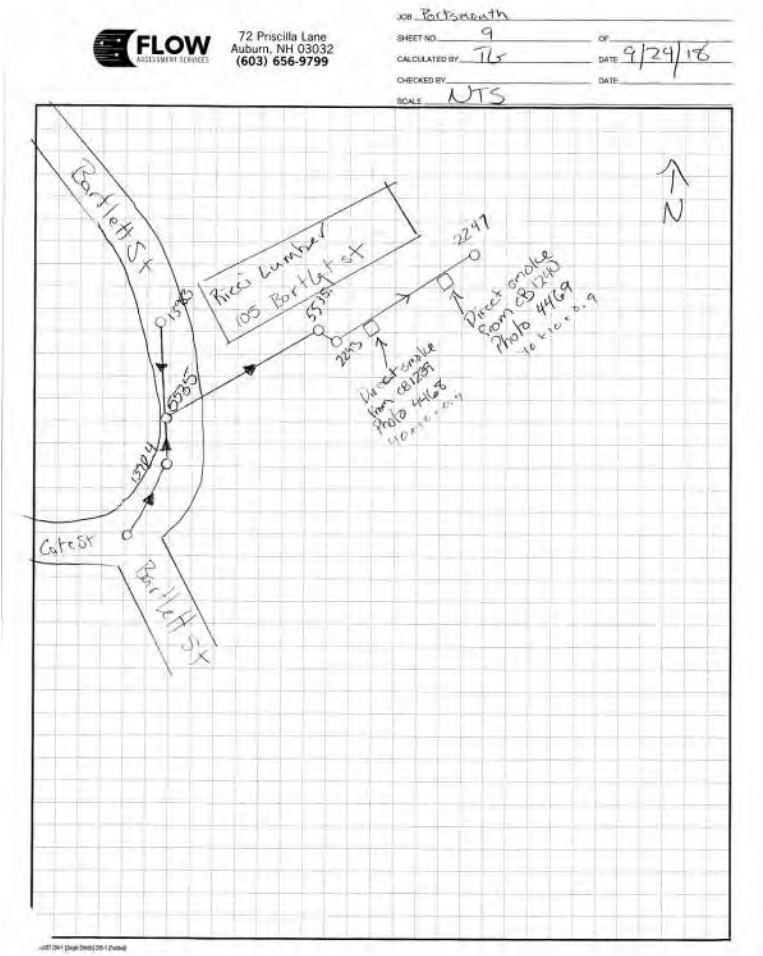
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#1239 - direct connection	400	0.9



Image #: DSCF4468.JPG



Sketch #: Subarea HS11 Sketch#9.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Route 1 R.O.W. - Frank Jones Center

Sub-System: HS11

Smoke Testing Log

Project No: 18001  
Date: 09/25/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from catch basin - direct connection	2800	0.9

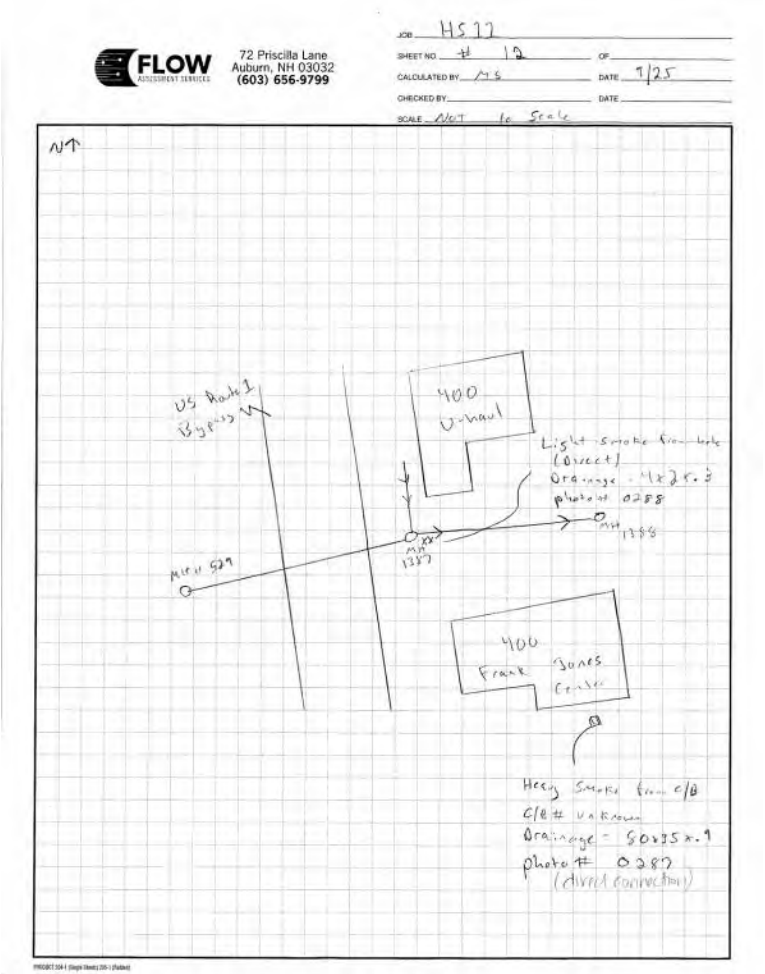


Image #: 0287.JPG

Sketch #: Subarea HS11 Sketch#12.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
50 Sunset Road

Sub-System: HS11

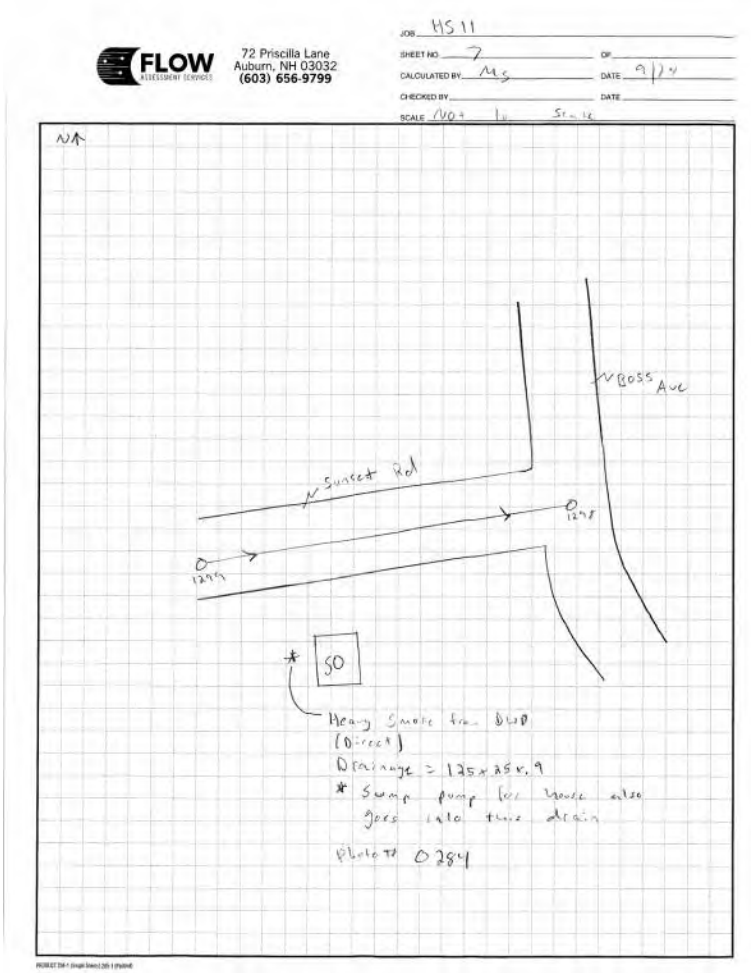
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from driveway drain - direct connection	3125	0.9



Image #: 0284.JPG



Sketch #: Subarea HS11 Sketch#7.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Thaxter Road

Sub-System: HS11

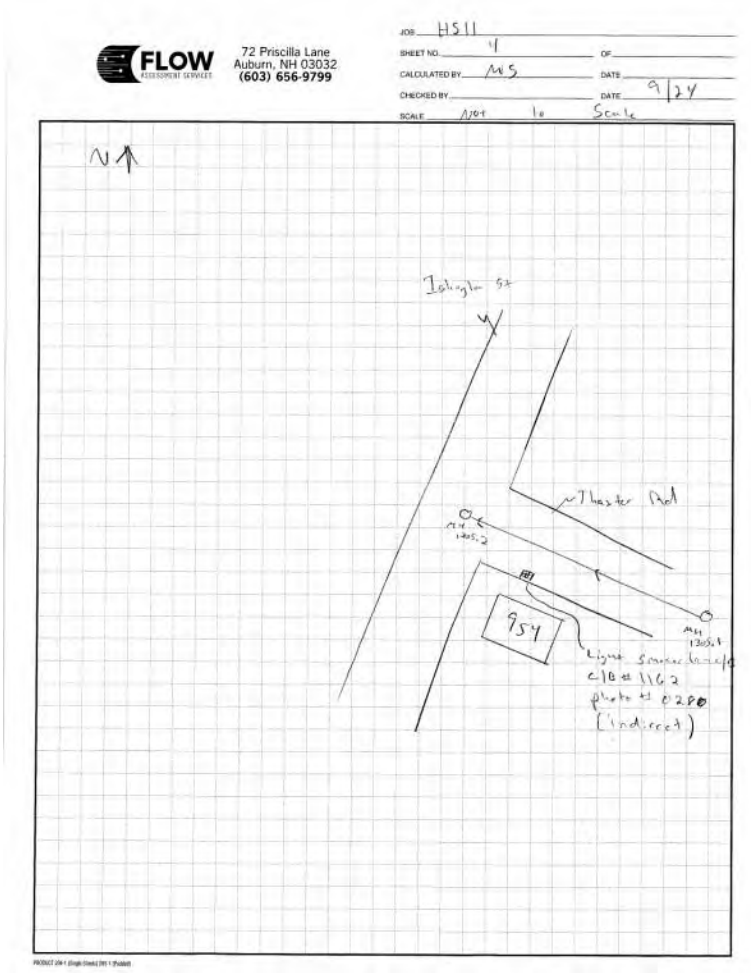
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#1162 - indirect connection. MH 1305.2 unnamed on map - see revised map.	0	0



Image #: 0280.JPG



Sketch #: Subarea HS11 Sketch#4.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Thaxter Road

Sub-System: HS11

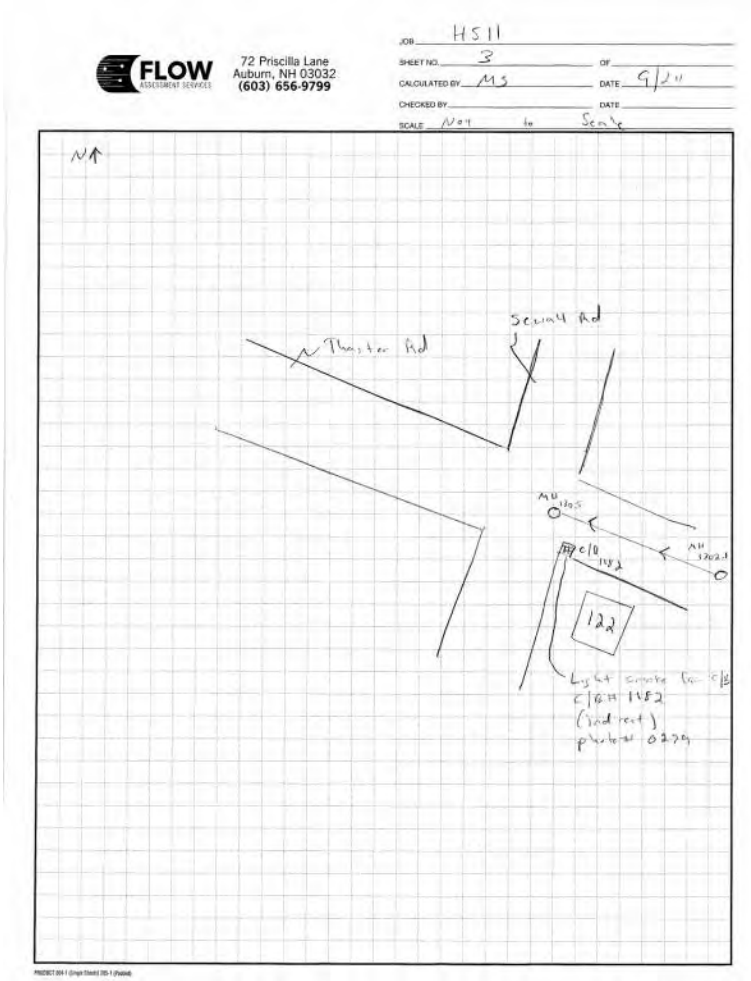
Smoke Testing Log

Project No: 18001  
Date: 09/24/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#1182 - indirect connection	0	0



Image #: 0279.JPG



Sketch #: Subarea HS11 Sketch#3.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
82 Woodbury Avenue

Sub-System: HS11

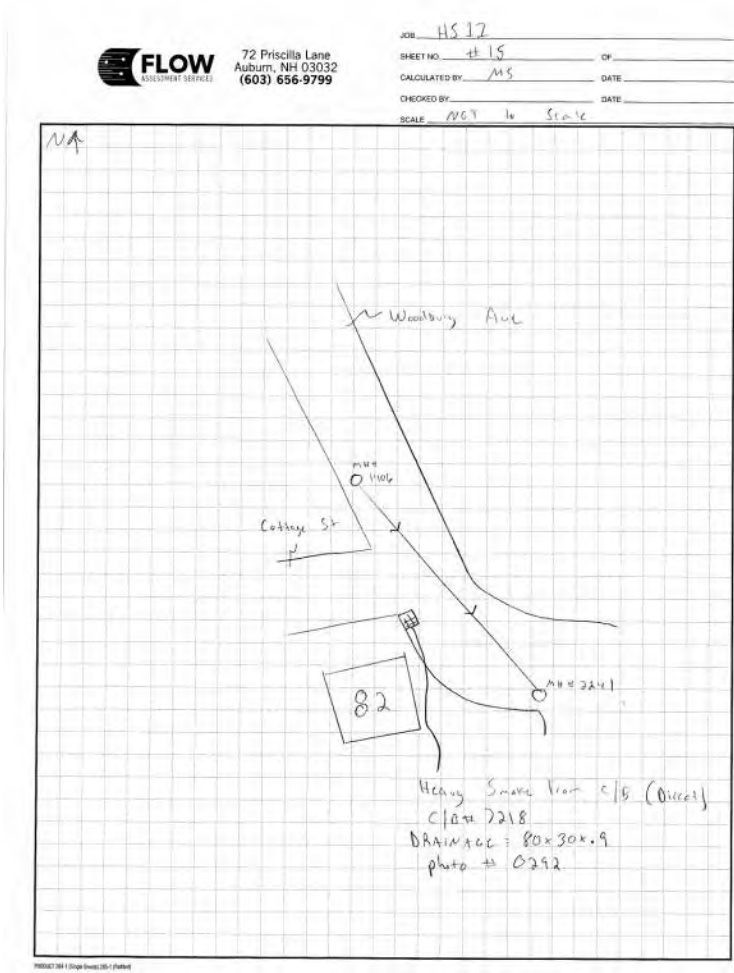
Smoke Testing Log

Project No: 18001  
Date: 09/25/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#7218 - direct connection	2400	0.9



Image #: 0292.JPG



Sketch #: Subarea HS11 Sketch#15.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Middle Road

Sub-System: HS15

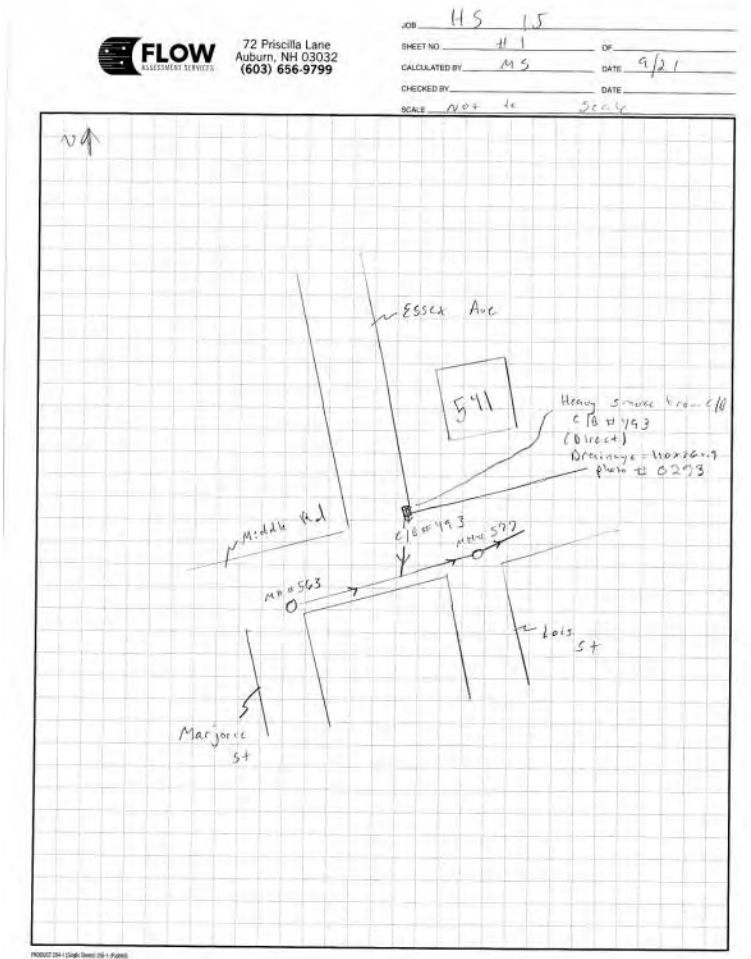
Smoke Testing Log

Project No: 18001  
Date: 09/21/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from catch basin#493 - direct connection	3960	0.9



Image #: 0273.JPG



Sketch #: Subarea HS15 Sketch#1.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:

Sub-System: LD1

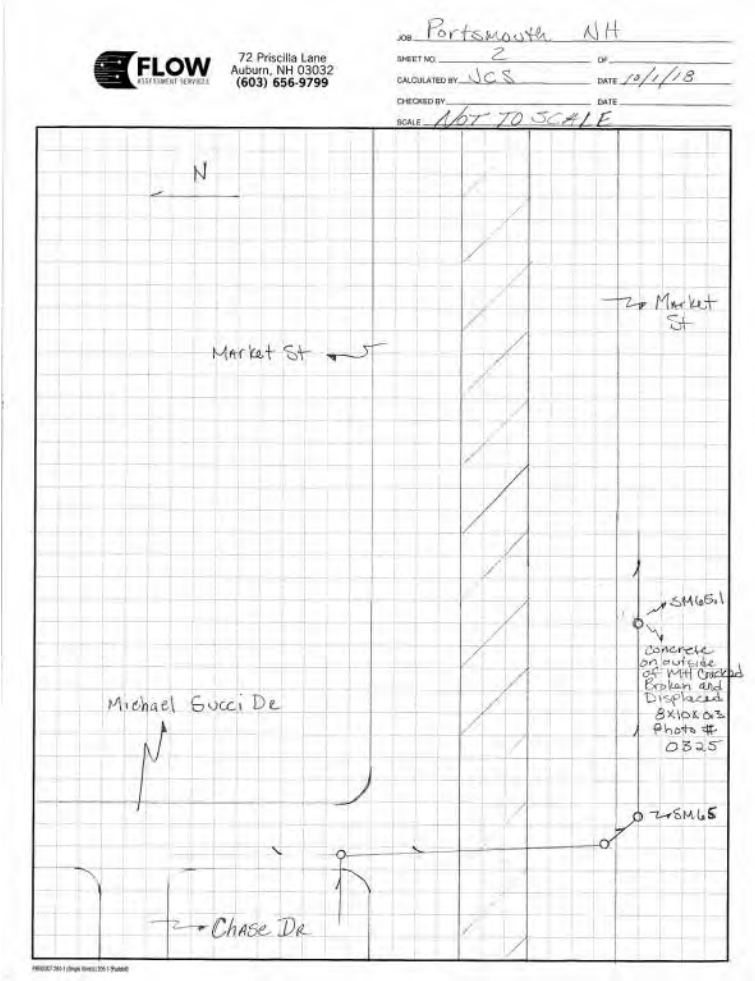
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
MH 65.1 unnamed on map - see revised map. Smoke from broken concrete outside of MH 65.1 - direct connection	80	0.3



Image #: IMG\_0325.JPG



Sketch #: Subarea LD1 Sketch#2.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Beechwood Street

Sub-System: LD1

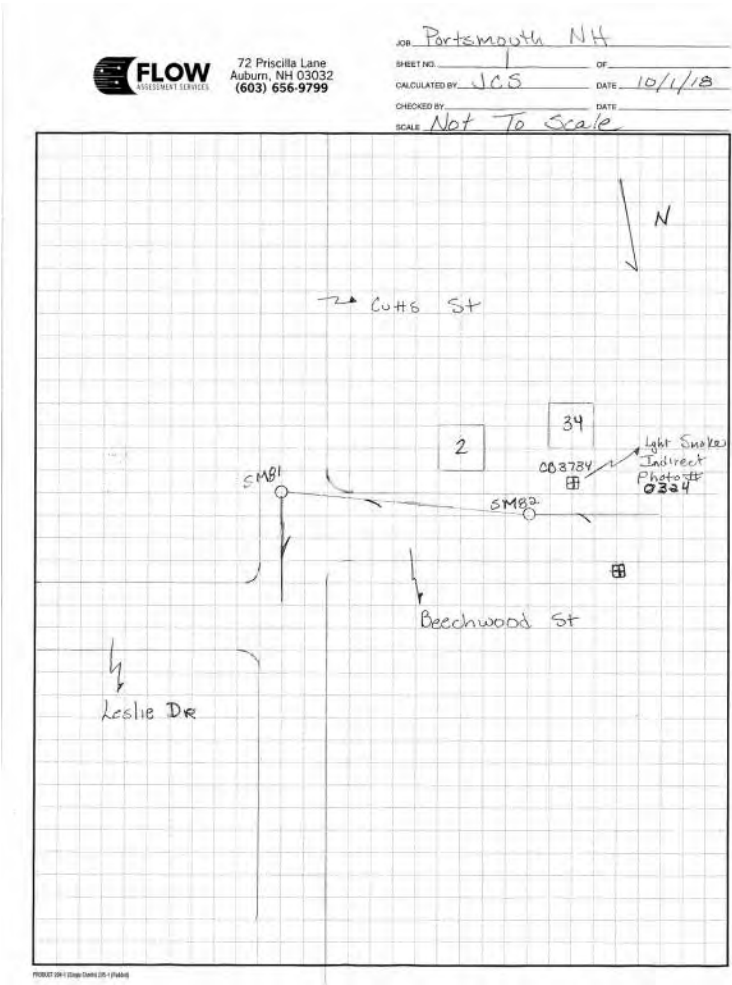
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#3734 - indirect connection	0	0



Image #: IMG\_0324.JPG



Sketch #: Subarea LD1 Sketch#1.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Market Street

Sub-System: LD1

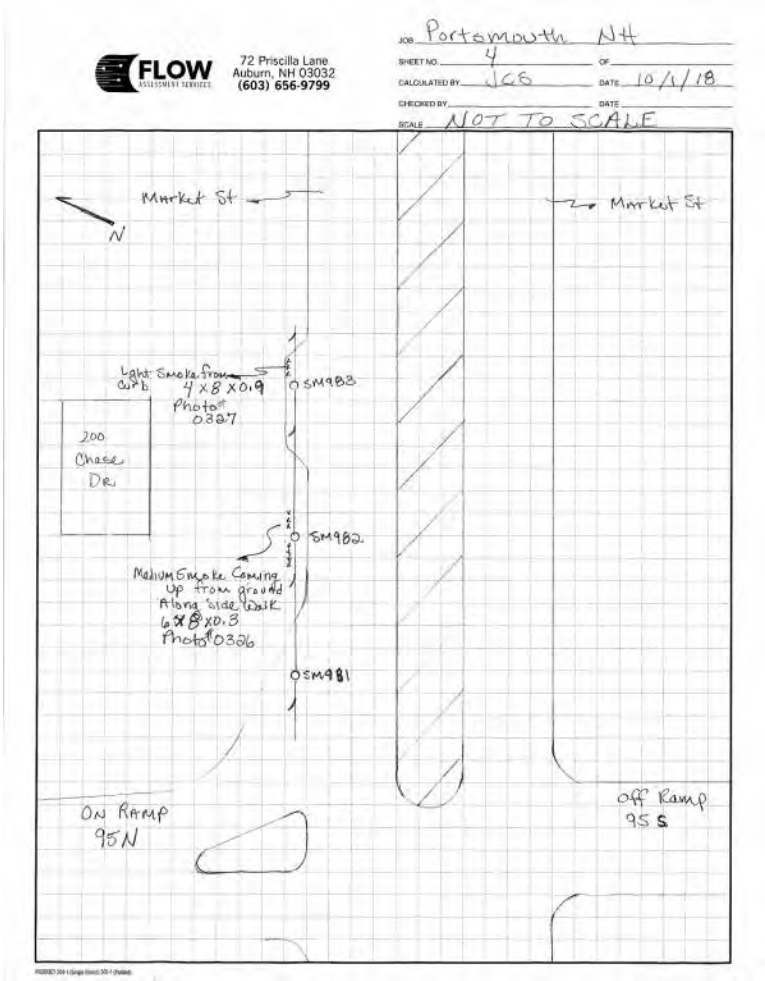
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from ground near sidewalk - direct connection	48	0.3



Image #: IMG\_0326.JPG



Sketch #: Subarea LD1 Sketch#4.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Market Street

Sub-System: LD1

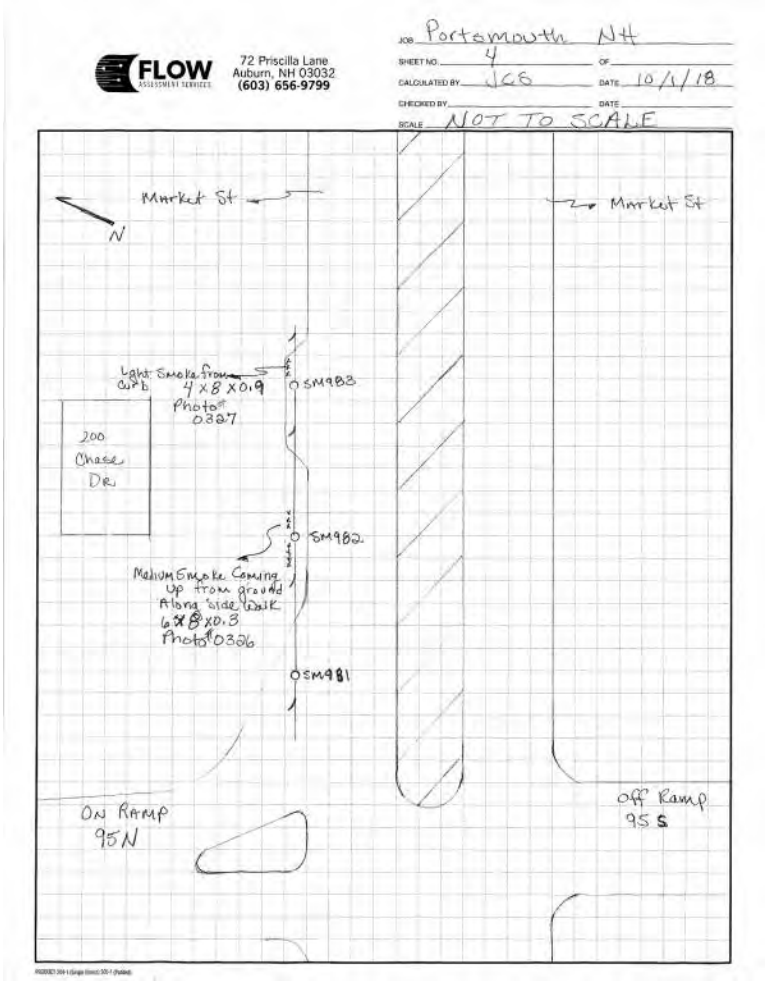
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from curb - direct connection	32	0.9



Image #: IMG\_0327.JPG



Sketch #: Subarea LD1 Sketch#4.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Market Street

Sub-System: LD1

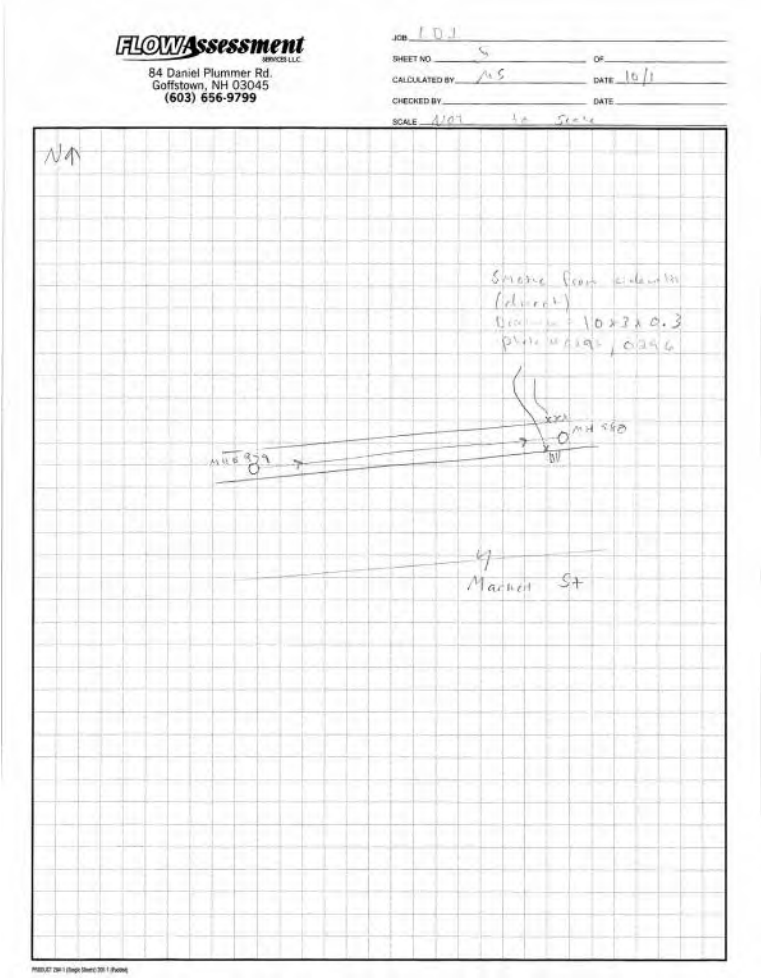
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from sidewalk/curb - direct connection	0	0



Image #: 0296.JPG



Sketch #: Subarea LD1 Sketch#5.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Market Street

Sub-System: LD1

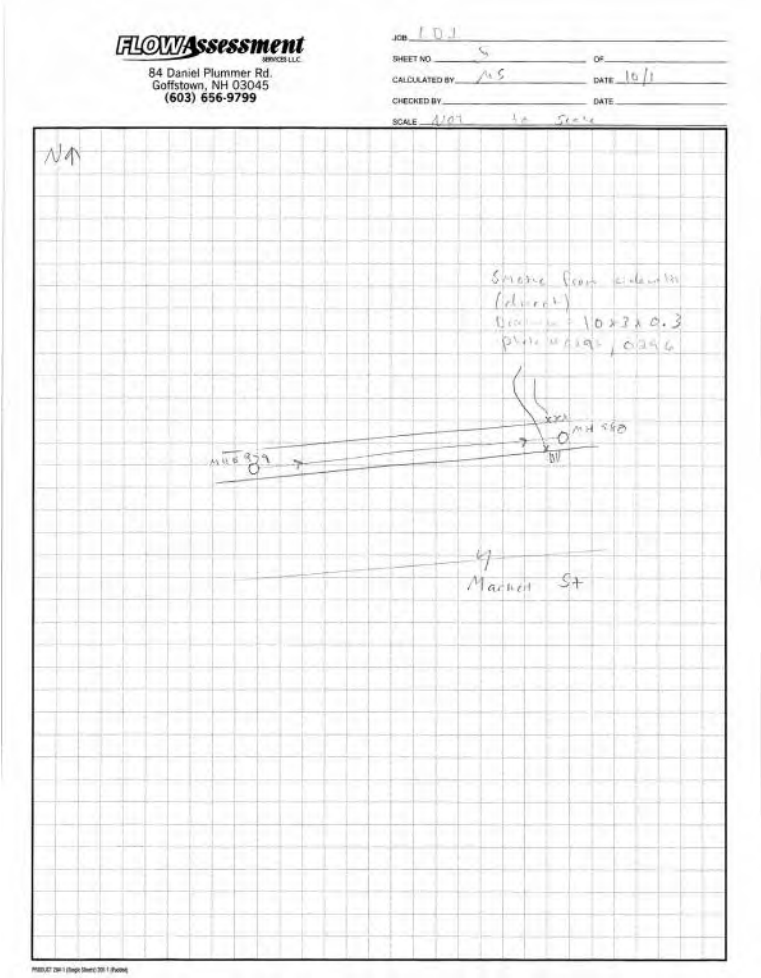
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from sidewalk/curb - direct connection	30	0.3



Image #: 0295.JPG



Sketch #: Subarea LD1 Sketch#5.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Portsmouth Boulevard

Sub-System: LD1

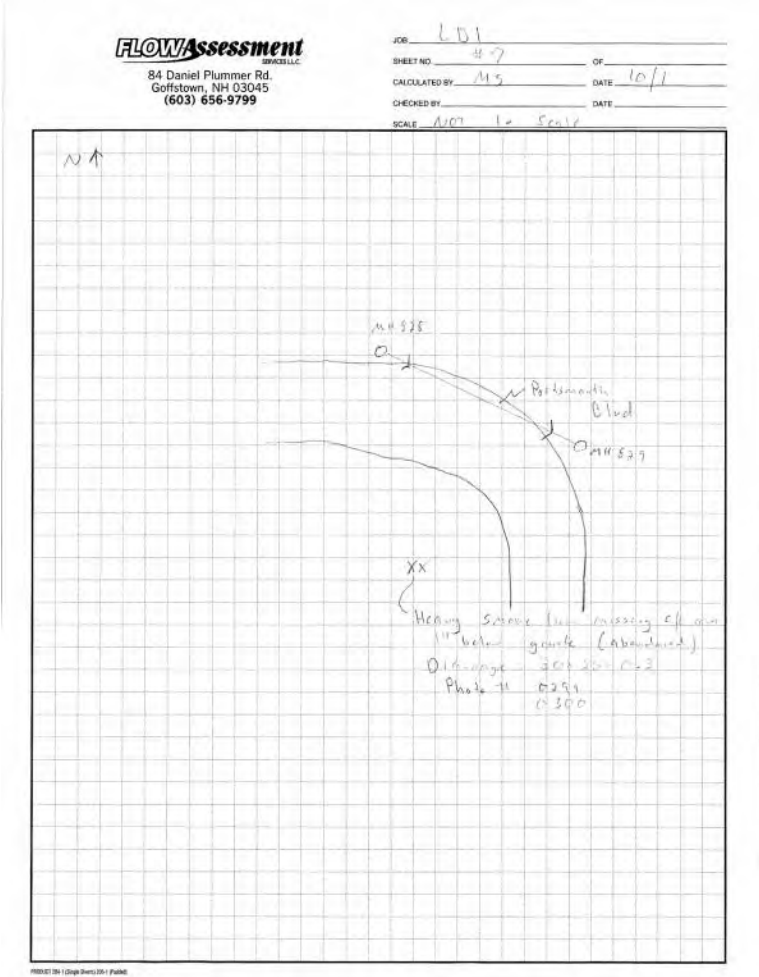
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from cleanout 1" below grade, missing cover - direct connection (Line abandoned)	0	0



Image #: 0300.JPG



Sketch #: Subarea LD1 Sketch#7.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Portsmouth Boulevard

Sub-System: LD1

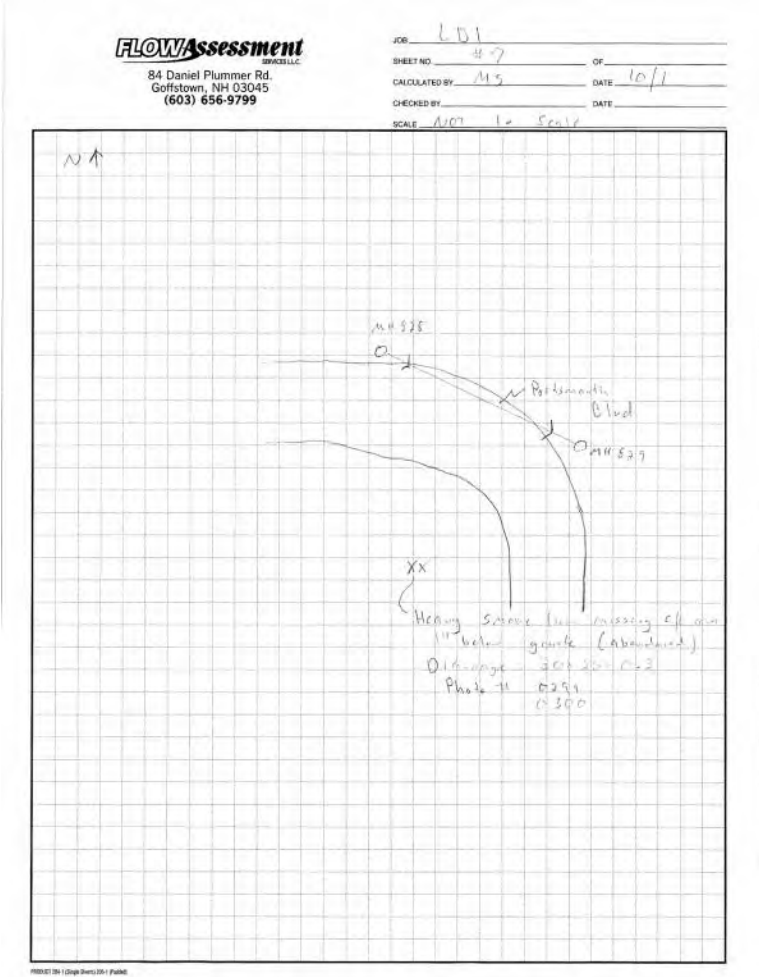
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from cleanout 1" below grade, missing cover - direct connection (Line abandoned)	750	0.3



Image #: 0299.JPG



Sketch #: Subarea LD1 Sketch#7.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Spinnaker Way

Sub-System: LD1

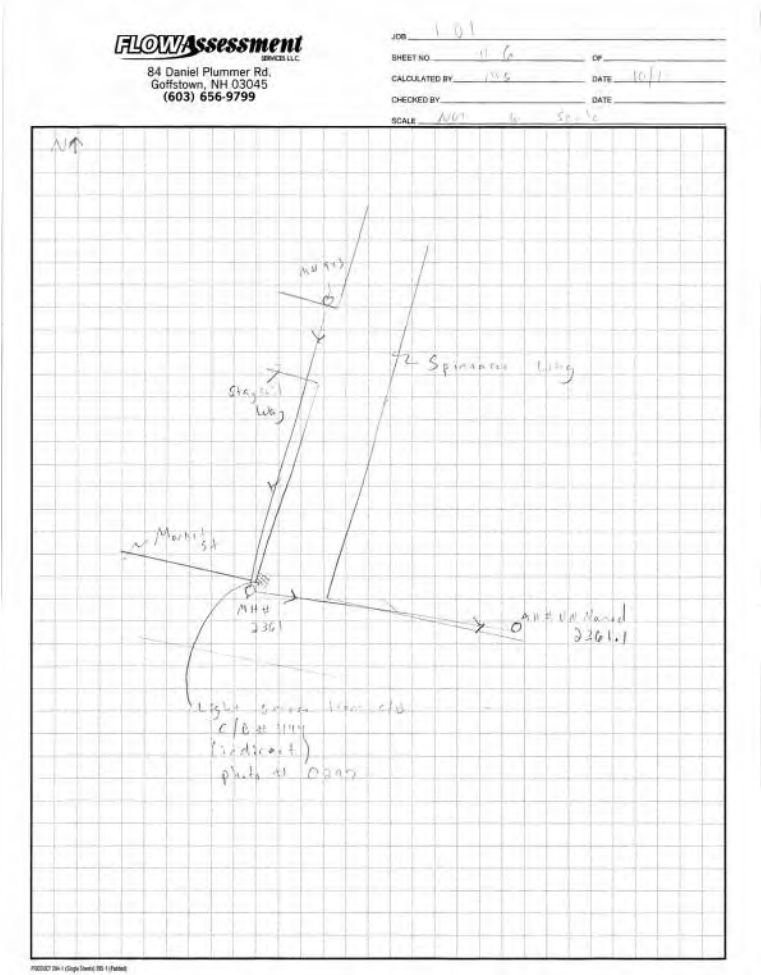
Smoke Testing Log

Project No: 18001  
Date: 10/01/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#444 - indirect connection	0	0



Image #: 0297.JPG



Sketch #: Subarea LD1 Sketch#6.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
6 Elwyn Road

Sub-System: LR1

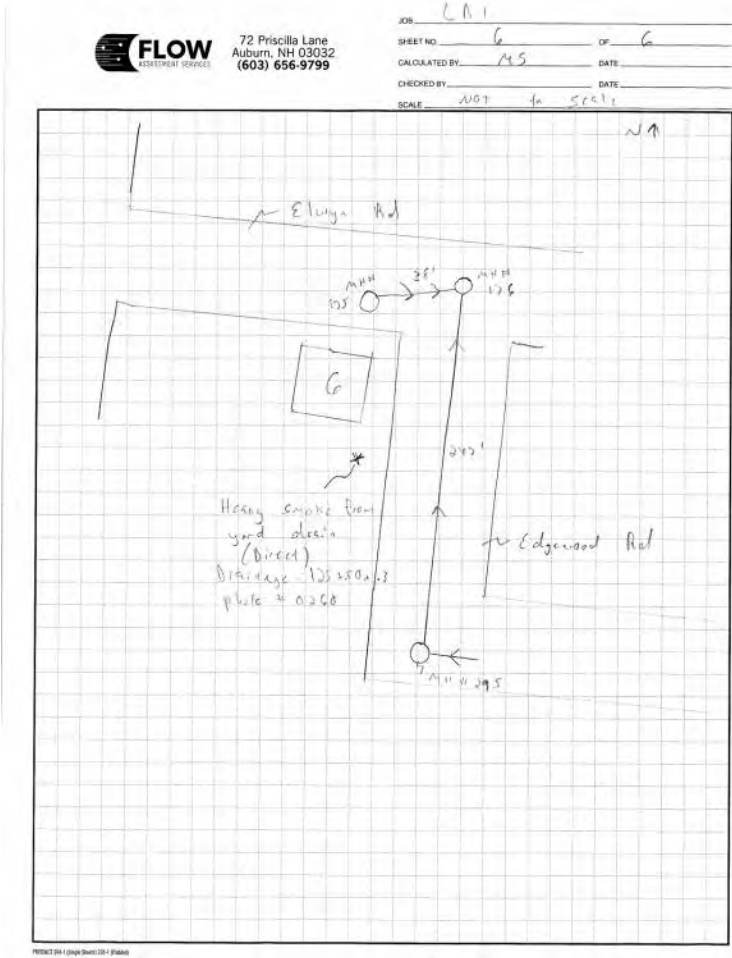
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from yard drain behind home -direct connection	6250	0.3



Image #: 0260.JPG



Sketch #: Subarea LR1 Sketch#6.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Elwyn Road R.O.W.

Sub-System: LR1

Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from around corbel of MH 343 - direct connection	0	0



Image #: 0257.JPG

Sketch #:



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Elwyn Road R.O.W.

Sub-System: LR1

Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from around corbel of MH 343 - direct connection	0	0



Image #: 0256.JPG

Sketch #:

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Elwyn Road R.O.W.

Sub-System: LR1

Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from around corbel of MH 343 - direct connection	2	0.9



Image #: 0255.JPG

Sketch #:



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Elwyn Road R.O.W.

Sub-System: LR1

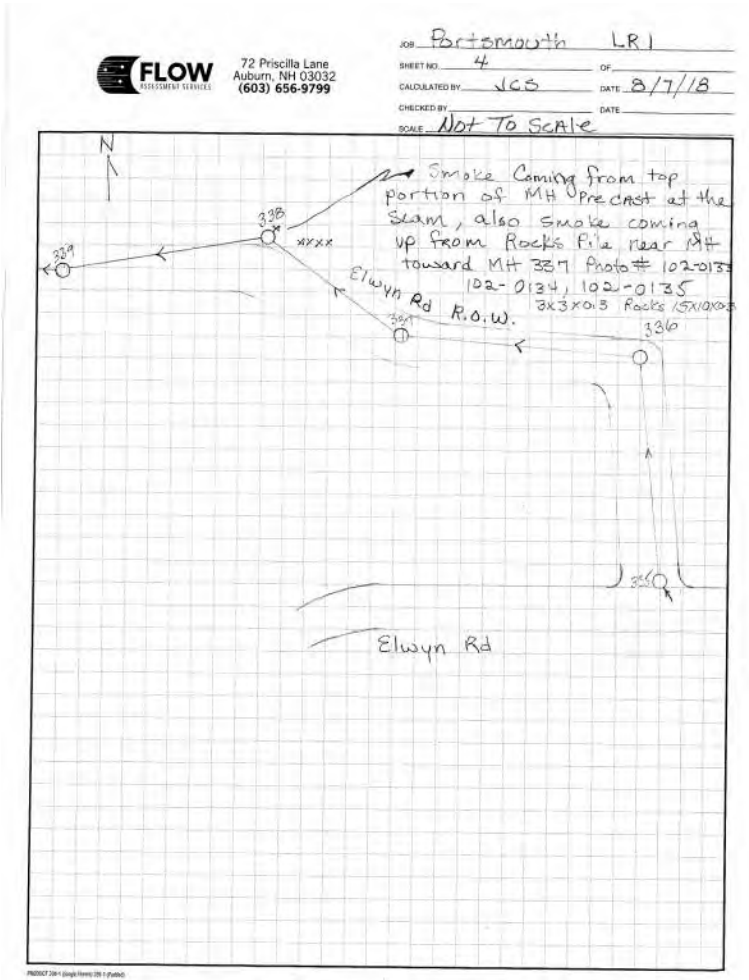
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from rock pile near MH 338 - direct connection	0	0



Image #: IMG\_0135.JPG



Sketch #: Subarea LR1 Sketch#4.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Elwyn Road R.O.W.

Sub-System: LR1

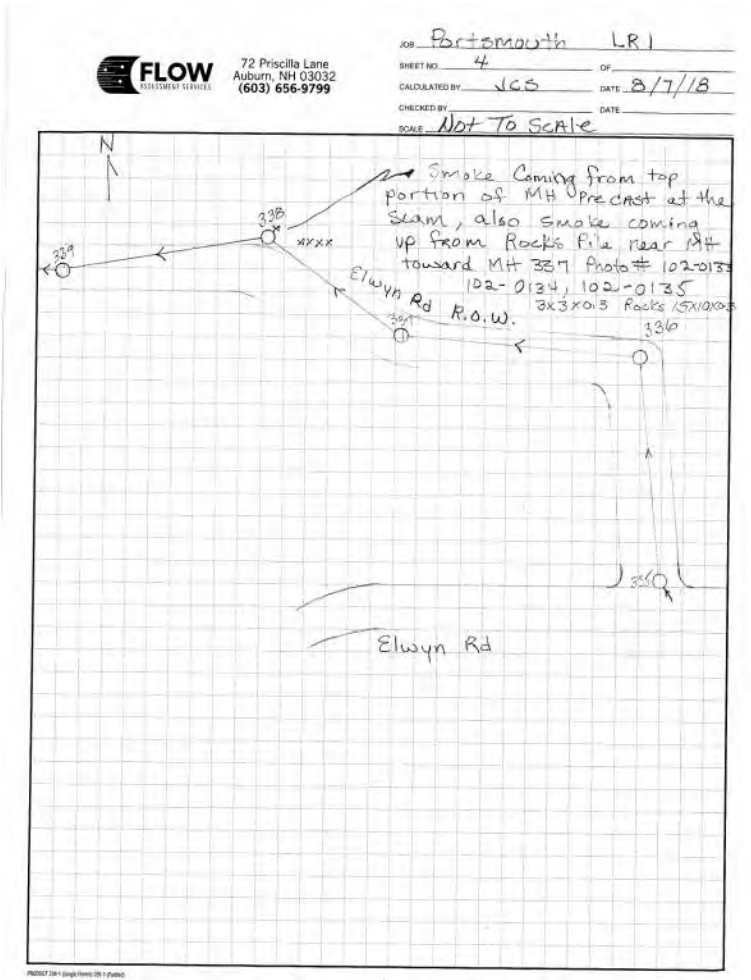
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from rockpile near MH 338 - direct connection	150	0.3



Image #: IMG\_0134.JPG



Sketch #: Subarea LR1 Sketch#4.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Elwyn Road R.O.W.

Sub-System: LR1

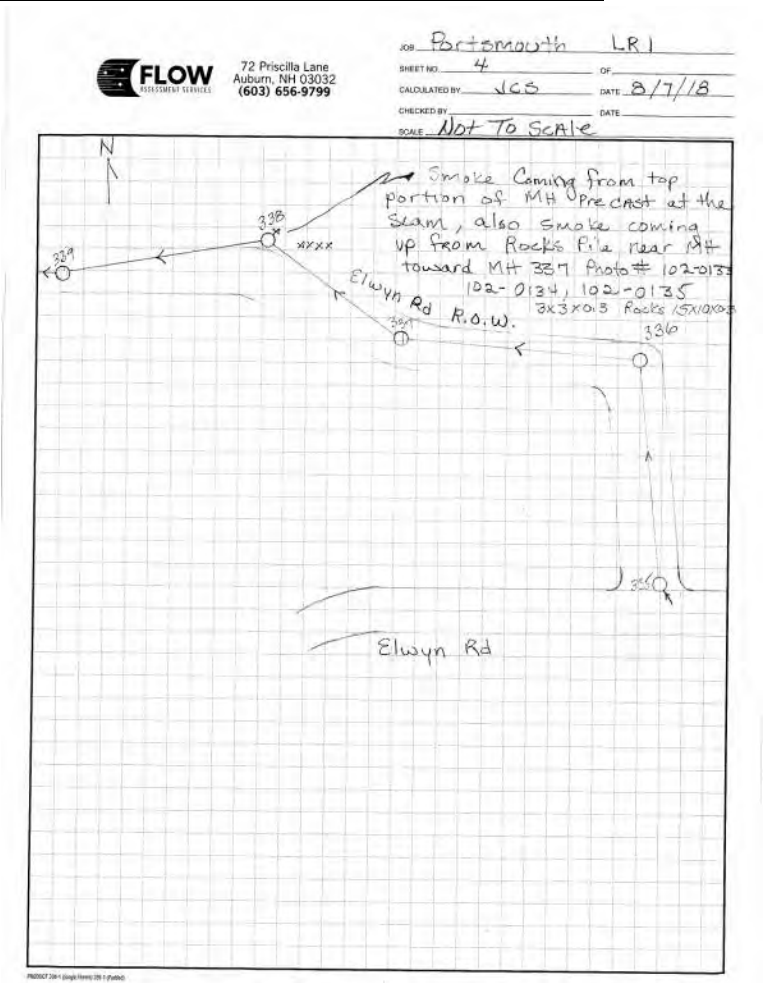
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from corbel of MH 338 - direct connection	9	0.3



Image #: IMG\_0133.JPG



Sketch #: Subarea LR1 Sketch#4.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Sagamore Avenue

Sub-System: LR1

Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
MH 5858 is in gutterline	150	0.9

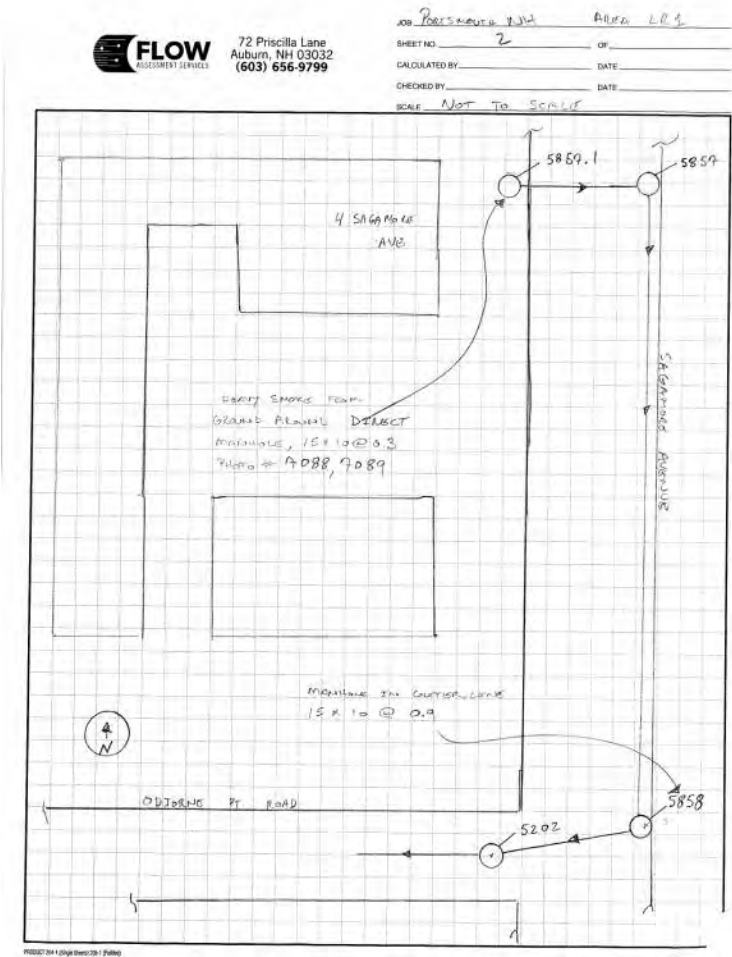


Image #:

Sketch #: Subarea LR1 Sketch#2.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Sagamore Avenue R.O.W.

Sub-System: LR1

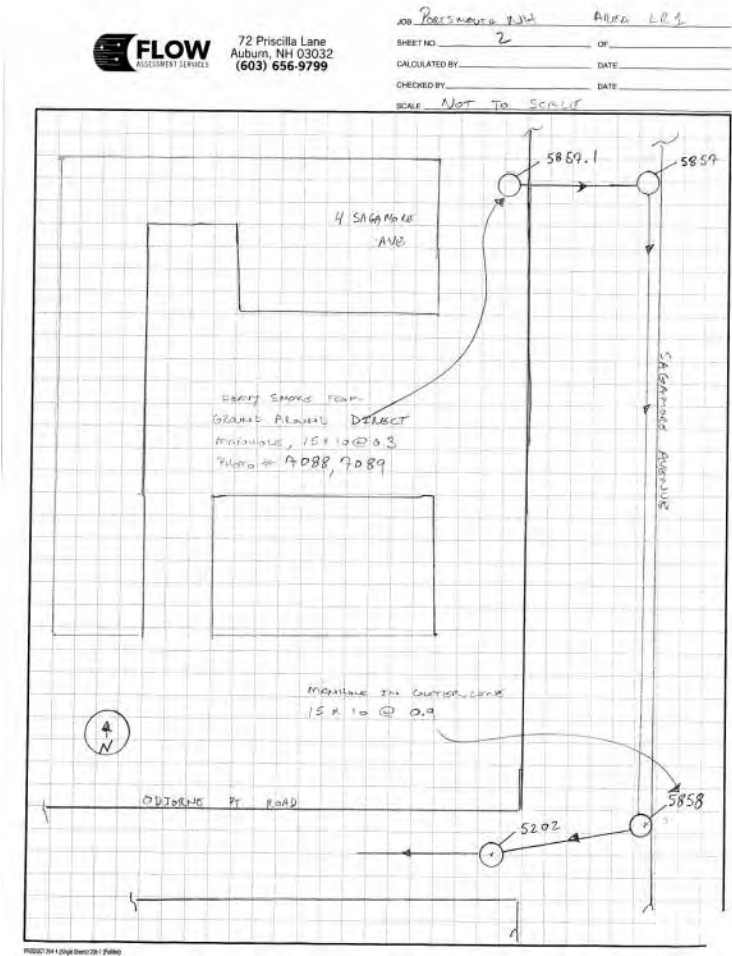
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from ground around MH 5857.1	0	0



Image #: DSCN7089.JPG



Sketch #: Subarea LR1 Sketch#2.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Sagamore Avenue R.O.W.

Sub-System: LR1

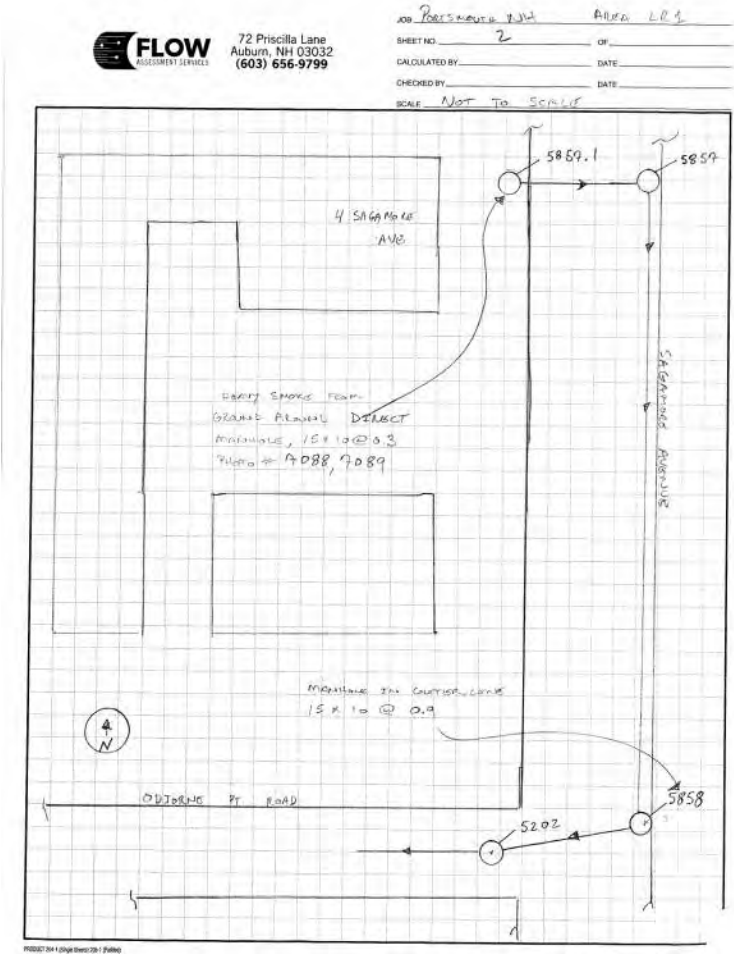
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Heavy smoke from ground around MH 5857.1 - direct connection. MH 5857.1 unnamed on map - see revised map.	150	0.3



Image #: DSCN7088.JPG



Sketch #: Subarea LR1 Sketch#2.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Taft Road

Sub-System: LR1

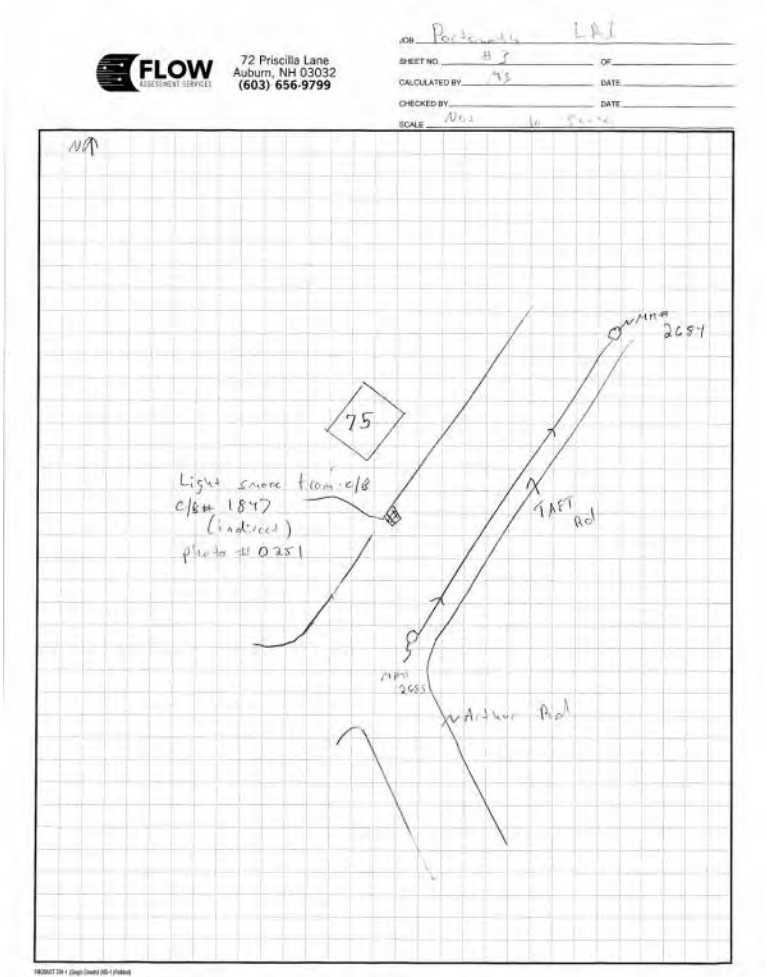
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#1847 - indirect connection	0	0



Image #: 0251.JPG



Sketch #: Subarea LR1 Sketch#3.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Taft Road

Sub-System: LR1

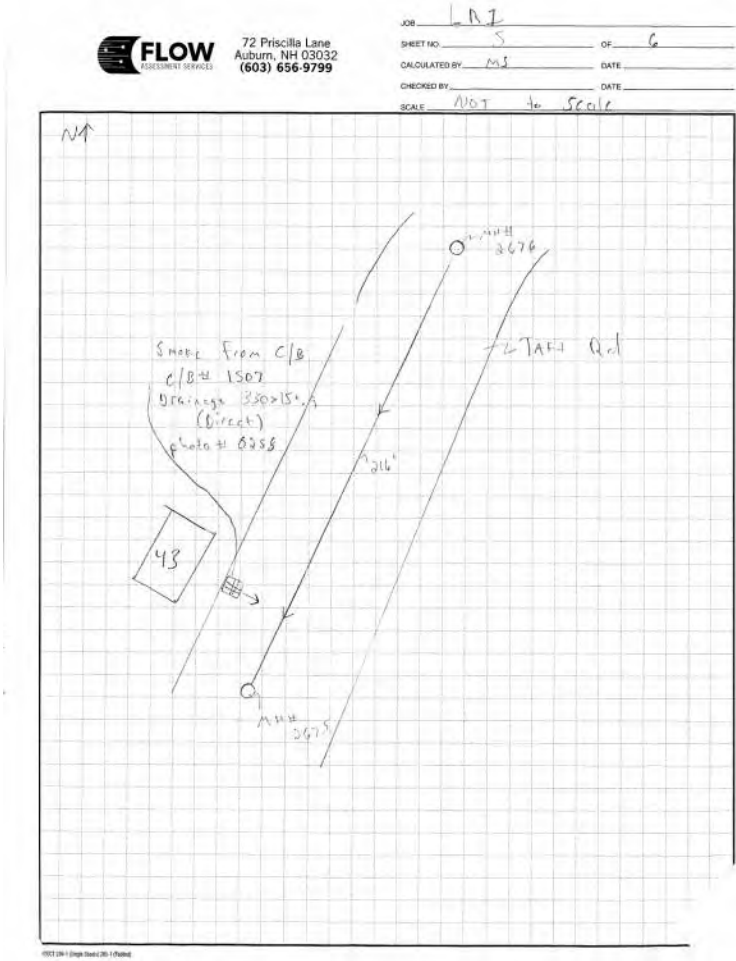
Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from catch basin#1507 - direct connection	4950	0.9



Image #: 0258.JPG



Sketch #: Subarea LR1 Sketch#5.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Taylor Lane

Sub-System: LR1

Smoke Testing Log

Project No: 18001  
Date: 09/07/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#1573 - indirect connection	0	0

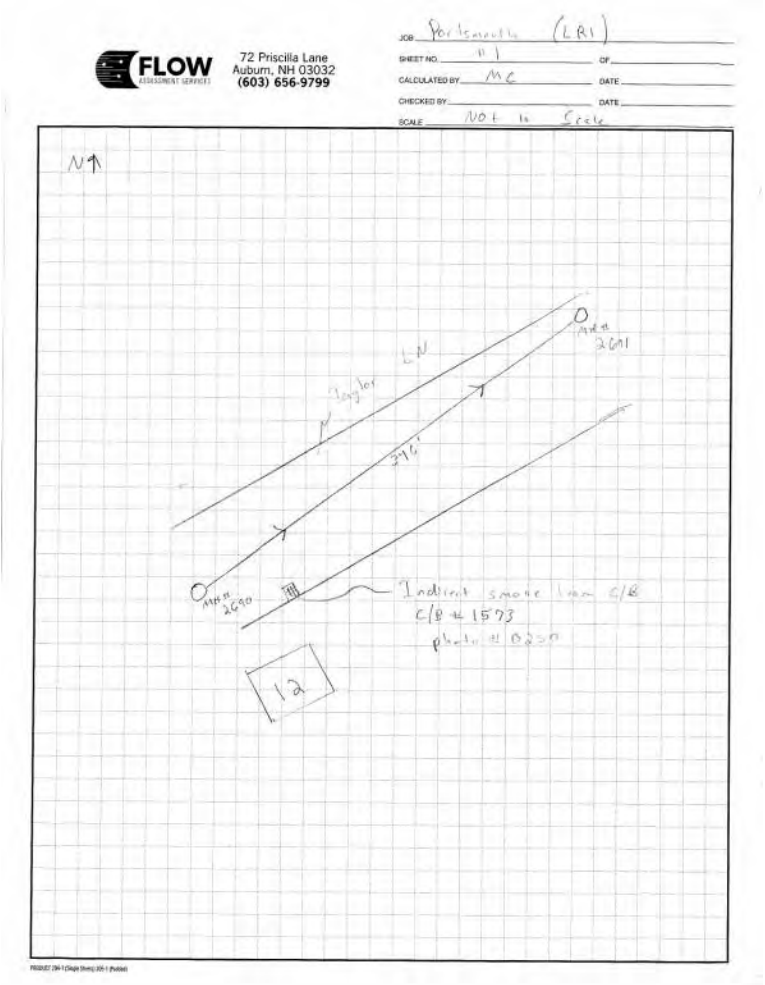


Image #: 0250.JPG

Sketch #: Subarea LR1 Sketch#1.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
420 Grant Drive

Sub-System: LR2

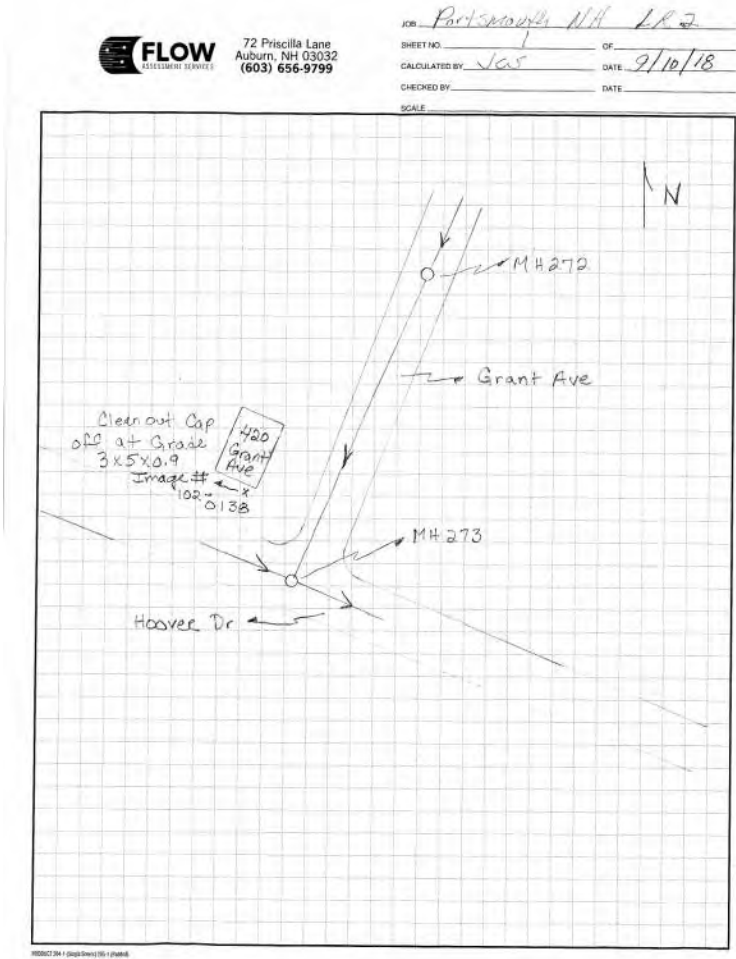
Smoke Testing Log

Project No: 18001  
Date: 09/12/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from cleanout missing cap, at grade - direct connection	15	0.9



Image #: IMG\_0138.JPG



Sketch #: Subarea LR2 Sketch#1.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
2021 Lafayette Road

Sub-System: LR2

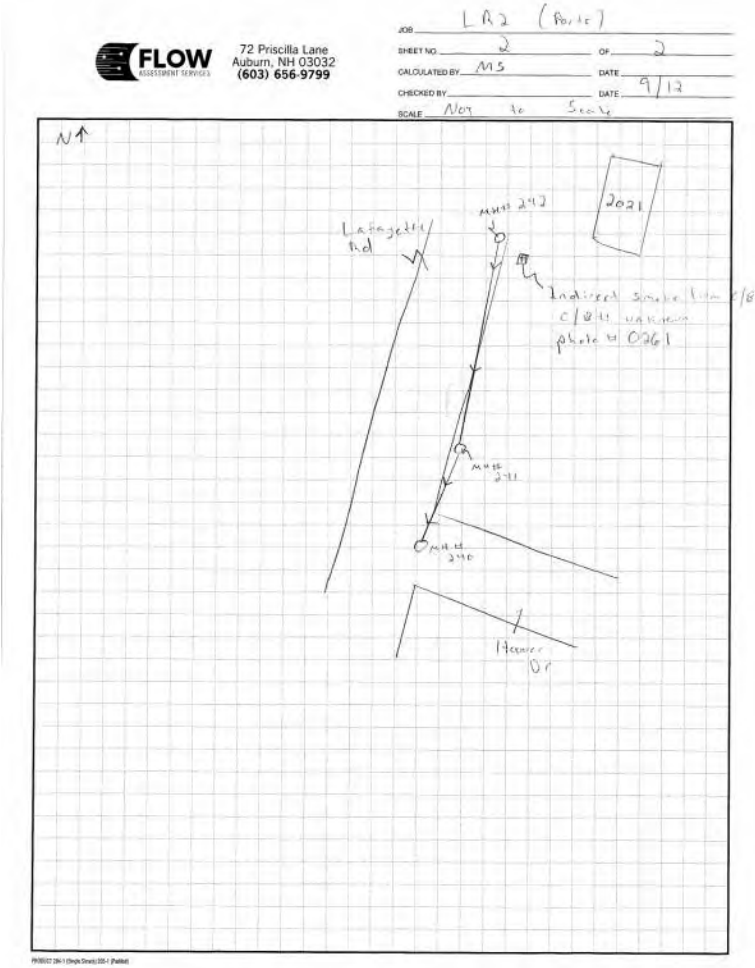
Smoke Testing Log

Project No: 18001  
Date: 09/12/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin - indirect connection	0	0



Image #: 0261.JPG



Sketch #: Subarea LR2 Sketch#2.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
380 Greenleaf Avenue

Sub-System: LR4

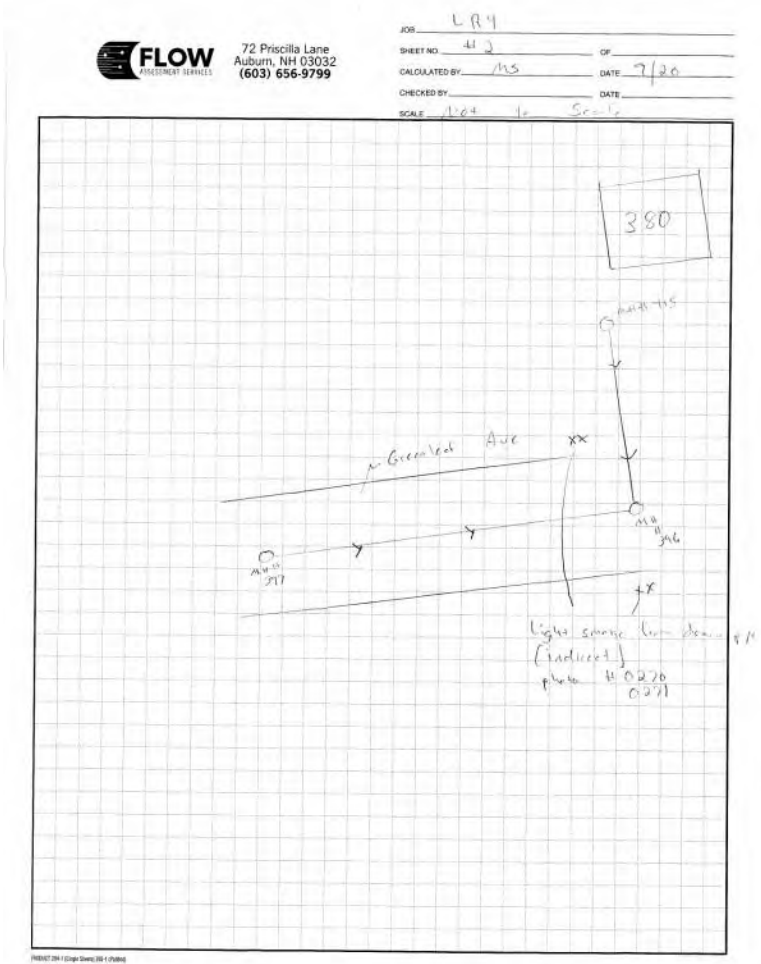
Smoke Testing Log

Project No: 18001  
Date: 09/20/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from drain pipe - direct connection	0	0



Image #: 0271.JPG



Sketch #: Subarea LR4 Sketch#2.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
380 Greenleaf Avenue

Sub-System: LR4

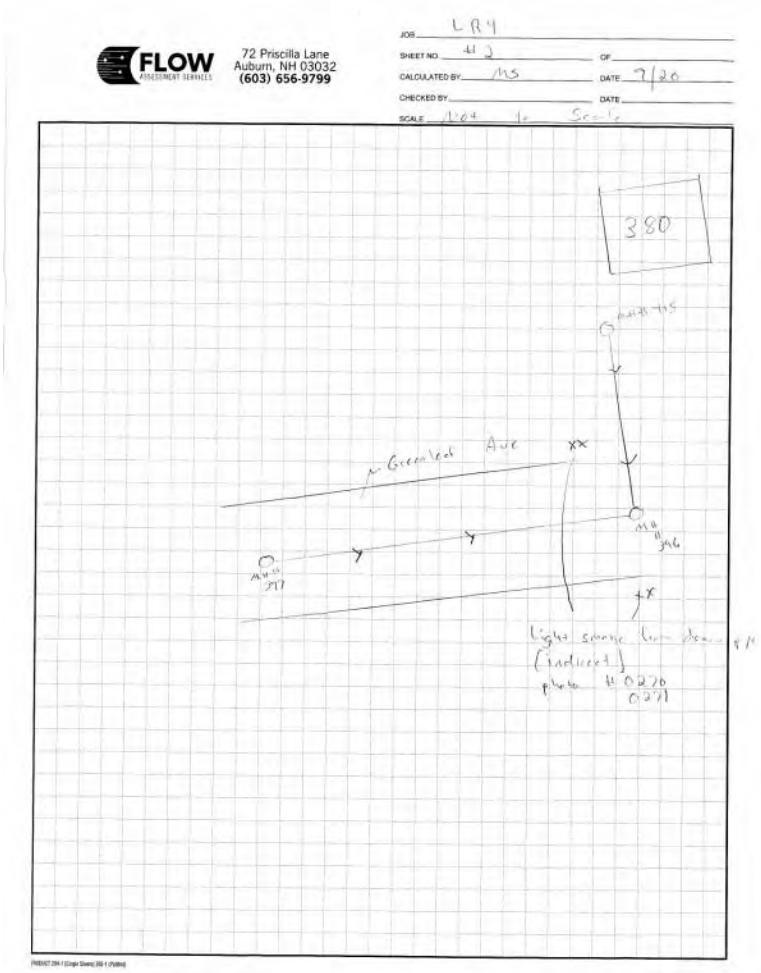
Smoke Testing Log

Project No: 18001  
Date: 09/20/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from drain pipe - indirect connection	0	0



Image #: 0270.JPG



Sketch #: Subarea LR4 Sketch#2.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Hillside Drive

Sub-System: LR4

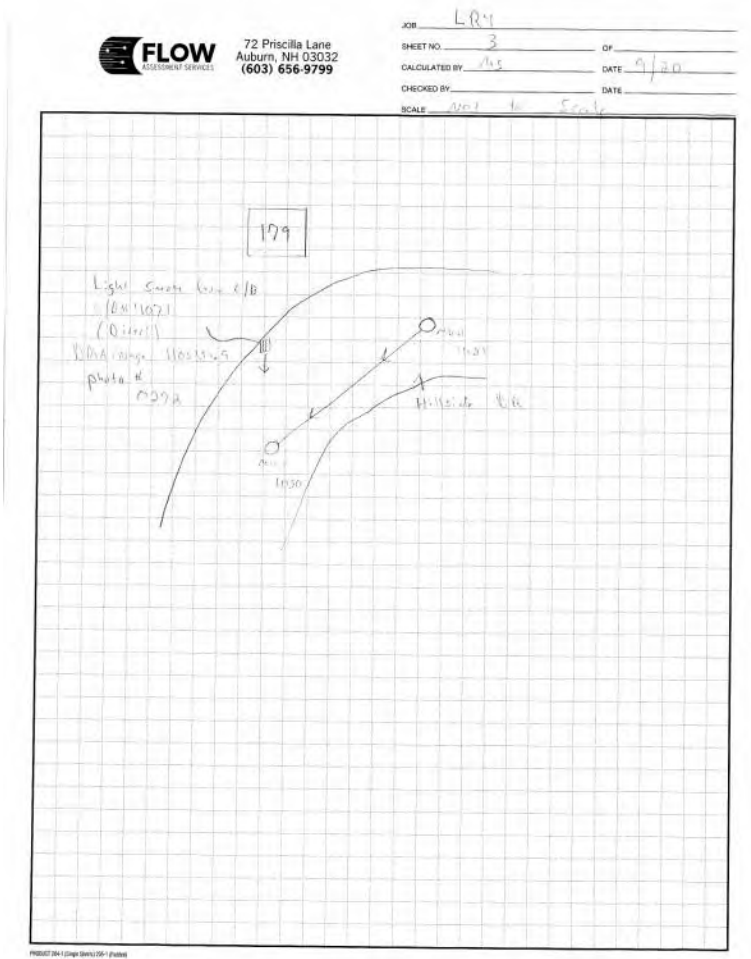
Smoke Testing Log

Project No: 18001  
Date: 09/20/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Light smoke from catch basin#4071 - direct connection	1650	0.9



Image #: 0272.JPG



Sketch #: Subarea LR4 Sketch#3.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Leavitt Avenue

Sub-System: LR4

Smoke Testing Log

Project No: 18001  
Date: 09/20/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
3 GPM leak from above outgoing line in MH 543	0	0



Image #: 0268.JPG

Sketch #:

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
10 McClintock Avenue

Sub-System: LR4

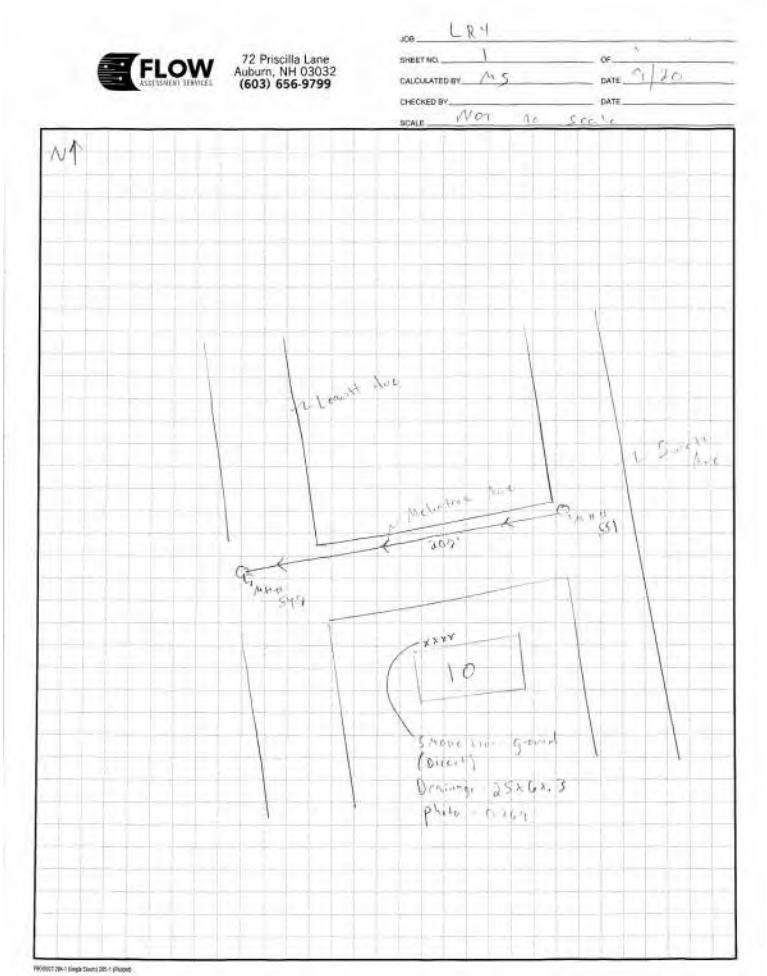
Smoke Testing Log

Project No: 18001  
Date: 09/20/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from ground - direct connection	150	0.3



Image #: 0269.JPG



Sketch #: Subarea LR4 Sketch#1.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
275 Constitution Avenue

Sub-System: LR6

Smoke Testing Log

Project No: 18001  
Date: 09/14/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from loose cleanout cover 6" above grade - direct connection	0	0



Image #: 0262.JPG

Sketch #:

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
225 Heritage Avenue

Sub-System: LR6

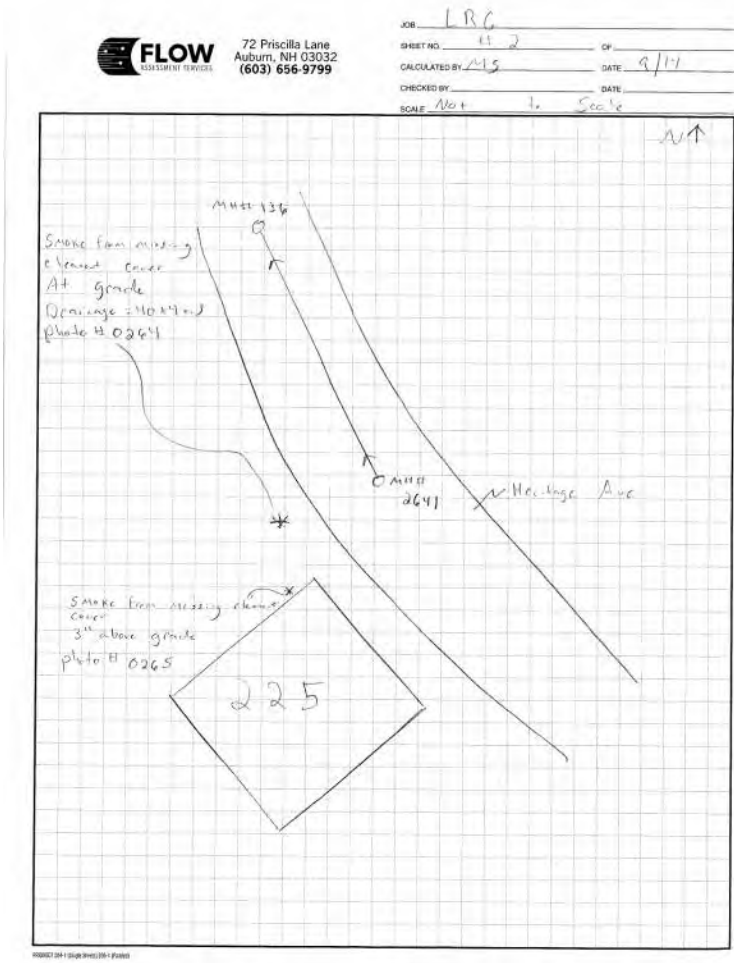
Smoke Testing Log

Project No: 18001  
Date: 09/14/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from cleanout missing cover, 3" above grade - direct connection	0	0



Image #: 0265.JPG



Sketch #: Subarea LR6 Sketch#2.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
225 Heritage Avenue

Sub-System: LR6

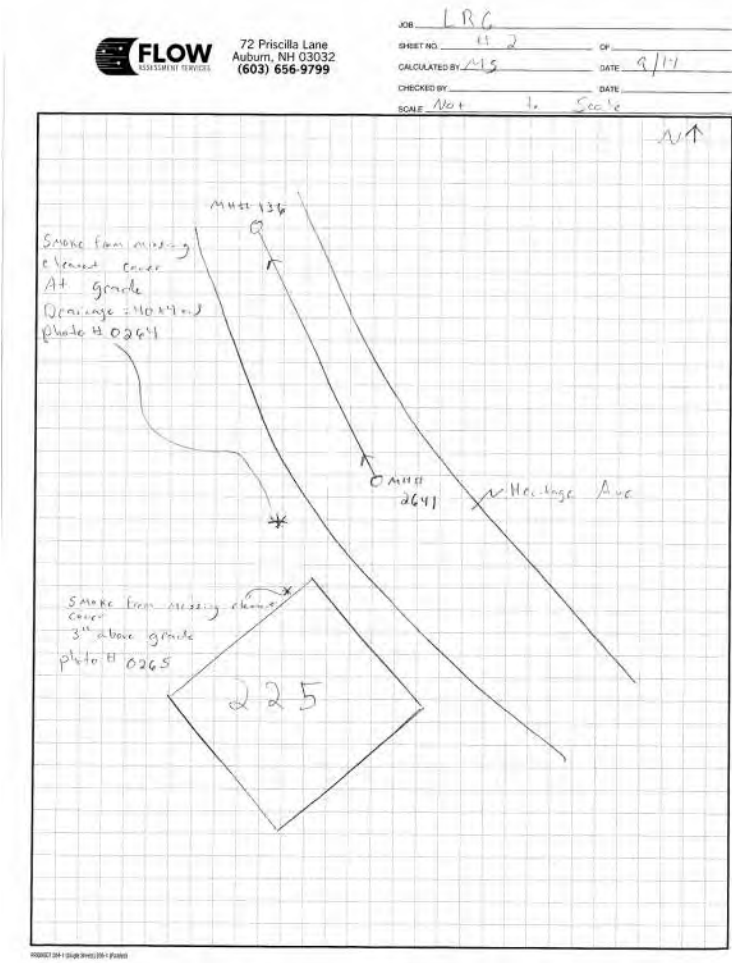
Smoke Testing Log

Project No: 18001  
Date: 09/14/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from cleanout missing cover, at grade - direct connection	160	0.3



Image #: 0264.JPG



Sketch #: Subarea LR6 Sketch#2.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
Lafayette Road

Sub-System: LR6

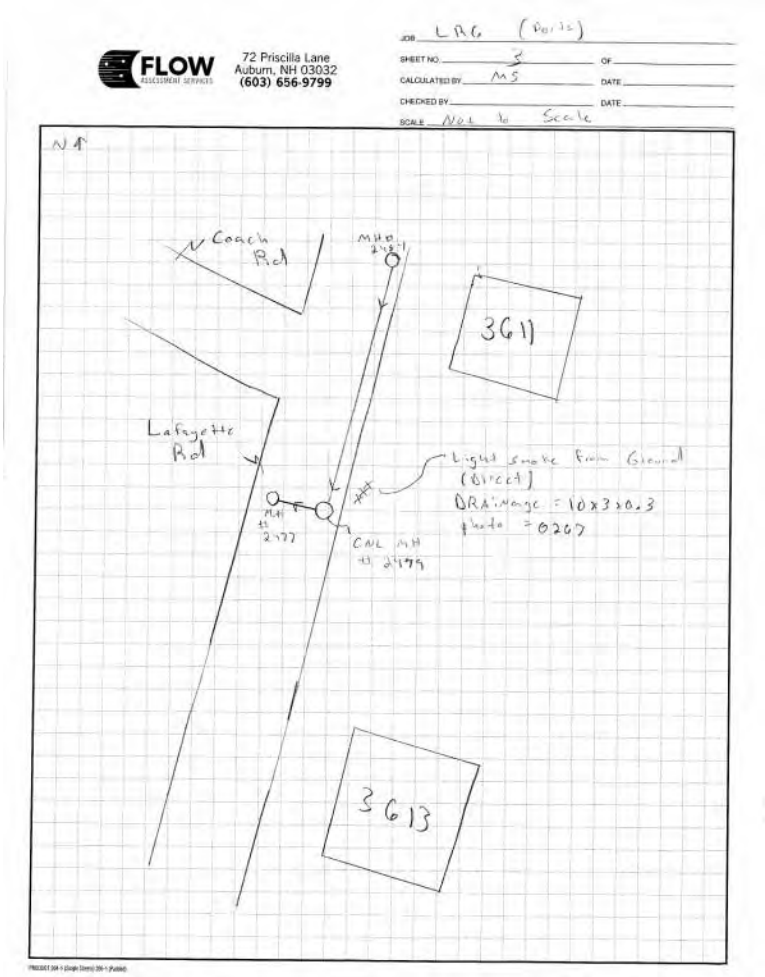
Smoke Testing Log

Project No: 18001  
Date: 09/14/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
MH 2479 is buried - footages combined. Smoke from ground near approximate location of MH 2479 - direct connection	30	0.3



Image #: 0267.JPG



Sketch #: Subarea LR6 Sketch#3.tif



Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
2468 Lafayette Road

Sub-System: LR6

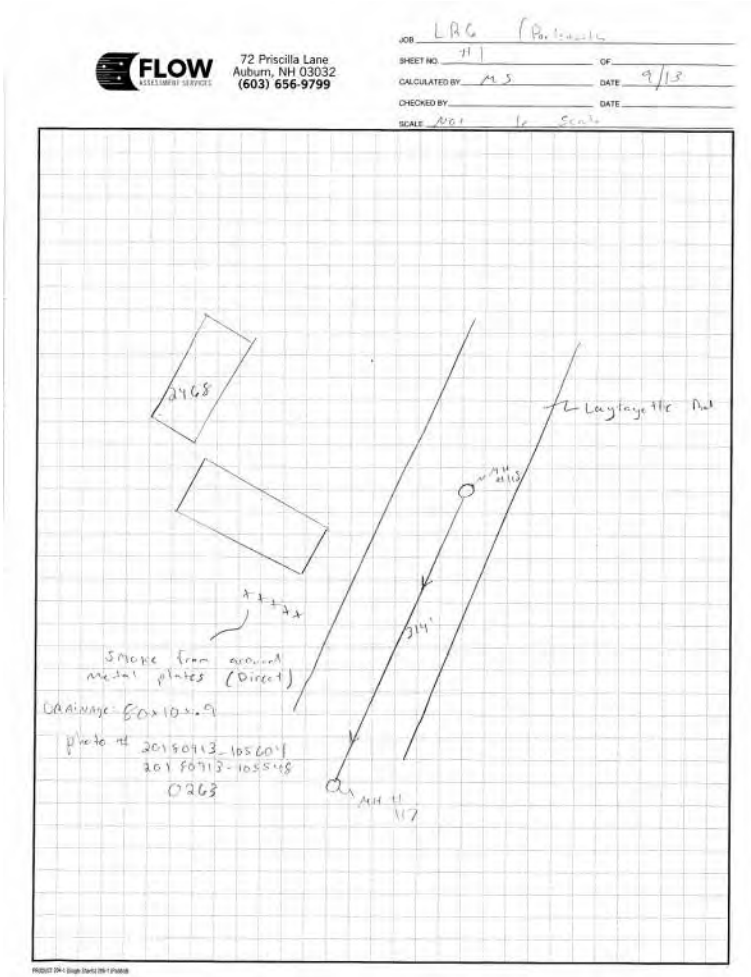
Smoke Testing Log

Project No: 18001  
Date: 09/14/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from metal plates and cracks - direct connection	0	0



Image #: 20180913\_105548.jpg



Sketch #: Subarea LR6 Sketch#1.tif

Flow Assessment Services, L.L.C.

Municipality: Portsmouth, NH  
Finding Location:  
2468 Lafayette Road

Sub-System: LR6

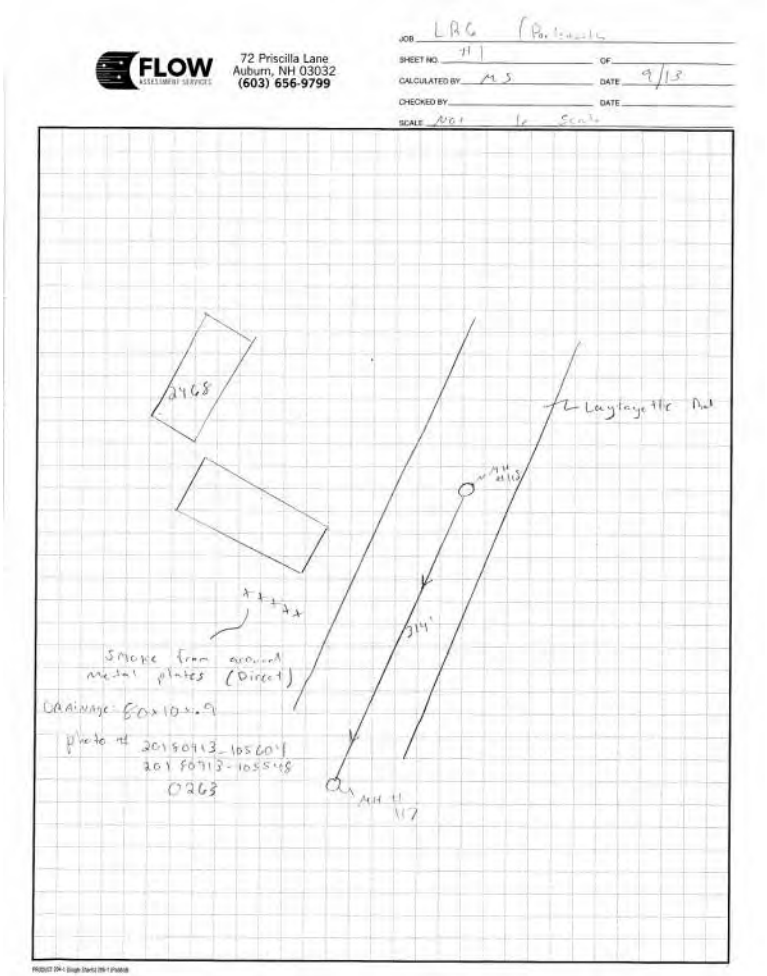
Smoke Testing Log

Project No: 18001  
Date: 09/14/2018  
Inspector: MS

Findings:	Drainage Area SqFt	Runoff Coeff
Smoke from metal plates and cracks - direct connection	0	0



Image #: 20180913\_105604.jpg



Sketch #: Subarea LR6 Sketch#1.tif



2468 Lafayette Road

## Smoke Testing Log

**Sub-System: LR6**

**Project No:** 18001

**Date:** 09/14/2018

**Inspector:** MS

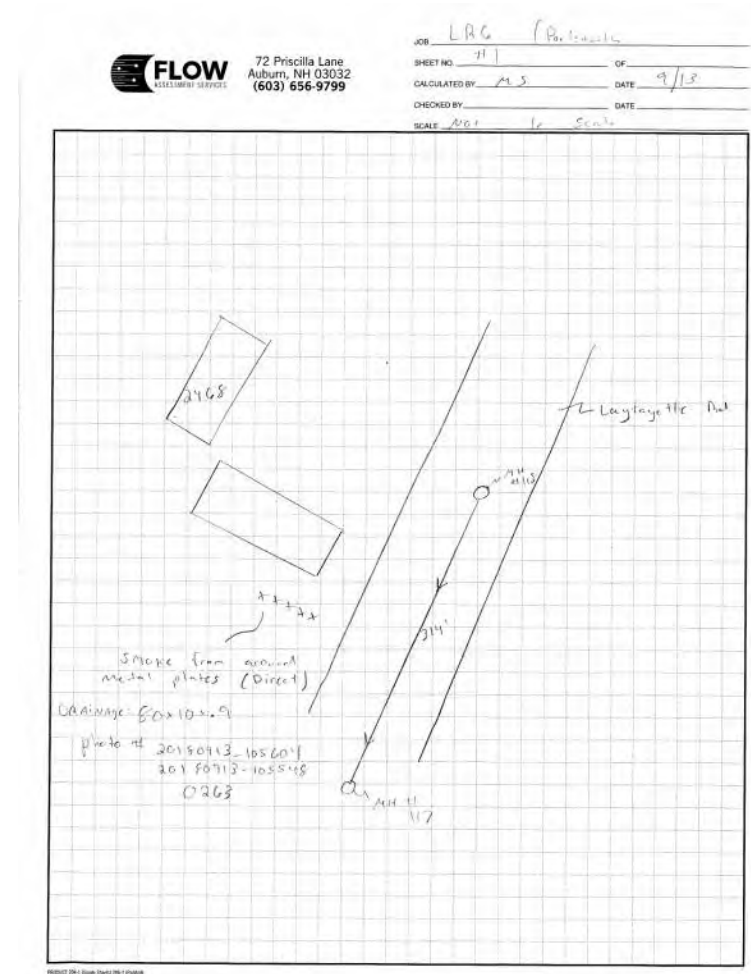
### Findings:

Smoke from metal plates and cracks - direct connection

Drainage  
Area SqFtRunoff  
Coeff

800

0.9



**Image #:** 0263.JPG

**Sketch #:** Subarea LR6 Sketch#1.tif



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