

# **Report**

## **Town of Dedham, MA**

### **2012 Inflow Investigation**

February 2013

***Weston&Sampson***

Weston & Sampson Engineers, Inc.  
Five Centennial Drive  
Peabody, MA 01960-7985

[www.westonandsampson.com](http://www.westonandsampson.com)  
Tel: 978-532-1900 Fax: 978-977-0100



**Town of Dedham, Massachusetts  
Weston & Sampson Project No. 2120623.A**

February 26, 2013

Mr. Jason L. Mammone, P.E.  
Director of Engineering  
55 River Street  
Dedham, Massachusetts 02026

**Re: 2012 Inflow Investigation**

Dear Mr. Mammone:

Weston & Sampson is pleased to submit our final report for the 2012 Inflow Investigation which included smoke and dye testing within sewer subareas HH, II, JJ, NN, PP, TT, and WW. A limited amount of smoke testing was also performed in sewer subarea XX in the Ledgewood Road area, at the town's request. These areas were selected for investigation because they were identified as most likely to contribute significant inflow volumes to the sanitary sewer system following the 2011 Town-Wide Flow Monitoring report. This report summarizes the results of the field work performed to identify sources of inflow to the sanitary sewer system. This report also presents a cost-effectiveness analysis (CEA) and preliminary design for rehabilitation of the identified inflow sources. The project areas are shown in Figures 1A and 1B, located in Appendix A.

***Project Description***

The Town of Dedham, Massachusetts is a residential community located southwest of Boston. Wastewater collected in the town drains east toward Boston where it enters the MWRA interceptor. Flow is ultimately treated at the Deer Island Wastewater Treatment Plant. The town's wastewater collection system consists of approximately 95 miles of gravity sewer with an average daily flow of 4 million gallons per day (MGD). The Dedham sewer system is divided into 26 sewer subareas.

According to the DEP Guidelines for conducting I/I Analyses and Sewer System Evaluation Survey (DEP Guidelines), sewer subareas that contribute at least 80 percent of the total inflow identified through monitoring are considered excessive. Based on data from the 2011 Town-Wide Flow Monitoring Report, the 14 sewer subareas contributing 80 percent of the peak flow should be investigated for inflow. The 14 subareas are GG, HH, II, JJ, KK, LL, NN, OO, PP, QQ, RR, SS, TT and WW. The seven subareas investigated under this report had the highest peak design storm inflow of those 14 subareas.

***Smoke Testing***

Smoke testing consists of pumping a white, non-toxic smoke into the sanitary sewer collection system and observing the surrounding area for smoke escaping from the ground or from drainage

structures. The appearance of smoke indicates either a direct or indirect connection through which surface runoff may enter the sewer system. Indirect sources include cracked pipes or offset joints in adjacent sewer and drain pipes that create an indirect connection between the drain and sewer systems. Direct sources include catch basins, driveway drains, patio drains, stairwell drains, yard drains or roof leaders, which discharge directly to the sewer system.

An indirect source constitutes rain water that infiltrates into the ground before entering the sewer system at a sewer system defect, either in a manhole or in a sewer pipe. It is assumed that only 50 percent of indirect inflow can be removed through rehabilitation, as the rain water could possibly enter the sewer system at another defect that has yet to be identified. Indirect inflow sources can occur during a rain event when there is an opportunity for a drainage structure to be hydraulically connected to the sanitary sewer system. An example of this is a cracked service connection located below a cracked drain line. When a rain event occurs, rain water leaks out of the drain line, through the soil and into the cracked service connection.

Inflow sources contribute storm inflow to the sewer system. According to DEP Guidelines, peak design storm inflow is defined as the peak amount of inflow that may enter the sanitary sewer during a one-year, six-hour storm event with an intensity of 0.87 inches per hour.

Smoke testing was performed by Weston & Sampson on approximately 155,000 linear feet (lf) of sanitary sewer in subareas HH, II, JJ, NN, PP, TT, WW and XX, from October 15 to November 15, 2012. Thirty nine (39) defects were identified through smoke testing. Thirteen of these defects contribute 618,573 gpd of peak design storm inflow. Smoke Testing Defect Logs and photos for each defect are included in Appendix B. The defects are listed below:

<b>Location</b>	<b>Defect No.</b>	<b>Description of Defect</b>
10 Helena Road	1	Open Cleanout (at grade)
51 Hastings Road	2	Open Cleanout (at grade)
46 Goshen Road	3	Moderate Smoke from Driveway Drain
112 Bonham Road	4	Open Cleanout (plastic rock cover) (at grade)
217 Bonham Road	5	Light Smoke from Open Drain Pipe
205 Bonham Road	6	Light Smoke from Catch Basin
212 Bonham Road	7	Light Smoke from Catch Basin
59 Gainsville Road	8	Light Smoke from Catch Basin
58 Gainsville Road	9	Light Smoke from Catch Basin
62 Gainsville Road	10	Light Smoke from Catch Basin
80 Hillsdale Road	11	Moderate Smoke from Catch Basin
94 Greensboro Road	12	Light Smoke from Edge of Pavement at Garage Door
163 Greensboro Road	13	Open Cleanout (at grade)
94 Alden Street	14	Moderate Smoke from Driveway Drain
30 Gaffney Road	15	Moderate Smoke from Catch Basin
46 Ridge Avenue	16	Heavy Smoke from Catch Basin (Direct)
70 Whiting Avenue	17	Light smoke from Catch Basin
95 Whiting Avenue	18	Light Smoke from Catch Basin
95 Abbott Road	19	Light Smoke from Catch Basin

96 Abbott Road	20	Light Smoke from Catch Basin
56 Mt. Vernon Street	21	Light Smoke from Catch Basin
78 Harvard Street	22	Heavy Smoke from Driveway Drain (roof leader discharge)
94 Chickering Road	23	Moderate Smoke from Catch Basin
106 Chickering Road	24	Light Smoke from Catch Basin
122 Chickering Road	25	Moderate Smoke from Catch Basin
121 Chickering Road	26	Light Smoke from Catch Basin
407 Harmony Hill	27	Light Smoke from Catch Basin
100 Chute Road	28	Heavy Smoke from Catch Basin
105 Chute Road	29	Moderate Smoke from Catch Basin
73 Pacella Drive	30	Light Smoke from Catch Basin
66 Pacella Drive	31	Light Smoke from Catch Basin
269 Highland Street	32	Open Cleanout (at grade)
300 Providence Highway	33	Smoke from Cracks in Pavement Around SMH II-1580
928 Providence Highway	34	Loose Cleanout (above grade)
92 Ledgewood Road	35	Moderate Smoke from Catch Basin
15 Intervale Road	36	Moderate Smoke from Catch Basin
27 Intervale Road	37	Light Smoke from Yard
98 Ledgewood Road	38	Light Smoke from Yard
156 Ledgewood Road	39	Moderate Smoke from SMH in Driveway

In addition to the 39 smoke testing defects described above, 14 suspect roof leaders and seven suspect driveway drains that did not smoke were identified during the testing. The suspect sources are considered as such because they discharge into the ground and their outlets were not visible.

Weston & Sampson identified additional I/I issues at five manholes. Infiltration defects were visible in manholes II-1130 and PP-910 including defective walls with protruding roots, active leaks and mineral deposits. Manhole PP-910 had significant infiltration, approximately 7,200 gpd, leaking through the walls and pipe connections. Three more manholes were observed to be susceptible to inflow. Some of these manholes could potentially collect runoff and contribute inflow during wet weather events. The total peak design storm inflow for these three manholes is 12,887 gpd.

A direct cross-connection was identified between the sanitary sewer and the drain at sewer manhole WW-440 on Bonham Road. An internal topside photo of manhole WW-440 and interior photo of the 8-inch vitrified clay (VC) pipe connection are located in Appendix B following defect sketch number five. This source contributes an estimated 494,000 gpd of peak inflow (calculated for full capacity in an 8-inch VC pipe using Manning's Equation).

Smoke testing defects and suspect sources are included in Table 1, *Smoke and Dye Testing Results*, in Appendix C. Of the 65 total smoke testing and manhole defects and suspect sources, 33 required further investigation through dye testing or dye flooding.

The sewer vent pipes at 50 buildings did not smoke during the testing. These houses may be connected to a septic system, have an obstruction in their service lines or plumbing systems, or

have traps on their service lines. A list of these buildings is included as Table 2, *Buildings With No Smoke From Sewer Vent*, in Appendix C.

### ***Dye Testing and Dye Flooding***

Sources identified during the smoke testing process are usually confirmed by performing dye testing or dye flooding. Dye testing uses less than 10 gallons of water and is conducted by introducing dyed water into a suspected inflow source and observing the surrounding sewer and drain lines for the emergence of the dye. Appearance of dye in the sewer system indicates nature of the inflow source's connection to the sewer system.

Dye testing was necessary at 18 defect and suspect source locations to confirm their connection. Weston & Sampson performed dye testing of defects and suspect sources, identified through smoke testing, on November 13 and 14, 2012. Dye testing of defects and suspect sources included ten driveway drains and eight roof leaders. Three of the smoke testing defects were confirmed as connected to the sanitary sewer. The dye test results are summarized in Table 1, in Appendix C.

Dye flooding was necessary at 20 smoke testing defect locations to confirm their connection. Dye flooding uses more than 10 gallons of water and was performed on November 29 and 30, 2012. Eleven catch basins were identified as having indirect connections to the sanitary sewer. The results are summarized in Table 1 and logs are included in Appendix D.

### ***Cost-Effectiveness Analysis***

In order to determine if rehabilitation is justified for a particular source of I/I, a CEA is conducted. The CEA compares the estimated cost for removing I/I to the estimated savings in transportation and treatment (T&T) costs resulting from the removal of I/I. T&T costs consist of capital costs to expand and upgrade the wastewater system plus annual Operation and Maintenance (O&M) costs. O&M costs are directly related to the quantity of flow being discharged to pump stations and treatment facilities. Increased usage will be reflected by increased O&M costs for electricity, cleaning, equipment repair, etc.

The calculated T&T cost for Dedham, using MWRA and the Town of Dedham's O&M and capital costs, is \$0.9877/gpd. In accordance with DEP Guidelines, the present worth of this T&T cost must be extended over the life of the rehabilitation method, estimated at 20 years, using a discount rate (or annual percentage rate) of 4.125% (DEP FY13). The present worth of the T&T costs for the Town of Dedham, assuming a 20-year rehabilitation life cycle, is \$13.27/gpd. The calculation is provided in the T&T Memo in Appendix E.

It should be noted that T&T costs can change annually. Therefore, if the recommended rehabilitation program included in this letter is not conducted within a year, it is recommended the T&T costs at the time of construction be compared to the value used for this analysis. Typically, if T&T costs increase, the amount of "cost-effective" rehabilitation may also increase.

The evaluation of cost-effectiveness for a particular I/I source is also based upon the portion of I/I that can be eliminated through rehabilitation. The percentage of I/I that can be removed

depends on the source and the rehabilitation method. It is estimated that indirect inflow and infiltration sources are 50 percent removable because indirect inflow and infiltration can migrate from a rehabilitated location to a location that did not previously show a need for rehabilitation. This is identified in the CEA as “removable.” The percentage of direct inflow removed is assumed to be 100 percent because direct inflow repairs typically involve the redirection of 100 percent of this flow to drainage structures.

The rehabilitation cost used in the CEA is based primarily on an estimate of the as-bid construction cost for the rehabilitation. Estimated rehabilitation costs were developed using prices from recent projects. The rehabilitation costs used in this report do not include the cost of additional investigation work or engineering services during design and construction. A list of rehabilitation unit costs used in the CEA is included in Appendix E.

The *MWRA Cost Effectiveness Analysis for I/I Sources*, Table 3 in Appendix C, shows the T&T cost associated with the observed I/I as well as recommended rehabilitation methods and costs. The CEA results produce one of three conclusions:

- **Excessive** indicates that the cost to rehabilitate the line segment is less than the associated T&T cost and that rehabilitation is recommended.
- **Non-Excessive** indicates that the cost to rehabilitate the line segment is more than the associated T&T cost and rehabilitation is not recommended.
- **Non-Excessive Recommended** indicates that the cost to rehabilitate is more than the T&T cost, but rehabilitation is still recommended due to the severity of the defect. Also, non-excessive recommended rehabilitations that are in need of structural repairs could become sources of infiltration or emergency collapses if the defect is not repaired. As degradation occurs these defects could lead to infiltration entering the sewer system at these structural defects.

The CEA identified:

- 631,460 gpd of excessive removable peak design storm inflow, 2,160 gpd of excessive removable indirect inflow and 4,320 gpd of excessive removable infiltration at an estimated rehabilitation cost of \$60,060. The associated T&T cost is \$8,465,461.
- 360 gpd of non-excessive recommended removable indirect inflow at an estimated rehabilitation cost of \$7,000. The associated T&T cost is \$4,777.

The above figures total approximately 638,300 gpd of removable I/I that is excessive or recommended at an estimated rehabilitation cost of \$67,060. Approximately \$23,750 of the rehabilitation work is located on private property, as shown in Table 3.

Peak design storm inflow is calculated for the direct inflow sources identified during this investigation using the Rational Formula for runoff. A calculation is attached in Appendix E for

reference. However, due to the configuration of the direct cross-connection on Bonham Road, peak inflow was calculated using Manning's Equation.

***Summary, Conclusions & Recommendations***

Weston & Sampson performed smoke and dye testing in sewer subareas HH, II, JJ, NN, PP, TT, WW and XX to identify sources of inflow to the sanitary sewer system. These areas had the highest quantity of inflow based on the data from the 2011 Town-Wide Flow Monitoring Program. Smoke and dye testing of approximately 155,000 lf of sewers were completed in these areas.

The following is a summary of our recommendations for removing the sources of I/I identified through smoke testing:

Install five cleanout caps:	\$ 1,000
Cementitious lining of four manholes:	\$ 5,200
Manhole root treatment of one manhole:	\$ 310
Install two manhole inflow dishes:	\$ 400
Replace two manhole covers:	\$ 500
Install one manhole watertight frame and cover:	\$ 1,000
Raise one manhole frame and cover:	\$ 1,000
Install 253 lf of Cured-in-Place Pipe:	\$ 12,650
Redirect one Catch Basin:	\$ 15,000
Redirect three Driveway Drains:	\$ 22,500
Replace one service connection (open cut):	\$ 7,000
Cap one sewer/drain cross connection:	\$ 500
<u>Total Estimated Construction Cost:</u>	<u>\$ 67,060</u>
Contingency (approximately 25% of construction):	\$ 16,765
<b><u>Total Estimated Cost:</u></b>	<b><u>\$ 83,825</u></b>

Approximately 4,477,000 gpd of peak design storm inflow was estimated in the 2012 Annual Program draft report for the seven subareas investigated in this project. A total of 638,000 gpd

of peak design storm inflow was identified during smoke testing. This accounts for approximately 14% of the estimated peak design storm inflow. There is a large portion of inflow that is entering the sewer system that was not accounted for during this project. It is recommended that the town attempt to identify this excessive inflow by investigating potential private inflow sources through building inspections. Building inspections are an effective way to identify private inflow sources. However, a Private Inflow Removal Policy should be adopted by the town prior to performing building inspections.

A Private Inflow Removal Policy should be established to address the repair of defects which are located on private property and the identification of new private inflow sources. Inflow removal on private property can be a challenging task for communities seeking to reduce wet weather flows. Working with homeowners can be difficult and presents complex liability issues that may be undesirable for the town to undertake. Our experience has shown that a combination of town support, either through amnesty or financial programs (incentive or reimbursement), public education, and follow-up is essential to a successful Private Inflow Removal program.

Weston & Sampson can provide suggestions for components of a Private Inflow Removal Policy. The Town of Dedham will need to determine which components will garner the most success based on political climate, financial capabilities and accepting private inflow discharges. We are available to meet with the town to discuss those options and assist in developing a policy to be adopted.

It is recommended that smoke testing be continued in the following subareas: KK, OO, LL, SS, GG, QQ, and RR. These subareas represent approximately 147,000 lf of sewer lines and have an estimated peak design storm inflow of 2,321,000 gpd. The projected cost for smoke testing is \$65,000.

We wish to thank you and the members of the Engineering Department staff for their assistance while completing this project. We are available to meet with you at your earliest convenience to discuss this report. Please do not hesitate to contact me at (978) 532-1900 with any questions or comments you may have.

Very truly yours,

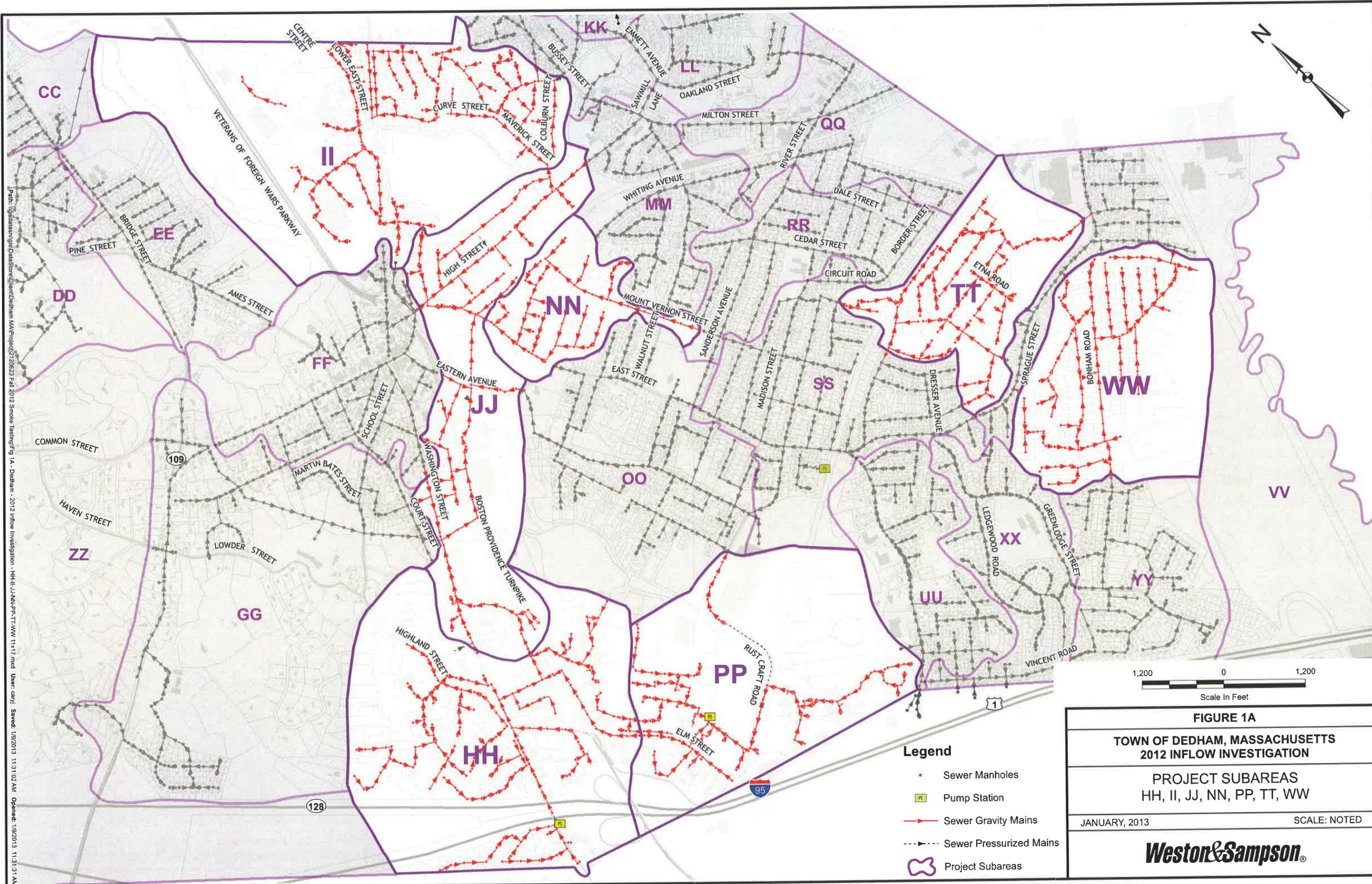
WESTON & SAMPSON



Donald G. Gallucci, P.E.  
Program Manager

cc: Ronald Lawrence, Project Engineer  
Deborah A. Finnigan, P.E., Infrastructure Engineer

**APPENDIX A**  
**FIGURES**



Path: \\gisdata\arcgis\GISDataStore\GISDataStoreClient\MapProject\2120623\_Fall\_2012\_Smoke\_Testing\Fig\_1A - Dedham - 2012 Inflow Investigation - HH-II-JJ-NN-PP-TT-WW 11x17.mxd User: caryj Saved: 1/9/2013 11:31:02 AM Opened: 1/9/2013 11:31:31 AM

- Legend**
- Sewer Manholes
  - P Pump Station
  - ▶— Sewer Gravity Mains
  - - -▶- - - Sewer Pressurized Mains
  - Project Subareas

**FIGURE 1A**

**TOWN OF DEDHAM, MASSACHUSETTS  
2012 INFLOW INVESTIGATION**

**PROJECT SUBAREAS  
HH, II, JJ, NN, PP, TT, WW**

JANUARY, 2013 SCALE: NOTED

**Weston & Sampson**



**APPENDIX B**

**SMOKE TESTING DEFECT LOGS**

**SMOKE TESTING DEFECT PHOTOS**

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/15/12

DEFECT: 1 thru 1

OWNER: Town of Dedham

SKETCH NO.: 1

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: 10 Helena Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
1	Open Cleanout (at grade)	225	Grass / Asphalt			x	28

SKETCH:



DEFECT SOURCE ○

DRAINAGE AREA ■



Weston & Sampson

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

0

1

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/15/12

DEFECT: 2 thru 2

OWNER: Town of Dedham

SKETCH NO.: 2

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: 51 Hastings Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
2	Open Cleanout (at grade)	400	Grass			x	32

SKETCH:



DEFECT SOURCE ○

DRAINAGE AREA ■

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

102



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/15/12

DEFECT: 3 thru 3

OWNER: Town of Dedham

SKETCH NO.: 3

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: 46 Goshen Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
3	Driveway Drain (moderate smoke)	1,501	Asphalt	x			33-35

SKETCH:



DEFECT SOURCE ○

DRAINAGE AREA ■



Wegman & Sampson

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

03

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/16/12

DEFECT: 4 thru 4

OWNER: Town of Dedham

SKETCH NO.: 4

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: 112 Bonham Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
4	Open Cleanout (plastic rock cover) (at grade)	300	Grass			x	37 - 39

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

Weston & Sampson

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

04



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/16/12

DEFECT: 5 thru 7

OWNER: Town of Dedham

SKETCH NO.: 5

MAP NO.: WW

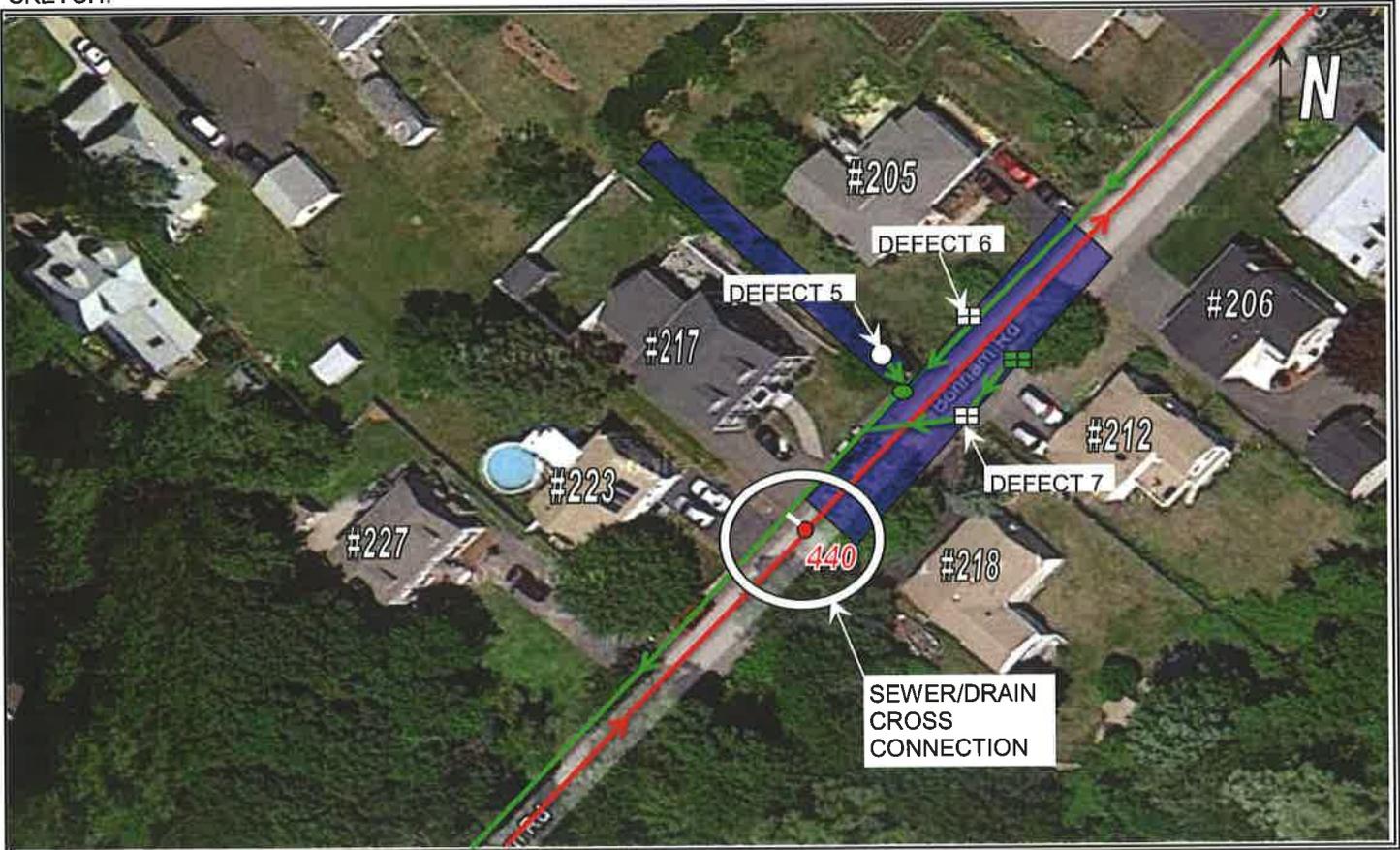
PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: Bonham Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
5	Light Smoke from Open Drain Pipe near house #217	690	Gravel		x		40
6	Light Smoke from Catch Basin near house #205	2,148	Asphalt		x		42
7	Light Smoke from Catch Basin near house #212	2,148	Asphalt		x		46

SKETCH:



DEFECT SOURCE ○ □  
DRAINAGE AREA ■



**Service Connection**

**Cross-Connection**

**Cross-Connection**



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TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

05



*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

06



Weston & Simpson  
TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING  
**07**

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/16/12

DEFECT: 8 thru 10

OWNER: Town of Dedham

SKETCH NO.: 6

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: Gainsville Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
8	Light Smoke from Catch Basin near house #59	936	Asphalt			x	57
9	Light Smoke from Catch Basin near house #58	936	Asphalt			x	58
10	Light Smoke from Catch Basin near house #62	936	Asphalt			x	59

SKETCH:



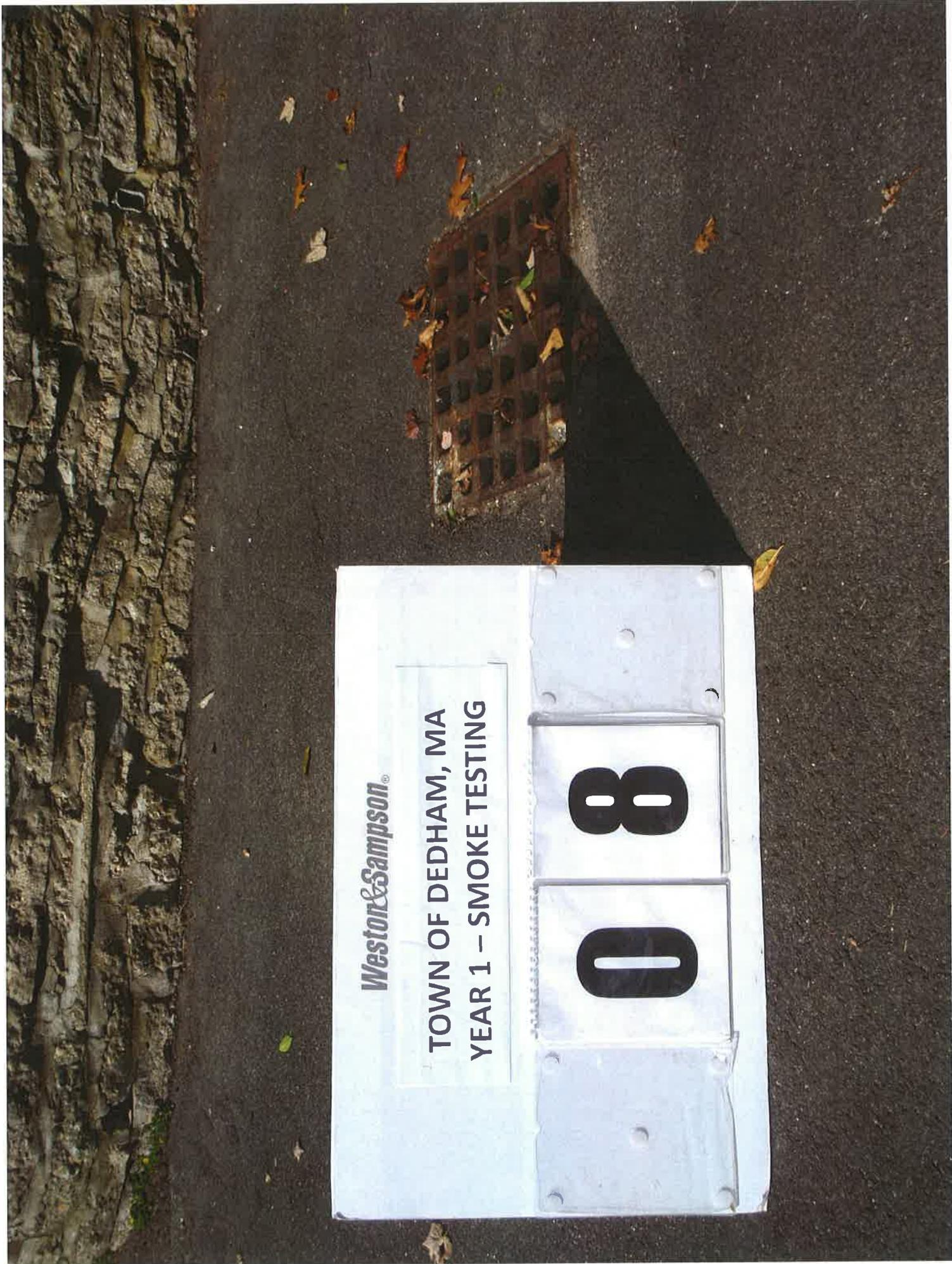
DEFECT SOURCE 

DRAINAGE AREA 

*Weston & Sampson*®

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

08



*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

09



*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

1

0



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/16/12

DEFECT: 11 thru 11

OWNER: Town of Dedham

SKETCH NO.: 7

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: Hillsdale Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
11	Moderate Smoke from Catch Basin near house #80	3,744	Asphalt		x		60

SKETCH:



DEFECT SOURCE 

DRAINAGE AREA 



*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

111

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/17/12

DEFECT: 12 thru 12

OWNER: Town of Dedham

SKETCH NO.: 8

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: NM/LD

LOCATION: 94 Greensboro Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
12	Light Smoke from Edge of Pavement at Garage Door / Potential Garage Drain or Broken SVC	150	Concrete			x	61

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

Weston & Sampson<sup>®</sup>

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

12

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/17/12

DEFECT: 13 thru 13

OWNER: Town of Dedham

SKETCH NO.: 9

MAP NO.: WW

PROJECT: Fall 2012 Smoke Testing

CREW: NM/LD

LOCATION: 163 Greensboro Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
13	Open Cleanout	372	Asphalt	x			62 - 63

SKETCH:



DEFECT SOURCE ○

DRAINAGE AREA ■

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

1

3



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/17/12

DEFECT: 14 thru 14

OWNER: Town of Dedham

SKETCH NO.: 10

MAP NO.: TT

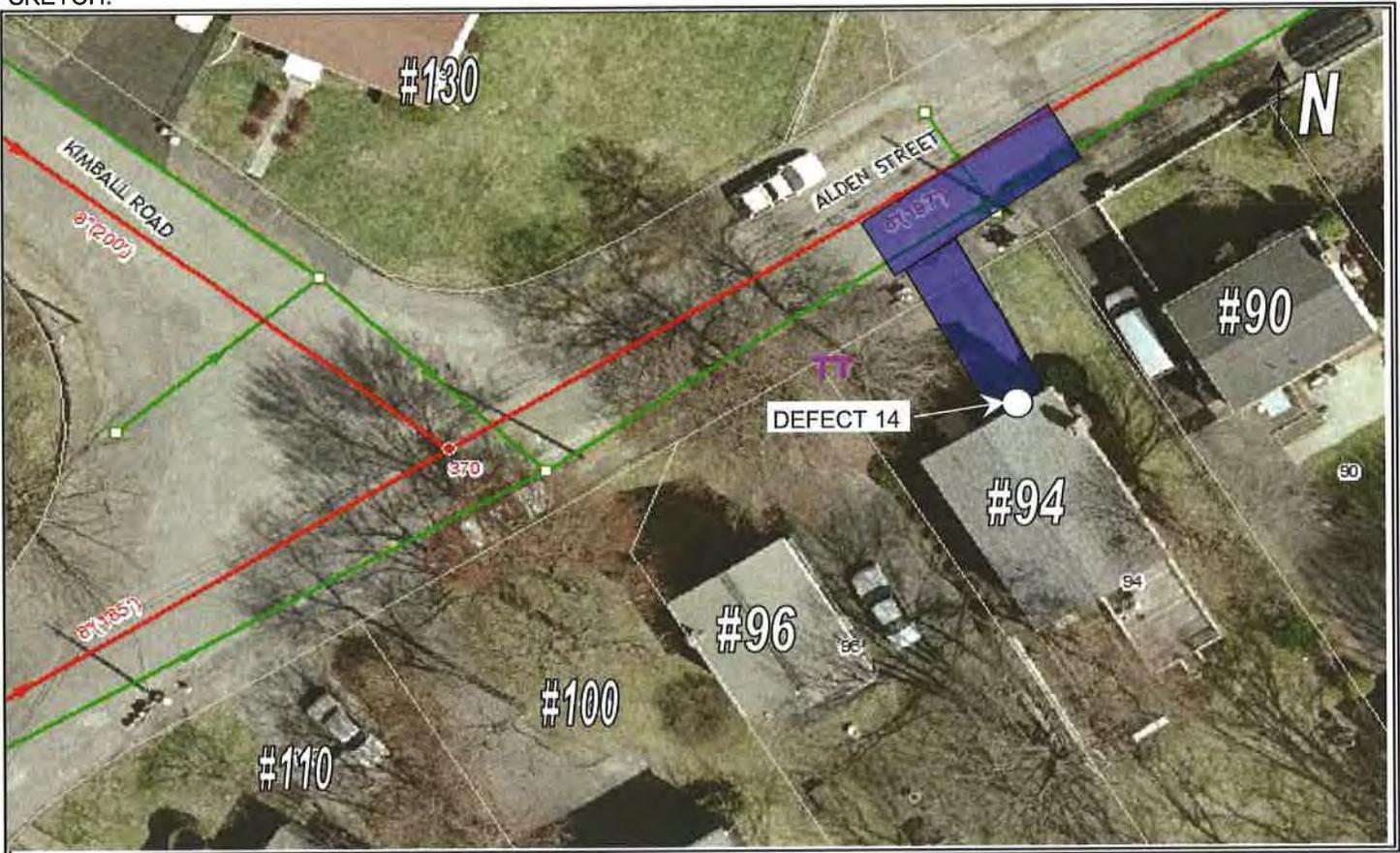
PROJECT: Fall 2012 Smoke Testing

CREW: NM/LD

LOCATION: 94 Alden Street

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
14	Moderate Smoke from Driveway Drain	960	Asphalt	x			64

SKETCH:



DEFECT SOURCE ○

DRAINAGE AREA ■

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

14

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/23/12

DEFECT: 15 thru 15

OWNER: Town of Dedham

SKETCH NO.: 11

MAP NO.: II

PROJECT: Fall 2012 Smoke Testing

CREW: NM/LD

LOCATION: Gaffney Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
15	Moderate Smoke from Catch Basin near house #30	1,321	Asphalt		x		69

SKETCH:



DEFECT SOURCE 

DRAINAGE AREA 

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

15



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/23/12

DEFECT: 16 thru 16

OWNER: Town of Dedham

SKETCH NO.: 12

MAP NO.: II

PROJECT: Fall 2012 Smoke Testing

CREW: NM/LD

LOCATION: Ridge Avenue

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
16	Heavy Smoke from Catch Basin (Direct) near house #46	4,500	Asphalt	x			73-76

SKETCH:



DEFECT SOURCE

DRAINAGE AREA

**Weston & Sampson.**

**TOWN OF DEDHAM, MA  
YEAR 1 -- SMOKE TESTING**

**1**

**6**



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/23/12

DEFECT: 17 thru 20

OWNER: Town of Dedham

SKETCH NO.: 13

MAP NO.: NN

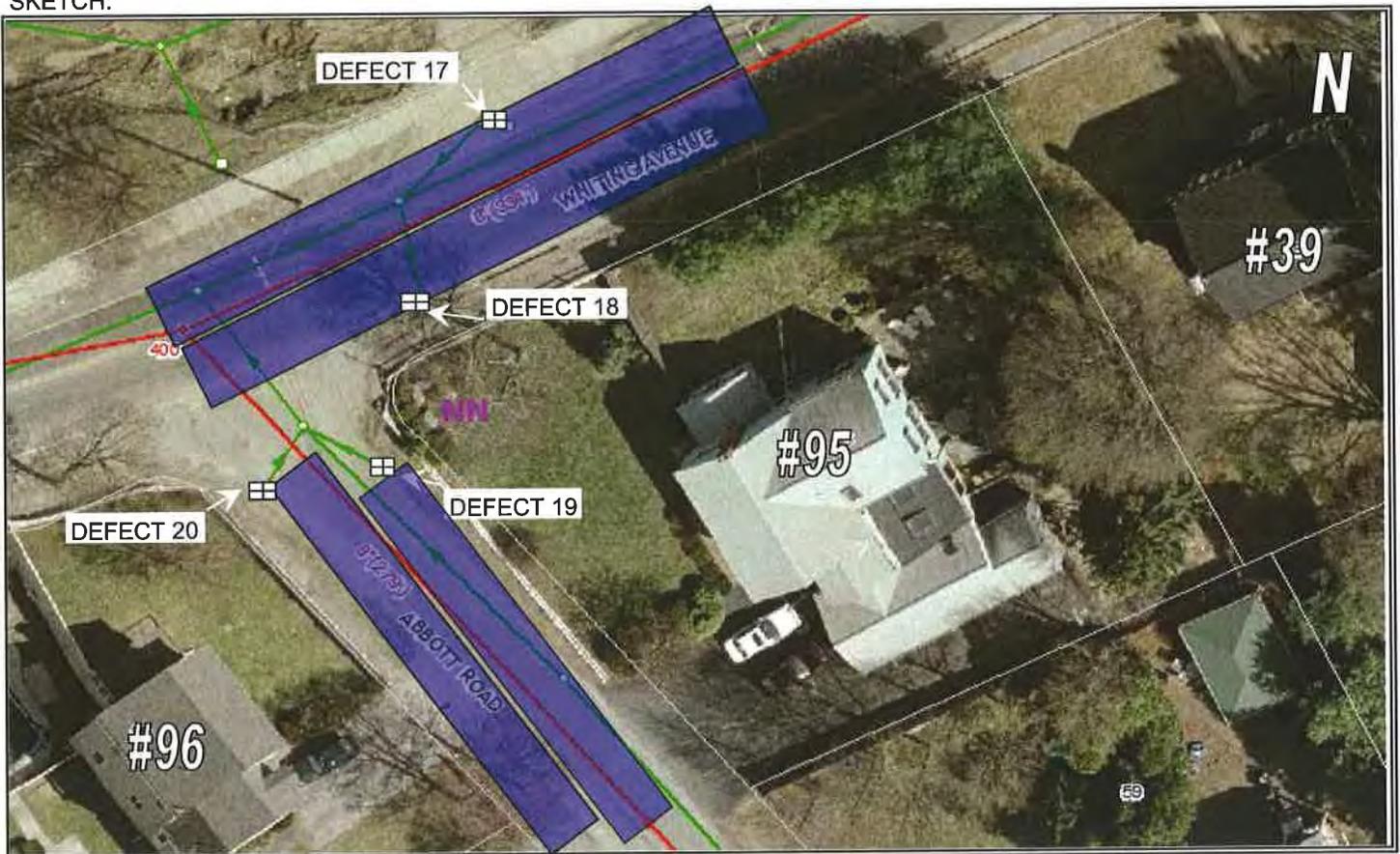
PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Abbott and Whiting

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
17	Light Smoke from Catch Basin near house #70	3,600	Asphalt			x	80
18	Light Smoke from Catch Basin near house #95	3,600	Asphalt			x	81-82
19	Light Smoke from Catch Basin near house #95	3,000	Asphalt			x	83-84
20	Light Smoke from Catch Basin near house #96	3,000	Asphalt			x	85-86

SKETCH:



DEFECT SOURCE

DRAINAGE AREA

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

117



**Weston & Sampson**

**TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING**

**118**



**Weston&Sampson**

**TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING**

**19**



**Weston&Sampson**<sup>®</sup>

**TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING**

**20**



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/24/12

DEFECT: 21 thru 21

OWNER: Town of Dedham

SKETCH NO.: 14

MAP NO.: NN

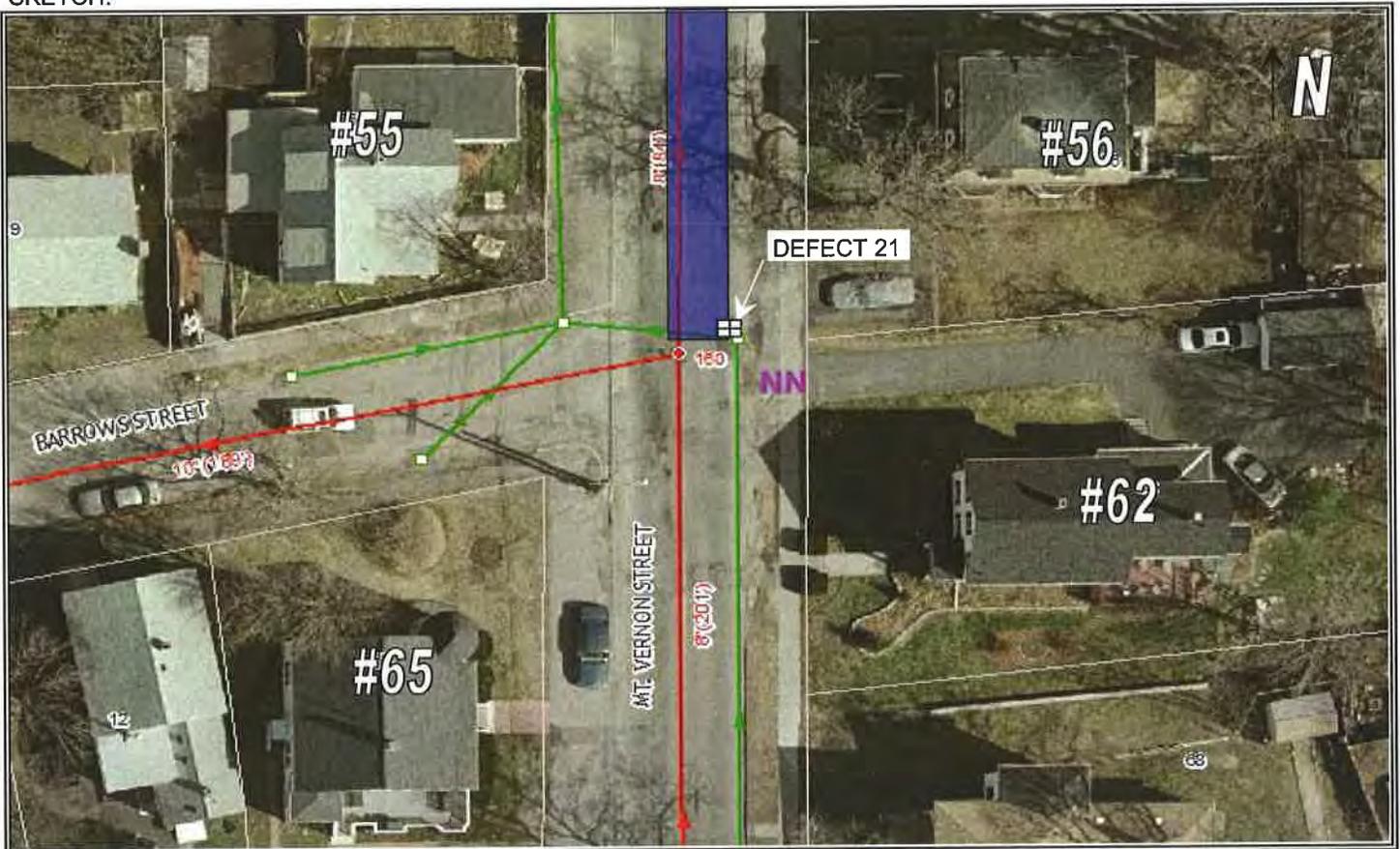
PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Mt. Vernon Street

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
21	Light Smoke from Catch Basin near house #56	2,100	Asphalt			x	

SKETCH:



DEFECT SOURCE

DRAINAGE AREA

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

21



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 10/25/12

DEFECT: 22 thru 22

OWNER: Town of Dedham

SKETCH NO.: 15

MAP NO.: JJ

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: 78 Harvard St.

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
22	Heavy Smoke from Driveway Drain (3 roof leaders discharge to driveway)	800	Asphalt	x			94-95
		1,800	Shingle				

SKETCH:



DEFECT SOURCE ○

DRAINAGE AREA ■



WestonSampson

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

22

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/02/12

DEFECT: 23 thru 24

OWNER: Town of Dedham

SKETCH NO.: 16

MAP NO.: HH

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Chickering Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
23	Moderate Smoke from Catch Basin near house #94	1,200	Asphalt		x		96
24	Light Smoke from Catch Basin near house #106	3,600	Asphalt			x	97

SKETCH:



DEFECT SOURCE   
DRAINAGE AREA 

FIRE LINE DO NOT CROSS

W. W. Thompson

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

2 3



Winstan/Sampson

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

2

4

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/02/12

DEFECT: 25 thru 26

OWNER: Town of Dedham

SKETCH NO.: 17

MAP NO.: HH

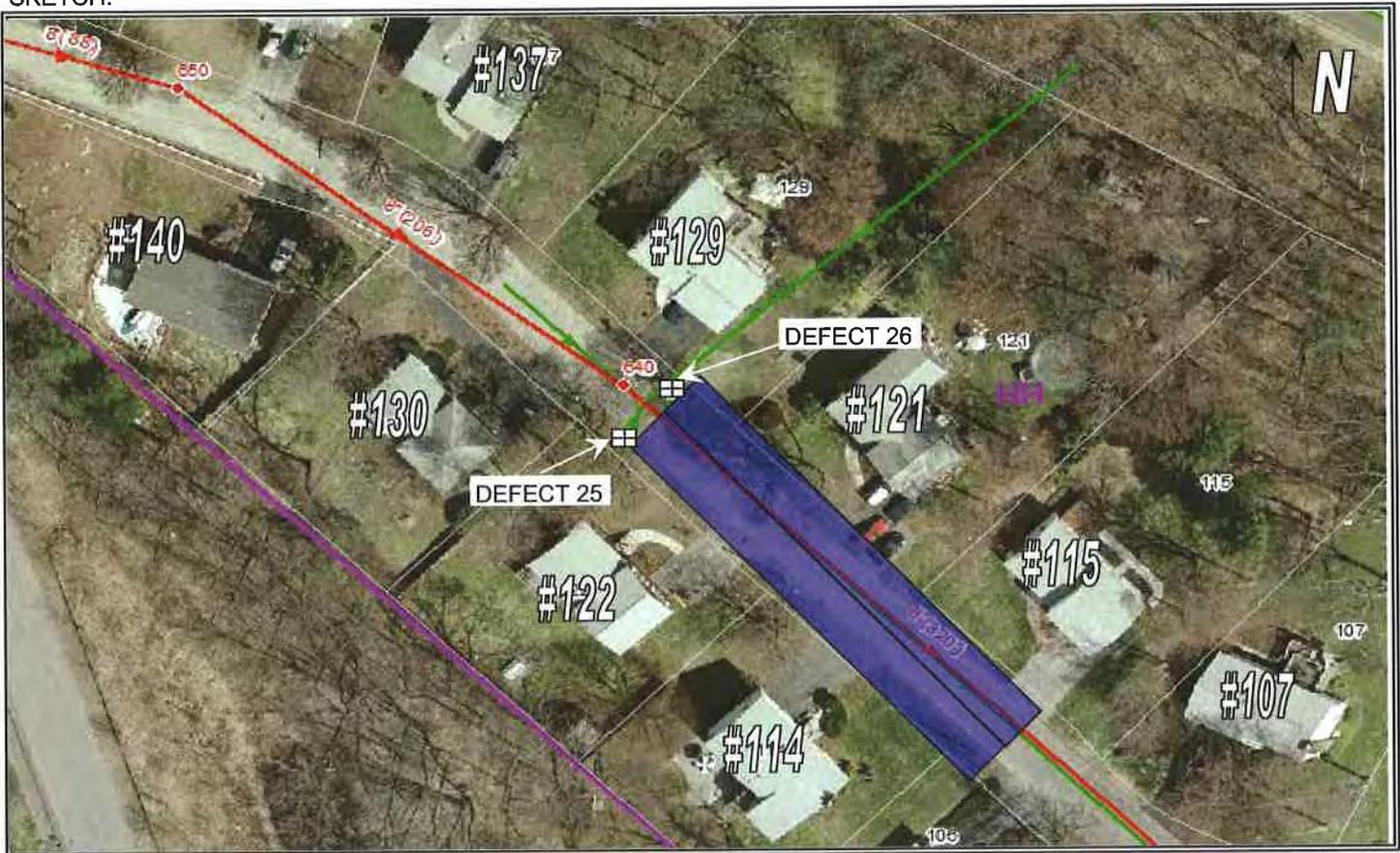
PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Chickering Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
25	Moderate Smoke from Catch Basin near house #122	3,600	Asphalt		x		98
26	Light Smoke from Catch Basin near house #121	3,600	Asphalt			x	99

SKETCH:



DEFECT SOURCE   
DRAINAGE AREA 

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

2

5

**Weston&Sampson**<sup>®</sup>

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

26



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/02/12

DEFECT: 27 thru 27

OWNER: Town of Dedham

SKETCH NO.: 18

MAP NO.: HH

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Harmony Hill

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
27	Light Smoke from Catch Basin near house #407	2,040	Asphalt			x	101

SKETCH:



DEFECT SOURCE    
 DRAINAGE AREA  

*Weston&Sampson*<sup>®</sup>

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

27



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/02/12

DEFECT: 28 thru 29

OWNER: Town of Dedham

SKETCH NO.: 19

MAP NO.: HH

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: Pacella / Chute

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
28	Heavy Smoke from Catch Basin near house #100	4,020	Asphalt		x		102
29	Moderate Smoke from Catch Basin near house #105	4,800	Asphalt		x		103

SKETCH:



DEFECT SOURCE

DRAINAGE AREA

**Weston&Sampson**<sup>®</sup>

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

**2**

**8**



**Weston&Sampson**

**TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING**

**2**

**9**



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/02/12

DEFECT: 30 thru 31

OWNER: Town of Dedham

SKETCH NO.: 20

MAP NO.: HH

PROJECT: Fall 2012 Smoke Testing

CREW: PC/LD

LOCATION: Pacella Drive

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
30	Light Smoke form Catch Basin near house #73	3,000	Asphalt			x	104
31	Light Smoke form Catch Basin near house #66	3,000	Asphalt			x	105

SKETCH:



DEFECT SOURCE ☒

DRAINAGE AREA ■

**Weston & Sampson** <sup>®</sup>

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

**30**



*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

31



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/05/12

DEFECT: 32 thru 32

OWNER: Town of Dedham

SKETCH NO.: 21

MAP NO.: HH

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: 269 Highland Street

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
32	Open Cleanout (at grade)	300	Grass		x		106-107

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston&Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

3

2



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/07/12

DEFECT: 33 thru 33

OWNER: Town of Dedham

SKETCH NO.: 22

MAP NO.: II

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: 300 Providence Highway

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
33	Smoke from cracks in sidewalk and pavement around SMH	225	Concrete			x	111

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston & Sampson.*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

33

33





924

Weston/Sampson  
TOWN OF DEERFIELD, VT  
YEAR 1 - SMOKE TESTING  
34

108

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/15/12

DEFECT: 35 thru 35

OWNER: Town of Dedham

SKETCH NO.: 24

MAP NO.: XX

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Ledgewood Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
35	Moderate Smoke from Catch Basin near house #92	1,800	Asphalt		x		

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

35



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/15/12

DEFECT: 36 thru 36

OWNER: Town of Dedham

SKETCH NO.: 25

MAP NO.: XX

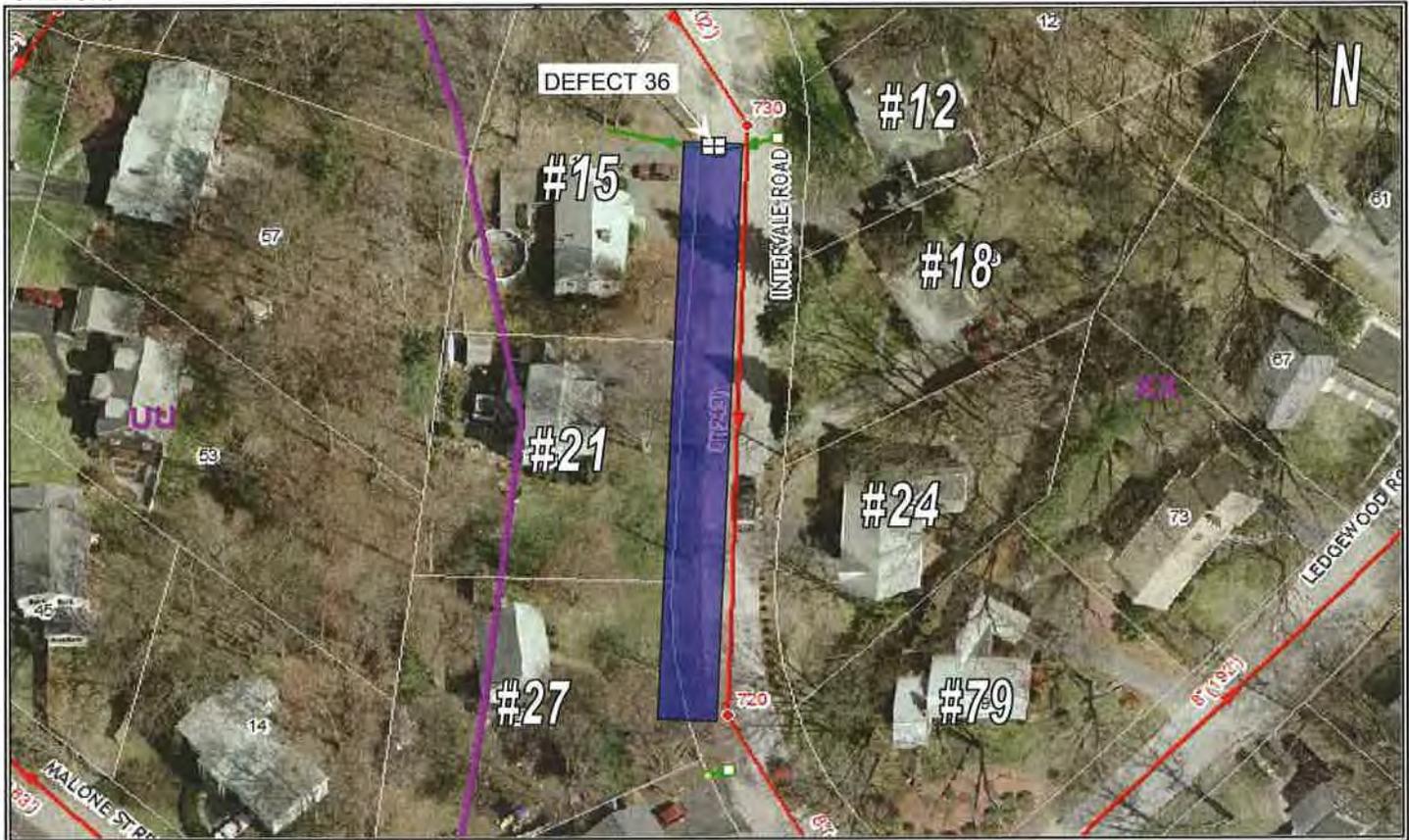
PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Intervale Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
36	Moderate Smoke from Catch Basin near house #15	2,916	Asphalt		x		

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston&Sampson.*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

3 6



**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/15/12

DEFECT: 37 thru 37

OWNER: Town of Dedham

SKETCH NO.: 26

MAP NO.: XX

PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Intervale Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
37	Light Smoke rising from yard near house #27	100	Grass			x	

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

37

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/15/12

DEFECT: 38 thru 38

OWNER: Town of Dedham

SKETCH NO.: 27

MAP NO.: XX

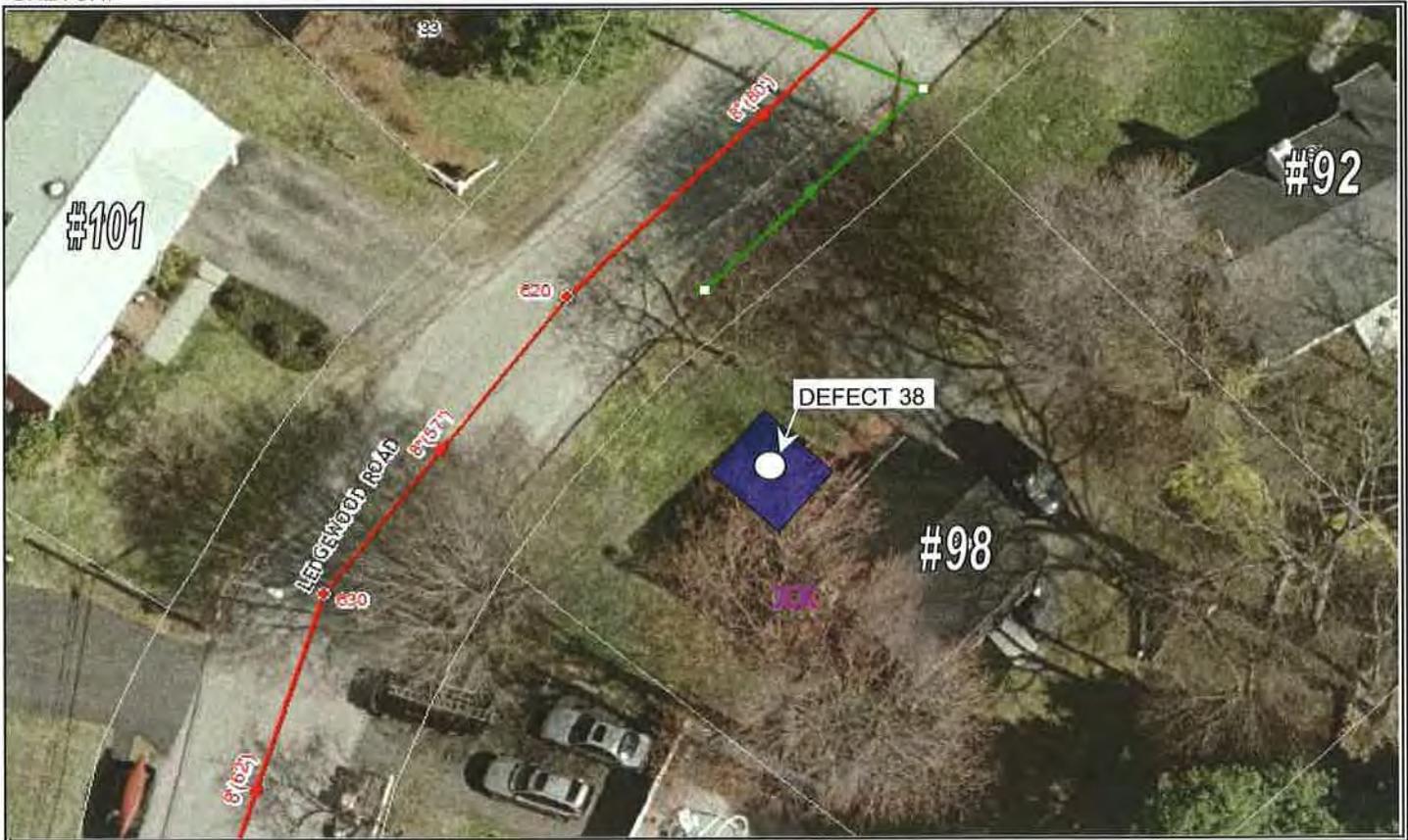
PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Ledgewood Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
38	Light Smoke rising from yard near house #98	100	Grass			x	

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 - SMOKE TESTING

3

8

**WESTON & SAMPSON  
SMOKE TESTING DEFECT LOG**

ENGINEER: Weston & Sampson

DATE: 11/15/12

DEFECT: 39 thru 39

OWNER: Town of Dedham

SKETCH NO.: 28

MAP NO.: XX

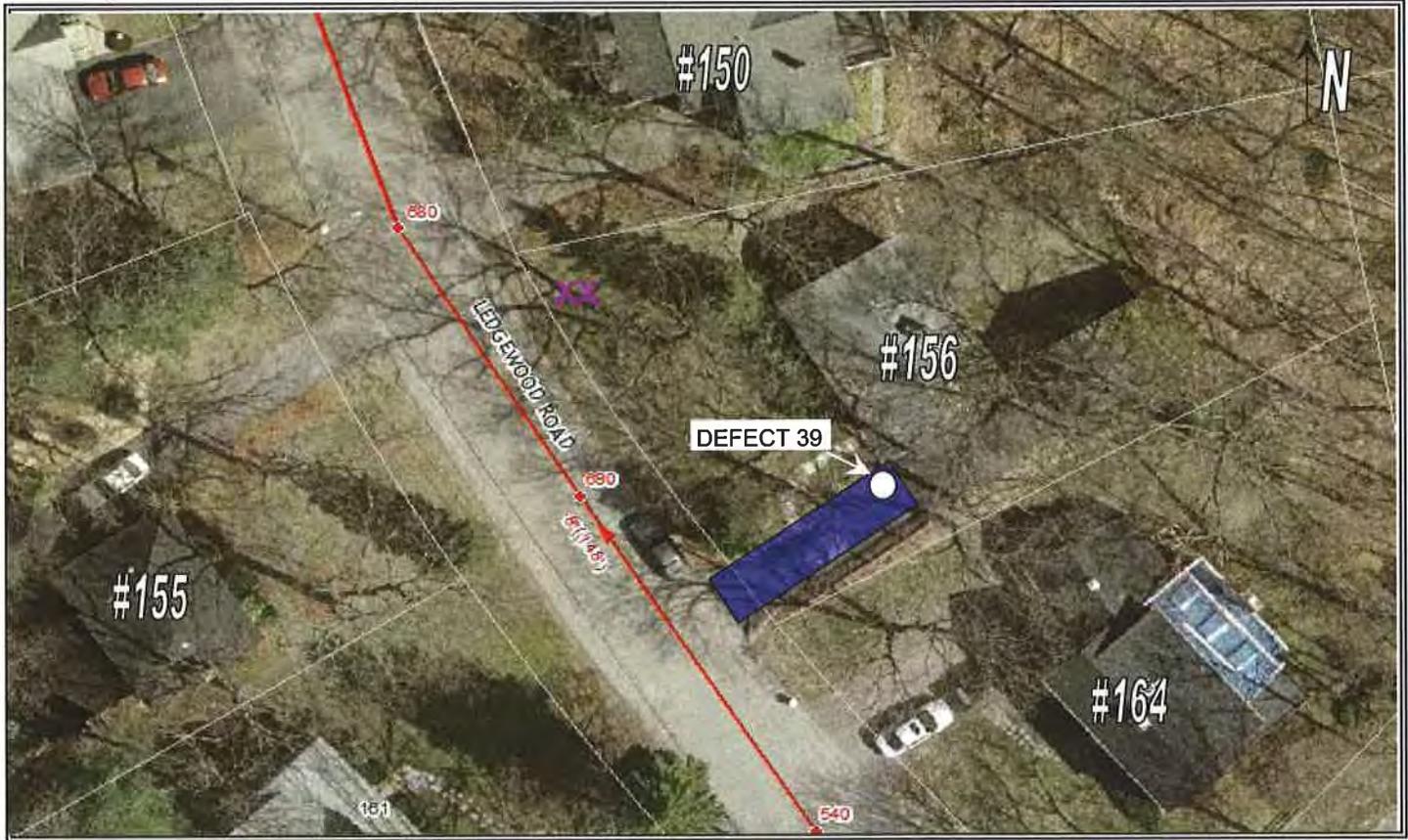
PROJECT: Fall 2012 Smoke Testing

CREW: PH/LD

LOCATION: Ledgewood Road

DEFECT	DESCRIPTION	Drainage Area (ft <sup>2</sup> )	Surface Type	Severity			Picture No.(s)
				Major	Mod	Minor	
39	Moderate Smoke from Service Manhole near house #156	540	Ashault		x		

SKETCH:



DEFECT SOURCE ○  
DRAINAGE AREA ■

*Weston & Sampson*

TOWN OF DEDHAM, MA  
YEAR 1 – SMOKE TESTING

3

9



## **APPENDIX C**

### **TABLES**

**TABLE 1  
SMOKE AND DYE TESTING RESULTS  
Dedham, Massachusetts - 2012 Inflow Investigation**

Location	Subarea	Defect No.	Description of Defect	Source Location (Public/Private)	Smoke Test Result			Dye Test/Flood Result	Infiltration (GPD)	Inflow		Recommendation
					Heavy	Light	None			Peak Design Storm Inflow (GPD)	Peak Indirect Inflow (GPD) <sup>1</sup>	
10 Helena Road	WW	1	Open Cleanout (at grade)	Private		x		No Dye Test Performed; Visual Confirmation		879		Install Cleanout Cap at 10 Helena Road
51 Hastings Road	WW	2	Open Cleanout (at grade)	Private		x		No Dye Test Performed; Visual Confirmation		1,562		Install Cleanout Cap at 51 Hastings Road
46 Goshen Road	WW	3	Driveway Drain (moderate smoke)	Private	x			Dye Observed Downstream at SMH WW350		17,585		Redirect Driveway Drain at 46 Goshen Road
112 Bonham Road	WW	4	Open Cleanout (plastic rock cover) (at grade)	Private		x		No Dye Test Performed; Visual Confirmation		1,172		Install Cleanout Cap at 112 Bonham Road
217 Bonham Road	WW	5	Heavy Smoke from Open Drain Pipe	Public		x		No Dye Test Performed; Visual Confirmation	494,000			Cap Drain/Sewer Cross Connection in SMH WW440
205 Bonham Road	WW	6	Heavy Smoke from Catch Basin	Public		x		No Dye Test Performed; Visual Confirmation				
212 Bonham Road	WW	7	Heavy Smoke from Catch Basin	Public		x		No Dye Test Performed; Visual Confirmation				
59 Gainsville Road	WW	8	Light Smoke from Catch Basin	Public		x		Dye Observed from Joints between SMH WW1140 and SMH WW1110				Cured-in-Place Pipe from SMH WW1140 and SMH WW1110 (253 LF) and Cementitious Lining of SMH WW1110
58 Gainsville Road	WW	9	Light Smoke from Catch Basin	Public		x		Dye Observed from Joints between SMH WW1140 and SMH WW1110				
62 Gainsville Road	WW	10	Light Smoke from Catch Basin	Public		x		Dye Observed from Joints between SMH WW1140 and SMH WW1110				
80 Hillsdale Road	WW	11	Moderate Smoke from Catch Basin	Public		x		Negative				
94 Greensboro Road	WW	12	Light Smoke from Edge of Pavement at Garage Door	Private		x		No Dye Test Performed; Visual Confirmation				
163 Greensboro Road	WW	13	Open Cleanout (at grade)	Private	x			No Dye Test Performed; Visual Confirmation		1,453		Install Cleanout Cap at 163 Greensboro Road
94 Alden Street	TT	14	Moderate Smoke from Driveway Drain	Private	x			Dye Observed in SMH TT350		11,247		Redirect Driveway Drain at 94 Alden Street
30 Gaffney Road	II	15	Moderate Smoke from Catch Basin	Public		x		Negative				
46 Ridge Avenue	II	16	Heavy Smoke from Catch Basin (Direct)	Public	x			No Dye Test Performed; Visual Confirmation		52,719		Redirect Catch Basin from SMH II900
70 Whiting Avenue	NN	17	Light smoke from Catch Basin	Public		x		Negative				
95 Whiting Avenue	NN	18	Light Smoke from Catch Basin	Public		x		Negative				
95 Abbott Road	NN	19	Light Smoke from Catch Basin	Public		x		Negative				
96 Abbott Road	NN	20	Light Smoke from Catch Basin	Public		x		Negative				
56 Mt. Vernon Street	NN	21	Light Smoke from Catch Basin	Public		x		No Dye Test Performed				
78 Harvard Street	JJ	22	Heavy Smoke from Driveway Drain (roof leader discharge)	Private	x			Dye Observed in SMH JJ390		30,460		Redirect Driveway Drain at 78 Harvard Street
94 Chickering Road	HH	23	Moderate Smoke from Catch Basin	Public	x			Dye Observed in lateral from house #94 from SMH HH630				Open Cut Point Repair 0+20 to 0+30 up SVC to 94 Chickering from SMH HH630
106 Chickering Road	HH	24	Light Smoke from Catch Basin	Public		x		Dye Observed in lateral from house #94 from SMH HH630				
122 Chickering Road	HH	25	Moderate Smoke from Catch Basin	Public	x			Dye Observed in lateral from house #94 from SMH HH630				
121 Chickering Road	HH	26	Light Smoke from Catch Basin	Public		x		Dye Observed in lateral from house #94 from SMH HH630				
407 Harmony Hill	HH	27	Light Smoke from Catch Basin	Public		x		Negative				
100 Chute Road	HH	28	Heavy Smoke from Catch Basin	Public	x			Dye Observed from Walls of SMH HH1110				Cementitious Lining of SMH HH1110
105 Chute Road	HH	29	Moderate Smoke from Catch Basin	Public		x		Dye Observed from Walls of SMH HH1110				
73 Pacella Drive	HH	30	Light Smoke from Catch Basin	Public		x		Dye Observed from Walls of SMH HH1110				
66 Pacella Drive	HH	31	Light Smoke from Catch Basin	Public		x		Dye Observed from Walls of SMH HH1110				
269 Highland Street	HH	32	Open Cleanout (at grade)	Private	x			No Dye Test Performed; Visual Confirmation		1,172		Install Cleanout Cap at 269 Highland Street
300 Providence Highway	II	33	Smoke from cracks in pavement around SMH 1580	Public		x		No Dye Test Performed				
928 Providence Highway	HH	34	Loose Cleanout (above grade)	Private		x		No Dye Test Performed; Visual Confirmation				
92 Ledgewood Road	XX	35	Moderate Smoke from Catch Basin	Public	x			Negative				
15 Intervale Road	XX	36	Moderate Smoke from Catch Basin	Public	x			Negative				
27 Intervale Road	XX	37	Light Smoke rising from yard	Private		x		No Dye Test Performed			720	Open Cut Point Repair (Station Unknown / TV Required)
98 Ledgewood Road	XX	38	Light Smoke rising from yard	Private		x		No Dye Test Performed			720	Open Cut Point Repair (Station Unknown / TV Required)
156 Ledgewood Road	XX	39	Moderate Smoke from SMH in driveway	Private	x			No Dye Test Performed		6,326		Replace Cover in Driveway at 156 Ledgewood Drive
6 Chute Road	HH	Suspect 1	Roof Leader entering ground	Private			x	Negative				
55 Elm Street	HH	Suspect 2	Roof Leader entering ground (Dedham Savings Bank)	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
269 Highland Street	HH	Suspect 3	Roof Leader entering ground	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
153 Curve Street	II	Suspect 4	Roof Leader entering ground	Private			x	Negative				
11 Gaffney Road	II	Suspect 5	Roof Leader entering ground	Private			x	Negative				
78 Gaffney Road	II	Suspect 6	Roof Leader entering ground	Private			x	Negative				
15 Gould Street	II	Suspect 7	Roof Leader entering ground and a Driveway Drain	Private			x	Negative				
27 Mount Hope Street	II	Suspect 8	Roof Leader entering ground	Private			x	Negative				
64 Washington Street	II	Suspect 9	Driveway Drain	Private			x	Negative				
34 Churchill Place	JJ	Suspect 10	Roof Leader entering ground	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
91 Harvard Street	JJ	Suspect 11	Roof Leader entering ground and a Driveway Drain	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
48 Churchill Place	JJ	Suspect 12	Roof Leader entering ground	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
42 Churchill Place	JJ	Suspect 13	Roof Leader entering ground	Private			x	Negative				
431 East Street	JJ	Suspect 14	Driveway Drain	Private			x	Negative				
40 Alden Street	TT	Suspect 15	Driveway Drain	Private			x	Negative				
135/137 Paul Street	TT	Suspect 16	Roof Leader entering ground and a Driveway Drain	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
126 Colwell Drive	WW	Suspect 17	Roof Leader entering ground	Private			x	Negative				
26 Hillsdale Drive	WW	Suspect 18	Driveway Drain	Private			x	No Dye Test Performed; Visually Confirmed to be Negative				
62 Greensboro Road	WW	Suspect 19	Driveway Drain	Private			x	Negative				
11 Pacella Drive	HH	Suspect 20	Driveway Drain	Private			x	Negative				
23 Pacella Drive	HH	Suspect 21	Driveway Drain	Private			x	Negative				

**TABLE 1  
SMOKE AND DYE TESTING RESULTS  
Dedham, Massachusetts - 2012 Inflow Investigation**

Location	Subarea	Defect No.	Description of Defect	Source Location (Public/Private)	Smoke Test Result			Dye Test/Flood Result	Infiltration (GPD)	Inflow		Recommendation
					Heavy	Light	None			Peak Design Storm Inflow (GPD)	Peak Indirect Inflow (GPD) <sup>1</sup>	
SMH TT50	TT	MH 1	Loose Cover ( below grade) (grass)	Public		x		No Dye Test Performed		586		Install Watertight Frame and Cover for SMH TT50
SMH TT530	TT	MH 2	Holes in Cover allows Inflow	Public			x	No Dye Test Performed		2,929		Replace Cover of SMH TT530
SMH II1130	II	MH 3	Heavy Roots	Public			x	No Dye Test Performed	1,440			Cementitious Lining and Root Treatment of SMH II1130
SMH HH160	HH	MH 4	Loose Cover ( below grade) (pavement)	Public			x	No Dye Test Performed		9,372		Raise Frame 3" and Install Inflow Dish for SMH HH160
SMH PP910	PP	MH 5	Major Infiltration from Walls and Connections	Public			x	No Dye Test Performed	7,200			Cementitious Lining of SMH PP910
<b>Total Public</b>									<b>8,640</b>	<b>559,606</b>	<b>5,040</b>	
<b>Total Private</b>									<b>0</b>	<b>71,854</b>	<b>1,440</b>	
<b>Total</b>									<b>8,640</b>	<b>631,460</b>	<b>6,480</b>	

**NOTE:** 1 - Indirect Inflow is assumed to be at least 720 GPD for lateral defects, 1,440 GPD for manhole defects and 2,880 GPD for mainline defects.

**TABLE 2**  
**BUILDINGS WITH NO SMOKE FROM SEWER VENT**  
**Dedham, Massachusetts - 2012 Inflow Investigation**

Subarea	House No.	Street Name
II	9	Lilac Lane
II	47	Lower East Street
II	85	Lower East Street
II	91	Lower East Street
II	15	Nancy Road
II	107	Sunset Avenue
II	111	Sunset Avenue
TT	286	Cedar Street
TT	318	Cedar Street
TT	321	Cedar Street
TT	14	Crane Street
TT	28	Crane Street
TT	47	Crane Street
TT	123	Crane Street
TT	168	Crane Street
TT	106	Kimball Road
TT	77	Paul Street
TT	107	Paul Street
TT	131	Paul Street
TT	146	Paul Street
TT	150	Paul Street
TT	169	Paul Street
TT	16	Savin Street
TT	16	Tarbox Street
TT	20	Tarbox Street
TT	32	Tarbox Street
TT	38	Tarbox Street
TT	15	Turner Street
TT	18	Turner Street
WW	13	Altoona Road
WW	19	Altoona Road
WW	35	Altoona Road
WW	50	Altoona Road
WW	46	Ardmore Drive
WW	11	Beloit Road
WW	27	Carlisle Road
WW	104	Colwell Drive
WW	71	Gainsville Road
WW	15	Goshen Road
WW	45	Goshen Road
WW	102	Goshen Road
WW	167	Greensboro Road
WW	171	Greensboro Road
WW	75	Hastings Road
WW	25	Hillsdale Road
WW	38	Hillsdale Road
WW	22	Nelson Drive
WW	33	Trenton Road
WW	152	Trenton Road
WW	63	Westchester Circle
<b>Total Buildings</b>	<b>50</b>	

**TABLE 3  
MWRA COST EFFECTIVENESS ANALYSIS FOR I/I SOURCES  
Dedham, Massachusetts - 2012 Inflow Investigation**

Location	Subarea	Defect No.	Description of Defect	Source Location (Public/Private)	Removable Infiltration (GPD)	Direct Inflow	Indirect Inflow		MWRA T&T Cost	Recommended Rehabilitation	Rehabilitation Cost	Conclusion
						Peak Design Storm Inflow (GPD)	Peak Indirect Inflow (GPD) <sup>1</sup>	Removable Peak Indirect Inflow (GPD)				
10 Helena Road	WW	1	Open Cleanout (at grade)	Private		879			\$11,664	Install Cleanout Cap at 10 Helena Road	\$200	Excessive
51 Hastings Road	WW	2	Open Cleanout (at grade)	Private		1,562			\$20,728	Install Cleanout Cap at 51 Hastings Road	\$200	Excessive
46 Goshen Road	WW	3	Driveway Drain (moderate smoke)	Private		17,585			\$233,349	Redirect Driveway Drain at 46 Goshen Road	\$7,500	Excessive
112 Bonham Road	WW	4	Open Cleanout (plastic rock cover) (at grade)	Private		1,172			\$15,546	Install Cleanout Cap at 112 Bonham Road	\$200	Excessive
217 Bonham Road	WW	5	Light Smoke from Open Drain Pipe	Public								
205 Bonham Road	WW	6	Light Smoke from Catch Basin	Public		494,000			\$6,555,380	Cap Drain/Sewer Cross Connection in SMH WW440	\$500	Excessive
212 Bonham Road	WW	7	Light Smoke from Catch Basin	Public								
59 Gainsville Road	WW	8	Light Smoke from Catch Basin	Public								
58 Gainsville Road	WW	9	Light Smoke from Catch Basin	Public			2,880	1,440	\$19,109	Cured-in-Place Pipe from SMH WW1140 and SMH WW1110 (253 LF) and Cementitious Lining of SMH WW1110	\$13,950	Excessive
62 Gainsville Road	WW	10	Light Smoke from Catch Basin	Public								
163 Greensboro Road	WW	13	Open Cleanout (at grade)	Private		1,453			\$19,277	Install Cleanout Cap at 163 Greensboro Road	\$200	Excessive
94 Alden Street	TT	14	Moderate Smoke from Driveway Drain	Private		11,247			\$149,244	Redirect Driveway Drain at 94 Alden Street	\$7,500	Excessive
46 Ridge Avenue	II	16	Heavy Smoke from Catch Basin (Direct)	Public		52,719			\$699,579	Redirect Catch Basin from SMH II900	\$15,000	Excessive
78 Harvard Street	JJ	22	Heavy Smoke from Driveway Drain (roof leader discharge)	Private		30,460			\$404,201	Redirect Driveway Drain at 78 Harvard Street	\$7,500	Excessive
94 Chickering Road	HH	23	Moderate Smoke from Catch Basin	Public								
106 Chickering Road	HH	24	Light Smoke from Catch Basin	Public			720	360	\$4,777	Open Cut Point Repair 0+20 to 0+30 up SVC to 94 Chickering from SMH HH630	\$7,000	Non-Excessive Recommended
122 Chickering Road	HH	25	Moderate Smoke from Catch Basin	Public								
121 Chickering Road	HH	26	Light Smoke from Catch Basin	Public								
100 Chute Road	HH	28	Heavy Smoke from Catch Basin	Public								
105 Chute Road	HH	29	Moderate Smoke from Catch Basin	Public			1,440	720	\$9,554	Cementitious Lining of SMH HH1110	\$1,300	Excessive
73 Pacella Drive	HH	30	Light Smoke from Catch Basin	Public								
66 Pacella Drive	HH	31	Light Smoke from Catch Basin	Public								
269 Highland Street	HH	32	Open Cleanout (at grade)	Private		1,172			\$15,546	Install Cleanout Cap at 269 Highland Street	\$200	Excessive
27 Intervale Road	XX	37	Light Smoke rising from yard	Private			720	360	\$4,777	Open Cut Point Repair (Station Unknown / TV Required )	\$7,000	Non-Excessive
98 Ledgewood Road	XX	38	Light Smoke rising from yard	Private			720	360	\$4,777	Open Cut Point Repair (Station Unknown / TV Required )	\$7,000	Non-Excessive
156 Ledgewood Road	XX	39	Moderate Smoke from SMH in driveway	Private		6,326			\$83,946	Replace Cover in Driveway at 156 Ledgewood Drive	\$250	Excessive
TT50	TT	MH 1	Loose Cover ( below grade) (grass)	Public		586			\$7,776	Install Watertight Frame and Cover for SMH TT50	\$1,000	Excessive
TT530	TT	MH 2	Holes in Cover allows Inflow	Public		2,929			\$38,868	Replace Cover of SMH TT530	\$450	Excessive
III130	II	MH 3	Heavy Roots	Public	720				\$9,554	Cementitious Lining and Root Treatment of SMH III130	\$1,610	Excessive
HH160	HH	MH 4	Loose Cover ( below grade) (pavement)	Public		9,372			\$124,366	Raise Frame 3" and Install Inflow Dish for SMH HH160	\$1,200	Excessive
PP910	PP	MH 5	Major Infiltration from Walls and Connections	Public	3,600				\$47,772	Cementitious Lining of SMH PP910	\$1,300	Excessive
<b>Total Excessive Public:</b>					<b>4,320</b>	<b>559,606</b>	<b>4,320</b>	<b>2,160</b>	<b>\$7,511,959</b>	<b>Total Excessive Public:</b>	<b>\$36,310</b>	
<b>Total Non-Excessive Recommended Public:</b>					<b>0</b>	<b>0</b>	<b>720</b>	<b>360</b>	<b>\$4,777</b>	<b>Total Non-Excessive Recommended Public:</b>	<b>\$7,000</b>	
<b>Total Non-Excessive Public:</b>					<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>\$0</b>	<b>Total Non-Excessive Public:</b>	<b>\$0</b>	
<b>Total Excessive Private:</b>					<b>0</b>	<b>71,854</b>	<b>0</b>	<b>0</b>	<b>\$953,502</b>	<b>Total Excessive Private:</b>	<b>\$23,750</b>	
<b>Total Non-Excessive Recommended Private:</b>					<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>\$0</b>	<b>Total Non-Excessive Recommended Private:</b>	<b>\$0</b>	
<b>Total Non-Excessive Private:</b>					<b>0</b>	<b>0</b>	<b>1,440</b>	<b>720</b>	<b>\$9,554</b>	<b>Total Non-Excessive Private:</b>	<b>\$14,000</b>	
<b>Total:</b>					<b>4,320</b>	<b>631,460</b>	<b>6,480</b>	<b>3,240</b>	<b>\$8,479,792</b>	<b>Total:</b>	<b>\$81,060</b>	

**NOTE:** 1 - Indirect Inflow is assumed to be at least 720 GPD for lateral defects, 1,440 GPD for manhole defects and 2,880 GPD for mainline defects.

**APPENDIX D**  
**DYE FLOODING DEFECT LOGS**

**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Gainsville Road

DEFECTS: 8 thru 10  
 SUBAREA: WW  
 DYE FLOOD NO.: 1  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
8	Light smoke from catch basin near house #59	936	Asphalt	10/16/12
9	Light smoke from catch basin near house #58	936	Asphalt	10/16/12
10	Light smoke from catch basin near house #62	936	Asphalt	10/16/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Positive

**Description of test:** Upon plugging and flooding of drain lines, dyed water was observed in MH 1120. Television inspection from MH 1120 towards MH 1140 identified dyed water incoming from the pipe connection at MH 1120 and mainline joints. Television inspection from MH 1120 towards MH 1110 identified similar defects as well. Defects 8 through 10 are associated with this indirect source. Total infiltration rates for these defects are approximately 2.0 gpm.

SKETCH:



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Hillsdale Road

DEFECTS: 11 thru 11  
 SUBAREA: WW  
 DYE FLOOD NO.: 2  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
11	Moderate smoke from catch basin near house # 80	3,744	Asphalt	10/16/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Negative

**Description of test:** Upon plugging and flooding drain lines, no dyed water was observed in any of the surrounding sewer manholes. Sewer manhole 910 is missing some mortar from brick chimney section. The drain manhole located next to sewer MH 910 is constructed of concrete block with little mortar visible. Due to the close proximity of these manholes and opening in the manhole walls, smoke most likely traveled between these manholes, causing smoke to exit from the nearby catch basin (defect 11).

**SKETCH:**



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Gaffney Road

DEFECTS: 15 thru 15  
 SUBAREA: II  
 DYE FLOOD NO.: 3  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
15	Moderate smoke from catch basin near house #30	1,321	Asphalt	10/23/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Negative

**Description of test:** Upon plugging and flooding drain lines, surrounding sewer structures were inspected for dyed water. No dyed water was observed in any of the inspected sewer manholes.

**SKETCH:**



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Whiting Avenue & Abbott Road

DEFECTS: 17 thru 20  
 SUBAREA: NN  
 DYE FLOOD NO.: 4  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
17	Light smoke from catch basin near house #70	3,600	Asphalt	10/23/12
18	Light smoke from catch basin near house #95	3,600	Asphalt	10/23/12
19	Light smoke from catch basin near house #95	3,000	Asphalt	10/23/12
20	Light smoke from catch basin near house #96	3,000	Asphalt	10/23/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Negative

**Description of test:** Upon plugging and flooding drain lines, no dyed water was observed in any of the surrounding sewer manholes. Sewer line on Whiting Avenue was lined from manhole-to-manhole after completion of the smoke testing. The source for defects 17 through 20 were most likely rehabilitated through the installation of the manhole-to-manhole liner.

**SKETCH:**



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Ledgewood Road

DEFECTS: 35 thru 35  
 SUBAREA: XX  
 DYE FLOOD NO.: 5  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
35	Moderate smoke from catch basin near house #92	1,800	Asphalt	11/15/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Negative

**Description of test:** The catch basins on Ledgewood Road connect and drain to the ground. Upon flooding of the drain system with dyed water, surrounding sewer structures were inspected and no dyed water was observed.

**SKETCH:**



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Intervale Road

DEFECTS: 36 thru 36  
 SUBAREA: XX  
 DYE FLOOD NO.: 6  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
36	Moderate smoke from catch basin near house #15	2,916	Asphalt	11/15/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Negative

**Description of test:** Upon plugging and flooding of the drain with dyed water, surrounding sewer structures were inspected. No dyed water was observed in the sewer.

SKETCH:



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Harmony Hill

DEFECTS: 27 thru 27  
 SUBAREA: HH  
 DYE FLOOD NO.: 7  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
27	Light smoke from catch basin near house #407	2,040	Asphalt	11/2/12

**Dye Flooding Results**

**Date of Test:** 11/29/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Negative

**Description of test:** Dyed water was introduced to the catch basin near house #407 (defect 17). This catch basin flows to a drain manhole near Washington Street that did not appear to have an outgoing line. Upon flooding of this drain line, sewer manhole 1520 was inspected and showed no signs of dyed water in the sewer flow.

**SKETCH:**



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Chickering Road

DEFECTS: 23 thru 26  
 SUBAREA: HH  
 DYE FLOOD NO.: 8  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
23	Moderate smoke from catch basin near house #94	1,200	Asphalt	11/2/12
24	Light smoke from catch basin near house #106	3,600	Asphalt	11/2/12
25	Moderate smoke from catch basin near house #122	3,600	Asphalt	11/2/12
26	Light smoke from catch basin near house #121	3,600	Asphalt	11/2/12

**Dye Flooding Results**

**Date of Test:** 11/30/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Positive

**Description of test:** Upon plugging and flooding of drain lines, dyed water was observed in MH 630 incoming from what appears to be a service connection to house #94. Television inspection of this 6-inch line identified dyed water infiltrating from a joint approximately 25 feet upstream of MH 630 at a rate of 0.5 gpm. This source is associated to defects 23 through 26.

SKETCH:



**WESTON AND SAMPSON  
DYE FLOODING DEFECT REPORT**

ENGINEER: Weston & Sampson  
 OWNER: Town of Dedham  
 PROJECT: Fall 2012 Smoke Testing  
 LOCATION: Pacella Drive & Chute Road

DEFECTS: 28 thru 31  
 SUBAREA: HH  
 DYE FLOOD NO.: 9  
 CONTRACTOR: NEPCCO

**Smoke Testing Results**

Leak No.	Description of Smoke Testing Defects	Drainage Area	Surface Type	Date
28	Heavy smoke from catch basin near house #100	4,020	Asphalt	11/2/12
29	Moderate smoke from catch basin near house #105	4,800	Asphalt	11/2/12
30	Light smoke from catch basin near house #73	3,000	Asphalt	11/2/12
31	Light smoke from catch basin near house #66	3,000	Asphalt	11/2/12

**Dye Flooding Results**

**Date of Test:** 11/30/12      **Contractor:** New England Pipe Cleaning Co.      **Result(s):** Positive

**Description of test:** Upon plugging and flooding of drain lines, dyed water was observed in MH 1110 incoming from the manhole walls. The sewer manhole is constructed of concrete block, with little mortar between blocks. Dyed water from the nearby catch basin lateral (defect 28) was infiltrating to the sewer manhole at a rate of 2.0 gpm.

**SKETCH:**



**APPENDIX E**  
**MWRA T&T COSTS**  
**RATIONAL EQUATION CONVERSION**  
**CONSTRUCTION UNIT COSTS**

## MEMORANDUM

DATE: December 12, 2012

FROM: Nathan Michael

TO: File 2120623.A

SUBJECT: T&T costs for Dedham, Massachusetts using MWRA methodology

Fiscal year 2012 Transportation & Treatment (T&T) costs for sewerage in the Town of Dedham can be calculated using both the MWRA Operation & Maintenance (O & M) and Capital charges, and the town's O & M and Capital costs. Therefore, MWRA charges are based mainly on sewage flow exiting the Town of Dedham. MWRA's FY12 sewerage charges to the Town of Dedham are shown in Table A, and Table B shows Dedham's FY12 O & M and Capital costs.

**TABLE A - MWRA CHARGES TO THE TOWN OF DEDHAM**

ITEM	FLOW (gallons/year)	FLOW (gallons/day)	MWRA CHARGE	COST (\$/GPD)
<b>Average Strength Flow*</b>				
Annual Wastewater Volume	1,454,819,000	3,985,805	\$1,232,630	\$0.3093
Total Suspended Solids (O & M and Capital)	1,454,819,000	3,985,805	\$416,366	\$0.1045
Biochemical Oxygen Demand (O & M and Capital)	1,454,819,000	3,985,805	\$326,350	\$0.0819
Maximum Monthly Flow	N/A	7,230,000	\$781,617	\$0.1081
Population **	1,454,819,000	3,985,805	\$2,162,592	N/A
<b>TOTAL</b>			<b>\$4,919,555</b>	<b>\$0.6038</b>

**NOTE:**

\*MWRA's charges only apply to average strength flow.

\*\*MWRA's population charges are not flow based, so it is not to be included in T & T cost.

**TABLE B – TOWN OF DEDHAM SEWERAGE COSTS**

ITEM	FLOW (gallons/year)	FLOW (gallons/day)	DEDHAM COST	COST (\$/GPD)
Debt Service (Capital Costs)	1,454,819,000	3,985,805	\$400,000	\$0.1004
O & M	1,454,819,000	3,985,805	\$1,130,000	\$0.2835
<b>TOTAL</b>			<b>\$1,530,000</b>	<b>\$0.3839</b>

Therefore, the total FY12 T&T cost for both the MWRA charges and the Town of Dedham's costs are \$0.9877 /GPD (\$0.6038 + \$0.3839).

According to the Department of Environmental Protection's (DEP) Guidelines for Performing I/I Analyses and SSES this cost of \$0.9877/GPD needs to be extended throughout the life of a rehabilitative measure. The life cycle for a rehabilitative measure can be set by good engineering judgement as well as backup documentation, depending on the type of rehabilitation. For this study, Weston & Sampson will use a life cycle of twenty years.

To find the present worth of a rehabilitative measure over a twenty-year period, a discount rate, or annual percentage rate, is required. According to the DEP, the discount rate for FY13 is 4.125%. To calculate the T&T cost in order to account for this twenty-year period, a present worth analysis must be done. The following formula will calculate the present worth of the T&T cost for the next twenty years:

**PRESENT WORTH ANALYSIS:**

Discount Rate = 4.125% (DEP FY13 Information)

Present Worth Factor:

$$\frac{(1+i)^n - 1}{i(1+i)^n} \quad \text{where: } i = \text{discount rate, or interest rate}$$

$$n = \text{number of years}$$

$$\frac{(1 + 0.04125)^{20} - 1}{0.04125 (1 + 0.04125)^{20}} = 13.44$$

Present Worth T&T Cost:

$$(\text{Present Worth Factor}) \times (\text{FY12 T \& T cost})$$

$$13.44 \times \$0.9877/\text{GPD} = \$13.27/\text{GPD}$$

Therefore, the T&T cost for the Town of Dedham, utilizing a present worth of the rehabilitation for a twenty-year period, with a discount rate of 4.125%, is \$13.27/GPD.

Town of Dedham T&T costs were derived using MWRA sewerage costs.

# The Rational Equation Conversion

$$Q = c * i * a$$

Q = flow (GPD)

c = Coefficient of Runoff (Dimensionless)\*

i = 0.87 in/hr (as per DEP Peak Design Storm)

a = area (ft<sup>2</sup>)

$$Q = c * \left(0.87 \frac{\text{in}}{\text{hr}} * \frac{24 \text{ hr}}{1 \text{ day}} * \frac{1 \text{ ft}}{12 \text{ in}}\right) * (x \text{ ft}^2) * \left(\frac{7.481 \text{ gal}}{1 \text{ ft}^3}\right)$$

$$Q = c * \left(1.74 \frac{\text{ft}}{\text{day}}\right) * (x \text{ ft}^2) * \left(\frac{7.481 \text{ gal}}{1 \text{ ft}^3}\right)$$

$$Q = c * \left(13.017 \frac{\text{gal}}{\text{ft}^2 * \text{day}}\right) * (x \text{ ft}^2)$$

$$\underline{Q(\text{GPD}) = c * 13.017 * a}$$

\*Coefficient of Runoff varies widely by surface type. e.g.:

c (pavement) = 0.9

c (grass) = 0.3

ESTIMATED UNIT COSTS FOR REHABILITATION

Dedham, MA - 2012 Inflow Investigation

RECOMMENDED REHABILITATION METHOD	ESTIMATED COST	RECOMMENDED REHABILITATION METHOD	ESTIMATED COST
<b>CLEAN, INSPECT, TEST &amp; SEAL</b> Clean, inspect, test & seal (8")	\$8.00 / lf	<b>CURED-IN-PLACE PIPE</b> Reline pipe (8") liner from MH to MH	\$50.00 / lf
<b>CHEMICAL ROOT TREATMENT</b> Chemical root treatment (8")	\$1.90 / lf	<b>CURED-IN-PLACE PIPE (STRUCTURAL)</b> Reline pipe (8") liner from MH to MH	\$55.00 / lf
<b>MANHOLE REHABILITATION</b> Build bench & invert	\$650.00 / mh	<b>SHORT LINER</b> Short liner (8")	\$375.00 / lf
Cementitious lining (precast/brick/block)	\$130.00 / vf	Structural short liner (8")	\$400.00 / lf
Install inflow dish	\$200.00 / mh	<b>SERVICE CONNECTION REHABILITATION</b> Replacement of wye connection (6" to 36")	\$800.00 / wye
Repair bench & invert	\$200.00 / mh	Cut protruding service	\$650.00 / each
Repair chimney	\$200.00 / mh	Grout service at connection with main	\$600.00 / each
Repair cone	\$200.00 / mh	<b>EXCAVATE &amp; REPLACE PIPE</b> Replace pipe (8")	\$700.00 / lf
Replace cover	\$250.00 / mh	<b>DIRECT CONNECTIONS</b> Redirect Roof Leader	\$2,500.00 / each
Replace frame	\$750.00 / mh	Redirect Catch Basin	\$15,000.00 / each
Replace/Raise/Reset frame & cover	\$1,000.00 / mh	Redirect Area or Driveway Drain	\$7,500.00 / each
Root treatment	\$310.00 / mh	Redirect Sump Pump	\$5,000.00 / each
Seal Invert	\$230.00 / mh	Install Cleanout Cap	\$200.00 / each
<b>CLEAN &amp; TELEVISION INSPECTION</b> Clean & TV (6" to 36" )	\$2.00 / lf	Install Cleanout Cap & Install Sump Pump	\$7,500.00 / each
Heavy Cleaning (6" to 36" )	\$15.00 /lf		
TV service connection from mainline to house	\$10.00 / lf		

**Weston&Sampson**<sup>®</sup>  
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