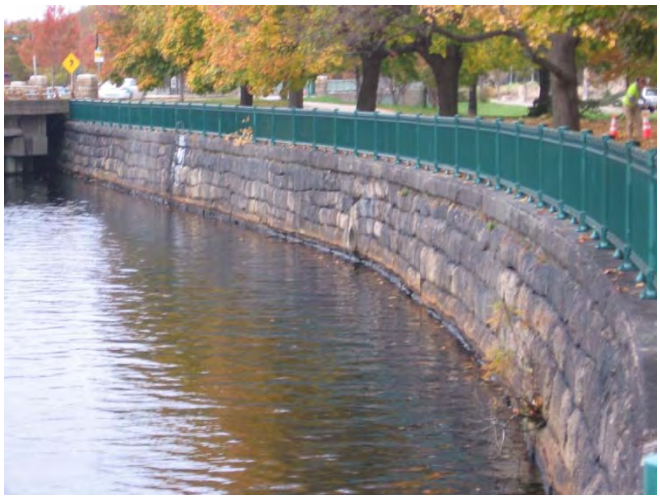
Environment

Prepared for:
Department of Conservation and Recreation
Boston, Massachusetts

Submitted by:
AECOM
Chelmsford, MA
May 2013

Illicit Discharge Detection Report

Permit Year 10 - 2012



AECOM

dcr

Environment

Prepared for:
Department of Conservation and Recreation
Boston, Massachusetts

Submitted by:
AECOM
Chelmsford, MA
May 2013

Illicit Discharge Detection Report

Permit Year 10 - 2012

Aaron Hopkins

Prepared By

Kate Sylvest

Reviewed By

Contents

List of Appendices

List of Tables

List of Figures

1.0 Introduction

At the request of the Massachusetts Department of Conservation and Recreation (DCR), AECOM Environment (AECOM) developed and performed an illicit discharge detection (IDD) program to identify possible illicit discharge sources in urbanized portions of the DCR's stormwater collection system. This project supports the provisions of Minimum Control Measure No. 3 of DCR's NPDES Small MS4 General Permit. This provision mandates the development and implementation of an illicit discharge detection and elimination plan to identify potentially hazardous releases into the stormwater system and establish the means to eliminate these discharges.

The U.S. Environmental Protection Agency (EPA) defines illicit discharges as any non-permitted discharge to a storm sewer system that is not composed entirely of stormwater. Sources for these flows include direct connections to a sanitary sewer line, piped floor drains from garages or basements, and illegally dumped fluids like motor oil and paint. These discharges can result in serious consequences for the ultimate receiving waterbody, including decreased water quality, the destruction of wildlife habitat, and a decrease in the aesthetic value of the waterbody. Illicit discharges are of particular concern in urbanized areas because of the high concentration of development and industrial and commercial facilities. However, non-permitted discharges that do not carry pollutants are not considered illicit including culverted streams, groundwater seepage, and potable water (Brown, Caraco & Pitt 2004).

Since this program began in 2008, AECOM has performed the following tasks to assess DCR's stormwater systems for illicit discharges:

- Program Year One - 2008
  - Produced a five year inspection schedule and rotation
  - Developed an illicit discharge identification and testing protocol
  - Performed illicit discharge inspections on approximately 20% of the DCR's stormwater systems in urban areas
- Program Year Two – 2009
  - Modified the IDD protocol to reflect improvements identified in Program Year One
  - Performed illicit discharge inspections on approximately 20% of the DCR's stormwater systems in urban areas
- Program Year Three – 2010
  - Modified the IDD protocol to reflect changes to field testing procedure
  - Modified the IDD rotation to reflect new priority areas
  - Performed illicit discharge inspections on approximately 20% of the DCR's stormwater systems in urban areas

- Program Year Four – 2011
  - Modified the IDD protocol to reflect changes to field documentation procedure
  - Performed illicit discharge inspections on approximately 20% of the DCR's stormwater systems in urban areas

The next sections detail the procedure and summarize the results from year five of the IDD Program.

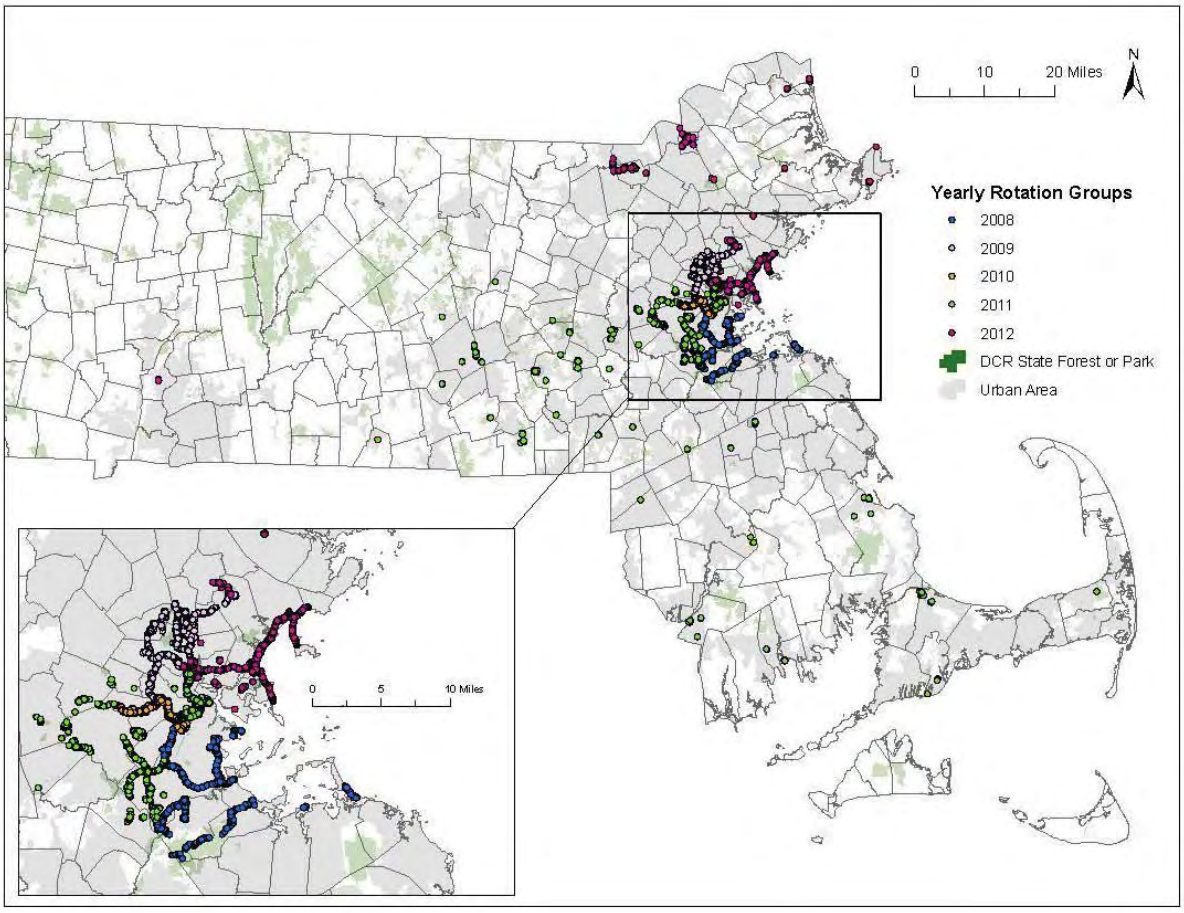
2.0 Methods

This section presents the methods AECOM used to develop and implement an IDD program for the DCR. In Program Year One (2008), AECOM divided the DCR's urban stormwater systems into five inspection zones, as presented in Section 2.1 and Figure 2-1. The IDD protocol developed in Program Year One was updated in the second, third, and fourth year of the program to reflect improvements and modifications as explained in Section 2.2. Section 3.0 describes AECOM's results for Program Year Five.

2.1 Five Year Inspection Rotation

In support of NPDES requirements, AECOM designed a rotating schedule to ensure that urban portions of DCR's stormwater systems will be investigated once every five years. AECOM previously mapped DCR's stormwater infrastructure in urban areas using digitized, scanned drainage plans, and field recorded global positioning system (GPS) data. Several aspects of these data were analyzed to establish five comparable IDD zones, shown in Figure 2-1, including: spatial continuity, number of stormwater features, total road miles, and proportion of data from drainage plans versus GPS surveys.

Figure 2-1. Yearly Rotation Groups



Prior to developing an inspection rotation, AECOM examined priority areas listed in the Stormwater Management Plan including suspected illicit connections based on previous site visits and direct discharges to impaired waterbodies. With the DCR, AECOM determined that these priority areas have a state-wide spatial distribution that would hinder IDD program implementation. Therefore, each rotation zone contains stormwater features and road miles grouped by spatial location. Approximately 50 percent of the infrastructure data for each zone are from scanned plan data and therefore had not been field verified prior to AECOM's IDD investigations.

2.2 Illicit Discharge Detection Procedure

AECOM performed illicit discharge detection investigations according to the protocol developed with the DCR in 2008, and revised in subsequent years of the program (see Appendix A), based on the Charles River Illicit Discharge Detection and Elimination Protocol, adopted from BWSC (2004) and Pitt (2004). The protocol relies primarily on visual observations and the use of field sampling and analysis using portable instrumentation during dry weather to complete a preliminary inspection and analysis of stormwater systems. AECOM compiled a field analytical kit designed to isolate the general source of a discharge based on its chemical characteristics. This process of testing samples and reviewing results in real-time provides a significant advantage in allowing field crews to perform further field reconnaissance and potentially identify the source of flow as a sanitary sewer, industrial discharge, natural source, or domestic water.

The AECOM team attempted to schedule field investigation activities to occur at times with less than a tenth of an inch of rain in the preceding 48 hours to ensure observed flows were the result of non-stormwater discharges. However, in cases when surveys took place within 48 hours of a rain event, field teams noted any observed flows and flagged those stormwater systems for a future visit during dry weather conditions. Using the stormwater system spatial database as a guide, field crews visited each accessible manhole or catch basin in a stormwater system, removed their covers and performed a thorough visual inspection. Notable visual indicators of illicit discharges consisted of dry weather flow, suspicious pipes, or any evidence to suggest potential contamination from intermittent sources. Signs of potential contamination included odors, staining, floatables, and foaming which could indicate the presence of sewage or wash water. Non-debris floatables could also indicate the presence of sanitary sewer water. Flows that field crews determined to be culverted streams or groundwater (by visual observation) were not noted as potentially illicit.

The field crew recorded illicit discharge observations and updates to the stormwater system spatial database in real-time on a hand-held field computer (Panasonic CF-U1 Toughbook). Field crews used a Trimble Pro XT external GPS receiver with sub-meter accuracy connected via Bluetooth technology to the handheld computer to record locations and data. Field crews recorded IDD program data in AECOM-designed data entry forms and associated data tables on the handheld computer using ESRI ArcPad version 10.0. The field computer contained aerial photographs, road maps, and the existing stormwater system data for reference and editing purposes. In areas where the stormwater system had been previously field surveyed, the field crew only recorded IDD program specific observations. When stormwater data originated from scanned design plans, the field crew took GPS coordinates and updated attributes for features within that system. Following field inspections, illicit discharge records and revised infrastructure data were then downloaded into Geographic Information System (GIS) software to update the DCR's stormwater database.

Improvements to the IDD Protocol made prior to the Program Year Two field season included use of the Toughbook hand-held computer, implementing advanced feature symbology, and enhancing data validation tools. These modifications led to the field inspection of nearly 100% of the stormwater

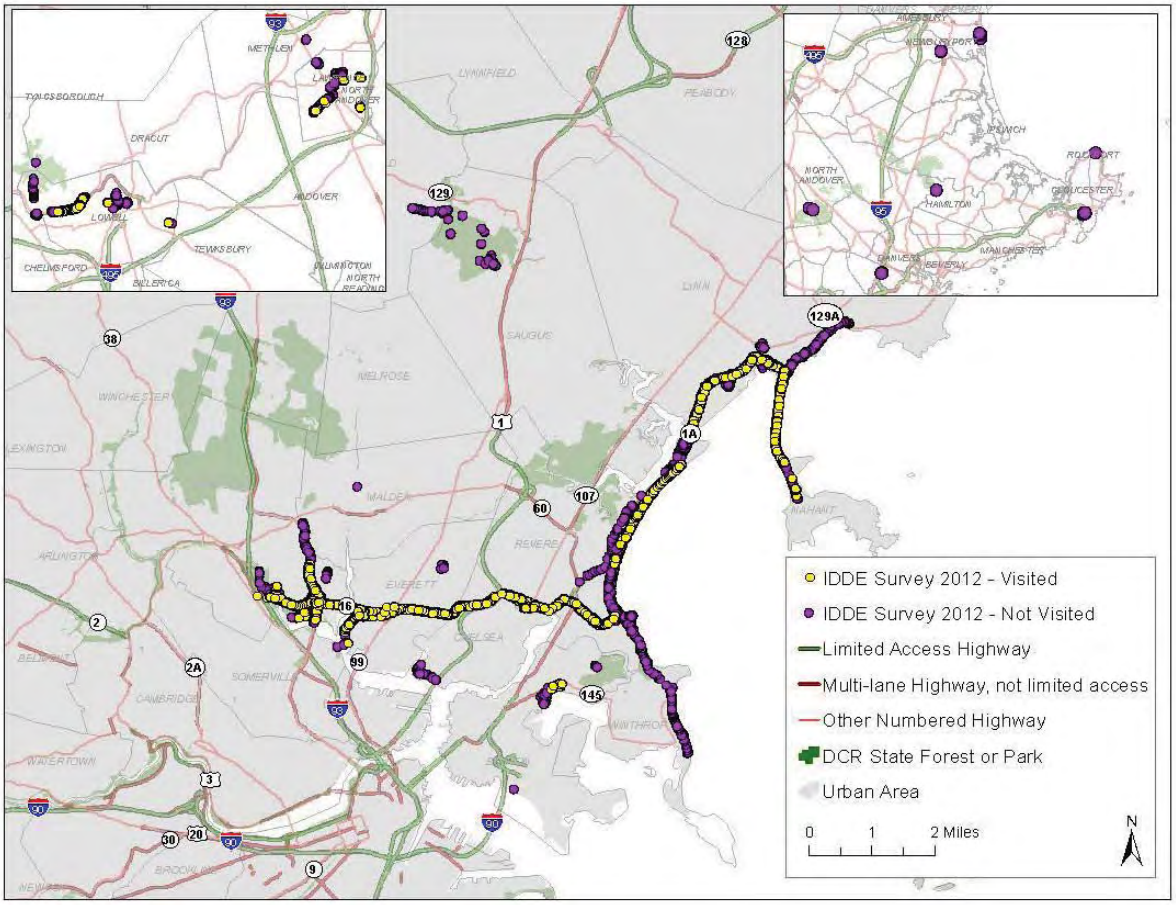
features in the investigation areas. A further modification made prior to Program Year Three was to replace the previously used boron test with an anionic surfactant test to identify non-borate based detergent contamination in analyzed flows. An improvement made prior to Program Year Four was to require field crews to fill out a summary form at all features where flows were observed to enhance the documentation process (Appendix B). Another improvement made prior to Program Year Four was the introduction of a GPS-equipped camera. The GPS camera, when paired with GIS, linked photographs taken in the field to features mapped in GIS and streamlined desktop analysis of illicit flows.

AECOM notified the DCR of observations and sampling results that indicated the presence of an illicit discharge. Evidence of intermittent illicit discharges, including staining and odors, noted during the field effort are recorded in DCR's stormwater database and will be available to future field and maintenance crews to help identify potential problem areas.

3.0 Program Year Five Results

AECOM implemented the IDD protocol outlined in Appendix A, commencing the fifth year of field investigations of the DCR's stormwater systems on August 23, 2012. The effort focused on the DCR parks and parkways just north of the Charles River including the Mystic River Reservation, the Revere Beach Parkway, and the Lynn Shore Reservation (Figure 3-1). Due to the complexity of the roadway layout and associated stormwater systems; the Year Five survey area was not completely investigated during the 2012 field season. In particular, the majority of the Revere Beach Parkway was intersected by numerous frontage roads, parking lots, and side streets with old and overlapping stormwater systems. The additional traffic management and complicated stormwater mapping that was required reduced the survey rate of the field teams. The portions of the survey area that were not visited in 2012 (Figure 3-1) will be visited in 2013 prior to the start of the Year Six rotation.

Figure 3-1. Program Year Five Survey Area



3.1 Sample Location Statistics

During the 2012 field season, AECOM field crews investigated 1,704 stormwater features for signs of illicit connections. Work was conducted in 15 cities and towns on 23 miles of roadway and included features in several DCR parks (Table 3-1).

Table 3-1. Summary of Work by Town

Town	Features	Roads (Miles)	Parks
Boston	31	0.2	Neponset River Reservation, Constitution Beach, Charles River Reservation
Brookline	2	*	Hammond Pond Parkway
Cambridge	4	*	Charles River Reservation
Chelsea	63	0.4	-
Everett	296	4.9	Revere Beach Parkway, Mystic River Reservation
Lawrence	53	*	Lt Col E.J. Higgins Mem Pool, Lawrence Riverfront S.P., Lawrence Heritage S.P., Geisler Memorial Pool
Lowell	73	*	Raymond J. Lord Memorial Pool, Lowell Heritage State Park, John J. Janas Memorial Rink
Lynn	239	4.2	Lynn Shore Reservation, Lynn Heritage State Park, Carroll Parkway
Medford	449	5.2	Mystic River Reservation
Milton	1	*	-
Nahant	117	1.5	Nahant Beach, Lynn Shore Reservation
Revere	371	6.7	Revere Beach Reservation, Revere Beach Parkway
Somerville	2	*	Mystic River Reservation
Ware	1	*	Quabbin Reservoir
Watertown	2	*	Charles River Reservation
Total	1704	23.2	-

*Features in parks only

Table 3-2 shows the breakdown of stormwater features by type. The stormwater systems were comprised primarily of catch basins, manholes, and outlets but also included other features such as yard drains, drywells, and oil/grit separators.

Table 3-2. Summary of Features Investigated in Program Year Five

Feature	Total
Catch basin	1,009
Manhole	517
Outlet	125
Other	53
Total	1,704

3.2 Sampled Flow Results

Field crews collected samples from 16 features with flow and field tested the discharge for a series of analytes according to the IDD protocol, described briefly in Section 2.2 and outlined in Appendix A. Based upon field analytical test results and field observations, AECOM crews categorized flows as either possibly illicit or not likely illicit. Figure 3-2 shows the procedure used to characterize flow samples from chemical analysis results based on the Charles River Illicit Discharge Detection and Elimination Protocol. In general, high surfactant levels indicate a wastewater source (sanitary sewer or washwater contamination, depending on ammonia to potassium ratio); low surfactant and high fluoride levels indicate a tap or irrigation source; and low surfactant and fluoride levels indicate a natural water source. Field tested temperature and pH, as well as visual inspection of the flow and stormwater system, also contributed to flow characterization. Table 3-3 details the visual observations, analytical results, and recommendations for each flow.

Figure 3-2. Field Analysis Flow Chart

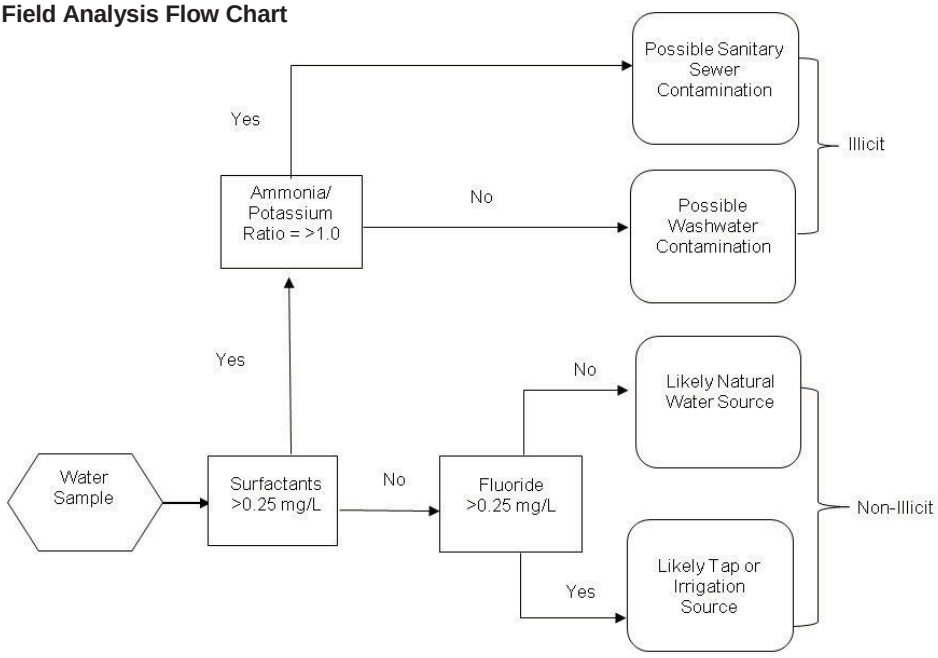


Table 3-3. Summary of Program Year Five IDD Analytical Results

Figure	Feature ID	Flow	Turbidity	Floatables	pH	Temp (°F)	Surfactants (mg/L)	NH_3 (mg/L)	K^+ (mg/L)	NH_3/K^+ Ratio	Fluoride (mg/L)	Potential Source	Justification	Recommended Action
Not Likely Illicit														
	4600	Trickle	None	None	8.4	59.5	0.25	0.00	3.00	0.00	0.28	Natural, Tap or Irrigation	Borderline surfactant, borderline fluoride, no suds observed	No action necessary
	13005	1/4 Full	None	None	8.1	60.4	0.25	NT	NT	NT	0.00	Natural Source	Low surfactant, low fluoride	No action necessary
	14399	Trickle	None	None	6.6	67.5	0.25	NT	NT	NT	0.12	Natural Source	Low surfactant, low fluoride	No action necessary
	14724	1/4 Full	None	None	8.1	74.6	0.25	NT	NT	NT	1.39	Tap or Irrigation	Borderline surfactant, high fluoride, no suds observed	No action necessary
	14984	1/4 Full	None	None	7.5	68.2	0.25	5.00	6.00	0.83	0.26	Natural, Tap or Irrigation	High surfactants, low NH_3/K^+ ratio	No action necessary
	19302	Trickle	None	Oil Sheen	7.4	62.2	0.38	0.00	0.00	NT	0.63	Natural, Tap or Irrigation	High surfactants, low NH_3/K^+ ratio	No action necessary
	25154	Trickle	None	Oil Sheen	6.2	73.0	0.10	2.00	0.00	NT	0.98	Tap or Irrigation	Low surfactant, high fluoride	No action necessary. Likely a tie-in from the adjacent municipal water line.
	25601	Trickle	None	None	8.4	59.5	0.10	NT	NT	NT	1.07	Tap or Irrigation	Low surfactant, high fluoride	No action necessary
	36054.2	Trickle	None	None	7.9	66.2	0.25	1.00	0.00	NT	0.97	Tap or Irrigation	High surfactants, low NH_3/K^+ ratio	No action necessary
Possibly Illicit														
3-3	467	Trickle	None	None	8.8	65.8	0.25	NT	NT	NT	0.81	Tap or Irrigation	Low surfactant, high fluoride	Visited within 48 hours of rain, revisit during dry weather
3-4	4498	Full	None	None	6.8	65.1	1.50	6.00	54.00	0.11	0.72	Washwater	High surfactants, low NH_3/K^+ ratio	Follow up site visit to confirm that flow is groundwater or that hoses have been removed.
3-5	12111	Trickle	None	None	7.2	75.6	0.25	10.00	11.00	0.91	0.25	Washwater	High surfactants, borderline NH_3/K^+ ratio	Visited within 48 hours of rain, revisit during dry weather
3-6	12649	1/2 Full	None	None	9.8	73.0	0.25	0.00	1.00	0.00	NT	Washwater	High surfactants, low NH_3/K^+ ratio	Visited within 48 hours of rain, revisit during dry weather
3-7	12660	Trickle	None	None	8.7	59.0	1.00	0.00	4.00	0.00	NT	Washwater	High surfactants, low NH_3/K^+ ratio	Revisit to collect representative flow sample.
3-8	23515	1/4 Full	None	None	8.2	60.4	0.50	15.00	16.00	0.94	0.00	Washwater	High surfactants, low NH_3/K^+ ratio	Visited within 48 hours of rain, revisit during dry weather
3-9	36092.1	Trickle	None	None	7.6	50.2	2.20	4.00	215.00	0.02	NT	Washwater	High surfactants, low NH_3/K^+ ratio	Revisit to determine the source of the flow, investigate areas where auto body shops are located.

NT = Not Tested

3.3 Summary of Suspected Illicit Discharges

Nine of the 16 sampled flows were determined to not be illicit based on findings from the field investigations and are not discussed further in this report. The following figures summarize the results of the analytical tests and field observations for the seven discharges determined by the field crew to be possibly illicit. The summaries include:

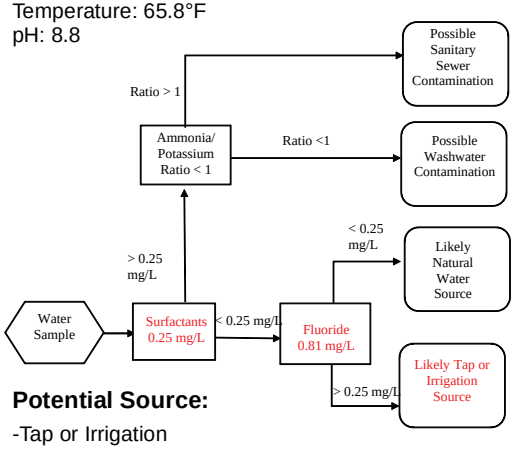
- Feature location
- Associated stormwater system
- Descriptions of the discharge
- Suspected source
- Photograph of feature
- Recommended actions

Figure 3-3
Summary for Feature 467
Fellsway, Everett, MA
Inspection Date: 09/21/12

Flow was observed in a manhole located on the Fellsway in Everett. The flow was traced upstream to a catch basin located in a residential area. A sample was collected and analytical testing results indicate that the flow is from a tap or irriagtion source. Rain occured during the 48 hours prior to the collection of the sample, therefore a revisit should be conducted to verify results.

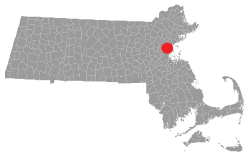
IDD Test Results:

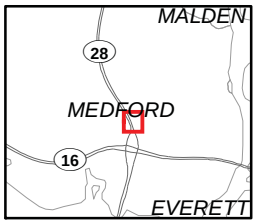
Days since last rain event: 2 (0.61" on 09/19/12)
Temperature: 65.8°F
pH: 8.8



Potential Source:

-Tap or Irrigation





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

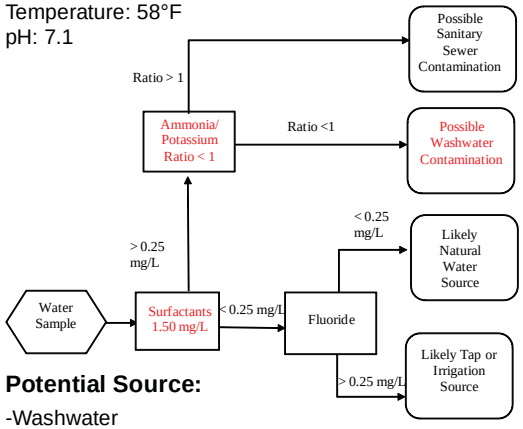
dcr AECOM

Figure 3-4
Summary for Feature 4498
Lynnway Road, Revere, MA
Inspection Date: 9/11/12

Colorless flow with a moderate sewage smell was observed draining from a hose into catchbasin 4498. The catchbasin was located near an active construction site at a pump house. Two hoses originating from the construction site were placed in the catchbasin. Water was observed dripping out of one hose and there was no flow in the other hose. According to contractors on site the hoses contained groundwater that was being pumped out of the construction site. While sampling the slow trickle from the hose, flow increased to a moderate trickle. Analytical test results suggest that the flow is washwater, not groundwater. There was standing water in catchbasin 4498 and flow was not observed in downstream features.

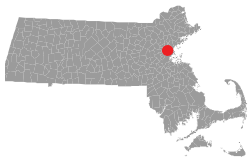
IDD Test Results:

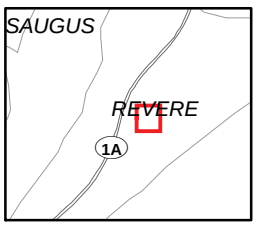
Days since last rain event: 4 (0.43" on 9/7/12)
Temperature: 58°F
pH: 7.1



Potential Source:

-Washwater





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

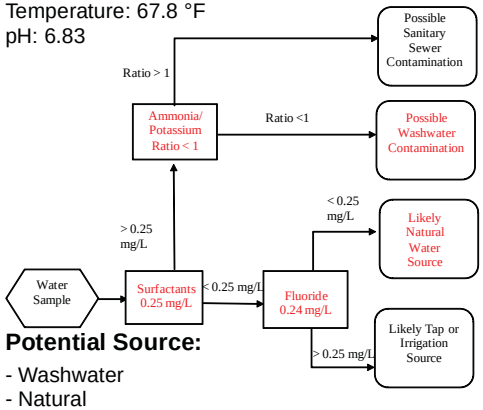
dcr AECOM

Catchbasin 4498

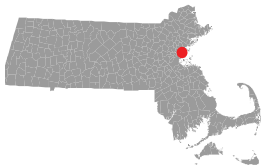
Figure 3-5
Summary for Feature 12111
Revere Beach Pkwy, Revere, MA
Inspection Date: 9/21/12

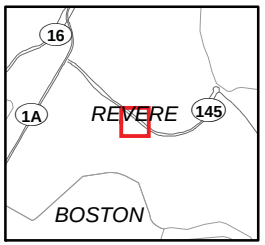
A steady flow with a sour odor was observed draining through manhole 12111. Manholes upstream of the manhole were off property and could not be checked. The manhole drained to an outfall near a culverted stream that connects to the Belle Isle inlet. Water surrounding the outfall outlet appeared cloudy. The connecting manholes were on the Suffolk Downs horse race track's property and likely receive surface runoff from the track and stable areas. Analytical testing produced inconclusive results. This feature was also visited within 48 hours of a rain event and should be revisited. Upon revisiting this feature, bacteria sampling should be conducted to test for run off containing fecal contamination from Suffolk Downs.

IDD Test Results:
Days since last rain event: 2 (0.61" on 9/19/12)
Temperature: 67.8 °F
pH: 6.83



Potential Source:
- Washwater
- Natural





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

dcr AECOM

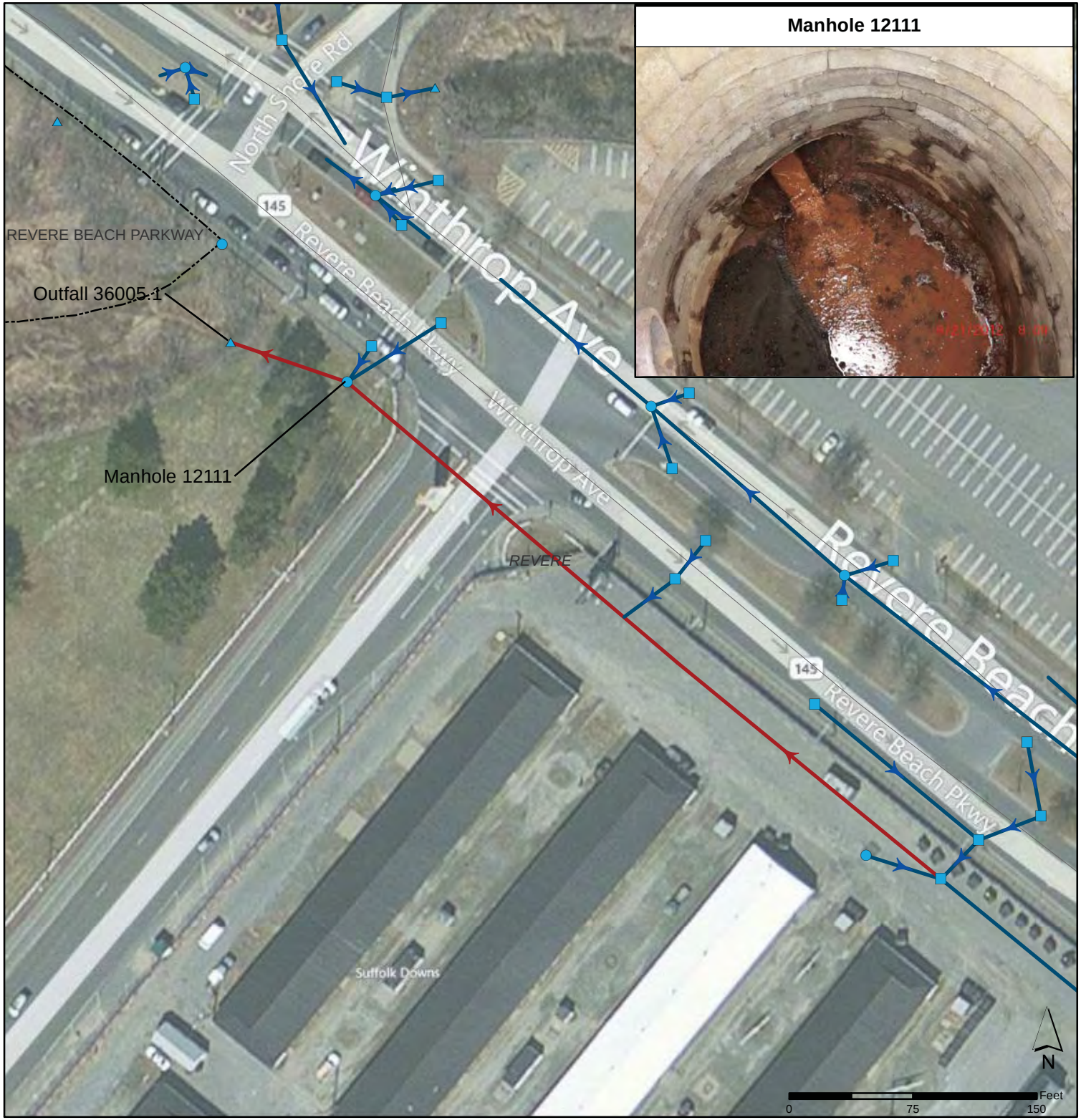
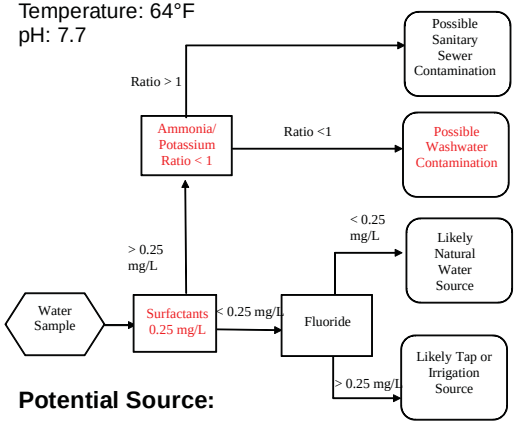


Figure 3-6
Summary for Feature 12649
Lynnway, Lynn, MA
Inspection Date: 10/10/12

Flow was observed coming from an 18" pipe off of DCR property on the Lynnway in Lynn. The flow was coming from the direction of a business parking lot off of the Lynnway. There was a period of rain during the sample window that may have contributed to the flow. Test results indicate that the flow had chemical characteristics similar to washwater.

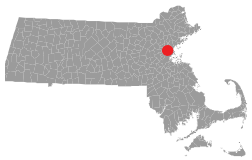
IDD Test Results:

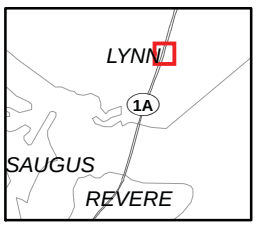
Days since last rain event: 0 (0.14" on 10/10/12)
Temperature: 64°F
pH: 7.7



Potential Source:

-Washwater





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

dcr AECOM

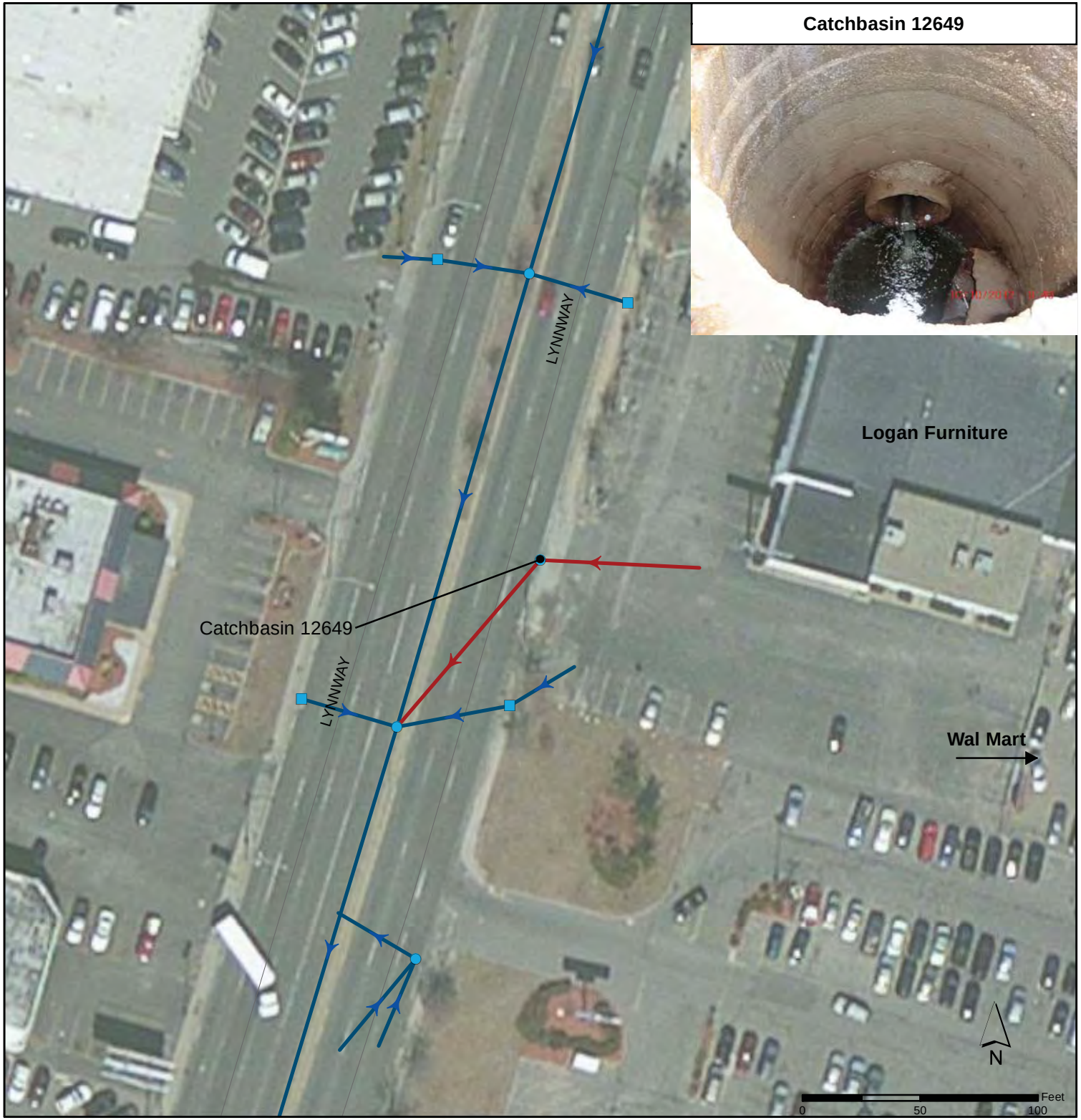
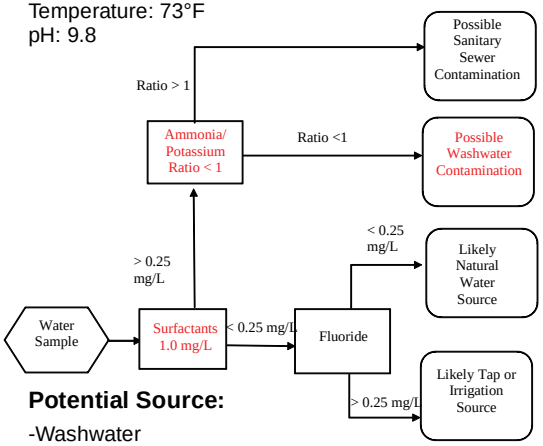


Figure 3-7
Summary for Feature 12660
Lynnway, Lynn, MA
Inspection Date: 10/12/12

Flow from an 18" pipe was observed in a manhole located on the Lynnway in Lynn. There was standing water in the manhole and the water line was near the flowing pipe. The sample that was collected contained standing water as well as the flow entering the manhole. A follow up visit should be conducted to determine whether the analytical results are representative of the flow or of the standing water.

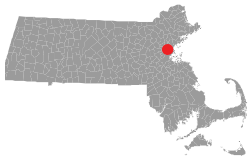
IDD Test Results:

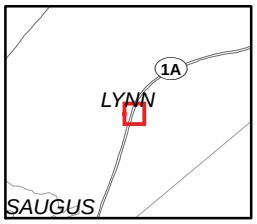
Days since last rain event: 2 (0.14" on 10/10/12)
Temperature: 73°F
pH: 9.8



Potential Source:

-Washwater





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

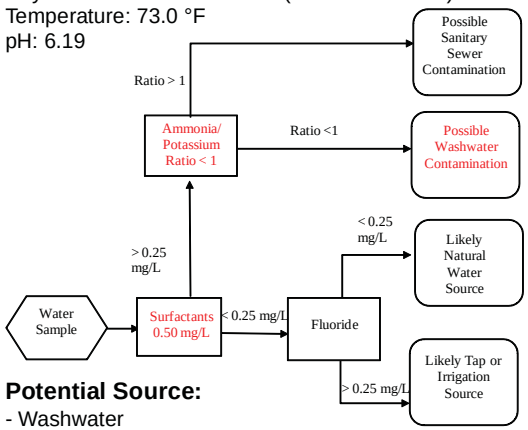
dcr AECOM

Figure 3-8
Summary for Feature 23515
Mystic View Road, Everett, MA
Inspection Date: 8/30/12

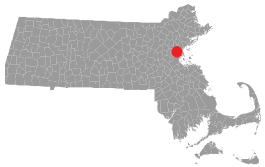
A trickling, oily flow with a strong petroleum odor was observed draining through a series of manholes beginning with manhole 23515. No flow was observed in the connecting catchbasins. The flow continued through the manhole system until reaching an underground detention tank or oil/grit separator. The tank outfalls into the nearby Mystic River, however, no flow was observed at the outfall. The manholes were located near a large stripmall, and Target was the closest potential source. This flow was observed within 48 hours of a rain event and will require a follow up visit.

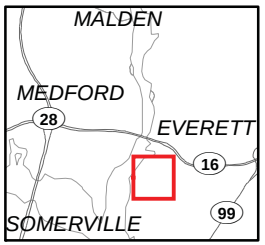
IDD Test Results:

Days since last rain event: 2 (0.15" on 8/28/12)
Temperature: 73.0 °F
pH: 6.19



Potential Source:
- Washwater





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

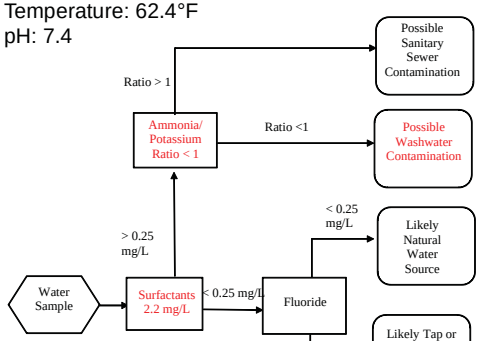
dcr AECOM

Manhole 23515

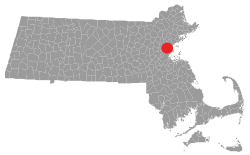
Figure 3-7
Summary for Feature 36092.1
Lynnway, Lynn, MA
Inspection Date: 10/23/2012

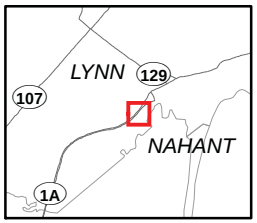
Flow was observed in a series of manholes that make up a trunk line along the Lynnway in Lynn. A trickle flow was observed in two manholes upstream of manhole 36092.1 and the field team observed the flow picking up slightly to a steady trickle in manhole 36092.1. A sample was collected and a cloudy color was observed as well as a wastewater odor. The flow was also observed in a downstream manhole but the odor and cloudy color were more apparent at manhole 36092.1. The field team noted that the area is densely settled with commercial businesses including auto body shops that may be contributing washwater to the system. Field investigation produced inconclusive results and this flow will require a follow up visit.

IDD Test Results:
Days since last rain event: 3 (0.16" on 10/20/12)
Temperature: 62.4°F
pH: 7.4



Potential Source:
-Washwater
-Nearby Laundromat





- Catchbasin
- Manhole
- Inlet
- Outlet
- Other
- Conveyance (Pipe)
- Retention/Detention Feature
- DCR Parkway in Urban Area
- DCR Property in Urban Area
- Town Boundary

Note: Red features represent observed dry weather flow path

dcr AECOM

4.0 Discussion and Conclusions

4.1 Program Year Five

The AECOM field team collected samples from 16 dry weather flows within the 2012 survey area. Field testing and source determination for nine of the observed flows suggest that they were not likely illicit connections. AECOM recommends further investigation of the other seven potentially illicit discharges, including additional follow up visits and extended surveys of the stormwater system in conjunction with adjacent property owners to identify, characterize, and eliminate the potentially illicit flows. In cases where flows originated from or continued onto property not owned by DCR, DCR will need to work with local municipalities or private landowners to address the suspected flows.

Features 467, 12111, 12649, and 23515 were visited within 48 hours of minor rain events. Since the observed flows may have been the result of the precipitation, or the rain may have diluted the chemical signature of an illicit discharge, these features will be revisited in 2013 under dry weather conditions. This follow up visit will confirm the presence or absence of a dry weather flow and provide representative water quality data for the discharge.

Feature 12660 also requires a follow up visit to obtain a representative sample for source determination. This flow was not inspected after a rain event but the discharging pipe was partially submerged in standing water in manhole. The confirmatory investigation should be conducted after an extended period of dry weather when the water level in the manhole is likely to be lower.

The hose that discharged to feature 4498 was from a temporary construction site at a municipal pump station. The operator of the site reported that the flow was groundwater but test results indicated the presence of surfactants and suggested potential washwater contamination. The site should be revisited to determine if the hose has been removed or confirm that the flow is completely groundwater.

Results from testing the flow at feature 36092.1 suggested potential washwater contamination. The area was densely settled and there were many commercial businesses in the vicinity of the dry weather flow including many auto body shops. A direct connection to any of the businesses in the area could not be determined in the field. Based on inconclusive source determination, and the presence of surfactants (detergents) in the sample, AECOM recommends that a follow-up visit be conducted on this system to further delineate the flow.

4.2 Illicit Discharge Detection Program Review

The Illicit Discharge Detection Program developed in 2008 and improved upon over several field seasons, allowed AECOM field crews to efficiently and safely investigate 1,704 features on 23 miles of highly urbanized roadway during Program Year Five. Technicians identified potentially illicit flows at seven out of the 1,704 features, or 0.28%. This occurrence of illicit discharges is similar to the low rates observed in Program Year One (0.19%), Program Year Two (0.63%), Program Year Three (0.43%), and Program Year Four (0.28%) and suggests that the study area, which included the aging and complex stormwater systems around the Revere Beach Parkway, is not more likely to have illicit connections than other portions of DCR's property.

Over the course of this five year program, DCR and AECOM investigated 10,949 individual stormwater features for signs of illicit discharges, or approximately 70% of DCR's mapped stormwater conveyance system in urban areas (Figure 4-1). An estimated 1,500 features that were scheduled to be surveyed as part of Program Year Five will be inspected in 2013 before the commencement of Program Year Six activities. The remaining 20% of the system represents areas that were not accessible during field surveys due to active construction work or traffic safety concerns and may be inspected during subsequent years of the IDD program.

Figure 4-1. Inspection Activities over the Five Year IDD Program

This effort identified 96 dry weather flows, of which nearly half (47) were determined to be non-illicit based on analytical results and field observations. The remaining 49 discharges had chemical or physical characteristics that indicated potentially illicit connections. This is an overall occurrence rate of only 0.45% and suggests that illicit connections to DCR's stormwater system in urban areas are rare.

5.0 References

Boston Water & Sewer Commission, 2004. *A Systematic Methodology for the Identification and Remediation of Illegal Connections.* 2003 Stormwater Management Report, chap 2.1.

Brown. E., D. Caraco, and R. Pitt. 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments.* Center for Watershed Protection, Elliott City, MD. http://www.epa.gov/npdes/pubs/idde_tableofcontents.pdf

Pitt, R. 2004 Methods for Detection of Inappropriate Discharge to Storm Drain Systems. *Internal Project Files.* Tuscaloosa, AL, *in* The Center for Watershed Protection and Pitt, R,, Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and *Technical Assessments:* Cooperative Agreement X82907801-0, U.S. Environmental Protection Agency, variously pages. Available at: http://www.cwp.org.

Datasheet for Trimble GPS Pathfinder ProXH Reciever. Trimble Navigation Limited, Westminster, CO. available at http://www.trimble.com/pathfinderproxh.shtml

Datasheet for Panasonic CF-U1 Toughbook, Panasonic Corporation of America, available at http://catalog2.panasonic.com/ webapp/wcs/stores/servlet/ModelDetail?storeId=11201&catalogId=13051&modelNo=Toughbook-U1

Edwards, P. 2007. HACH DR/890 Colorimeter Procedures Manual, 8th edition, HACH Company, Loveland, CO.

Appendix A

Standard Operating Procedures

DCR Illicit Discharge Detection

Field Investigation

Standard Operating Procedure

Summer 2012

1.0 Site Characterization Notes

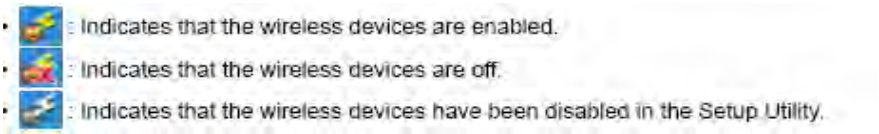
- Review stormwater infrastructure map of area and determine most effective approach for IDD survey.
- Establish safe working area using traffic control contractor and state police detail.
- Open stormwater feature and confirm/update attributes in database for both points and lines. If from plans you will be prompted to collect a GPS location for the feature.
- If change point location, then also need to move line endpoints.
- Deleted features Points: Delete box set to yes, feature should disappear once map is refreshed
- Deleted features Lines: actually delete features by selecting and deleting
- Duplicate points: Choose which one is “more right” and update that feature. Set the duplicate feature to Delete “yes” and in the Notes include the ENSR_ID of the “right” feature we are keeping.
- If a feature does not appear on the GPS unit, create a new feature and enter attributes. A GPS point will automatically be collected for point features.

2.0 GPS Notes

- To open program, either choose Button 1 or click on IDDE shortcut folder and choose the map file.
- Bluetooth trouble shooting: The GPS should automatically connect. Note that it may take a few minutes. Try the following actions:

  On Computer:

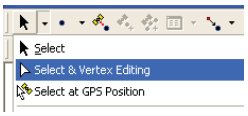
  - Check GPS Preferences:
    - Protocol-- NMEA 0183
    - Port-- COM Port 40
    - Baud Rate-- 4800
  - Check to see if the Wireless Switch is turned on



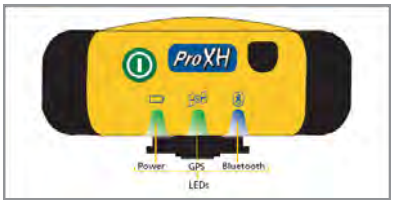
On GPS Reciever:

- Make sure GPS receiver is on and Bluetooth is activated (blue light slowly flashes) If not, press and hold power button for >5 seconds to turn on Bluetooth

- Camera instructions: Choose Button 2 or Start>Programs>AMCap
  - Will save picture to folder with shortcut on desktop
- Must be in editor mode to change point/record data and must click “OK” to save GPS form.



- To edit pipes, choose the vertex editor. Digitize pipes from upstream to downstream.
- The GPS unit must be turned off during lunch and at the end of the day to save battery.
- The GPS unit needs to be charged every night; either in the office or at home (make sure you have the charger).



During operation, the LEDs provide the following status information:

LED	Color	Mode	Status
Power	Green	Solid	Good
	Red	Short flash[1]	Low
	Amber	Short flash	Charging
	Amber	Solid	Fully charged and on external power
GPS	Green	Long flash[2]	Generating positions
	Green	Rapid flash[3]	Too few satellites or poor geometry
Bluetooth	Blue	Waiting heartbeat flash[4]	Activated and waiting
	Blue	Long flash	Activated and connected
	Blue	Off	Bluetooth has not been activated or has been turned off
	Blue	Toggle flash[5]	Bluetooth toggled on and off event

[1] Short flash - one flash ever three seconds
[2] Long flash - one flash per second
[3] Rapid flash - two flashes per second
[4] Waiting heartbeat flash - one flash every three seconds
[5] Toggle flash - five short flashes over two seconds

3.0 Illicit Discharge Detection Steps

1. Examine stormwater feature for dry weather flow.
2. If no flow is present look for signs of potential contamination from intermittent sources (staining, floatables, foam etc.), input observations on the IDD page of the GPS form and photograph the evidence (noting the photo filename in the IDD record).
3. If dry weather flow present don latex gloves and safety glasses and collect a water sample using the remote collection device. Use caution to only sample the dry weather flow and avoid sampling water from the sump.
4. Immediately measure pH and temperature using the YSI pH10. Record the results, along with physical observations of the flow, on the GPS form.
5. Cap, label with feature ENSR ID and store the sample jar. Note on the maps and in the field book the location of any samples taken.
6. Photograph the discharge and note the photo name any additional relevant information on the GPS form. Save the GPS data by clicking “OK”.
7. Continue to survey the remaining features of the system. Trace the dry weather flow upstream until the source is discovered, the drainage comes from off DCR property, or the flow disappears.
8. Collect, label and retain the most upstream water sample of the dry weather flow. The previous downstream flow samples are not required and can be emptied into the stormdrain.
9. Once the most upstream location of the discharge has been identified, edit the feature point which will create another IDD record for that feature, perform chemical analysis on this sample and enter the new temperature and sample analysis results in the GPS form. Complete flow summary form.

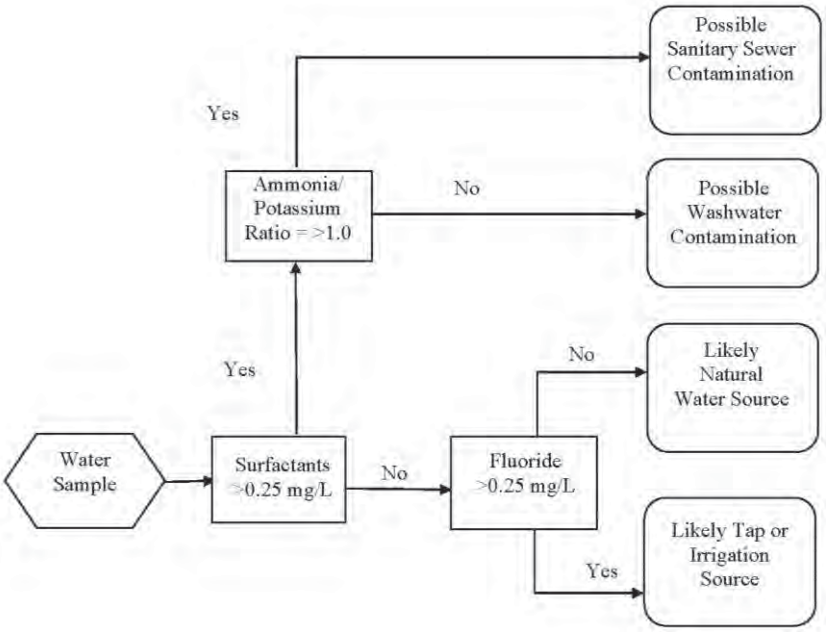
4.0 Calibration of Equipment

- Rachel MacPhee will calibrate the YSI pH10 weekly and record the calibration results in the field notebook.
- The Horiba Compact Ion meter must be calibrated using the 1-point calibration before use (max once per day) and record the calibration results in the field notebook.
- The 2-point calibration for the Horiba Compact Ion meter should be preformed once a month and record the calibration results in the field notebook.

5.0 Chemical Analysis Steps

1. Temperature and pH of the sample is taken a second time preceding the testing.
2. For Ammonia and Fluoride, test using the DR/890 Colorimeter and follow the appropriate HACH procedures included in the field kit. For Potassium, test using the Horiba Compact Ion Meter. For Surfactants use the Detergents detection kit and follow appropriate procedures in the field binder.
3. Press the “Ratio” button the GPS form to calculate the NH_3/K Ratio for comparison with the benchmark.

4. Visually inspect surroundings and note the land use, buildings and utilities in the area. Also note any non-stormwater surface water; landscaping, irrigation, streams, etc.
5. If possible, determine the likely source of the discharge using the chemical results, physical conditions, visual observations and the information on Tables 1 and 2.
6. Notify Aaron Hopkins or Kaitlin Sylvester about the location, characteristics and likely source of any illicit discharges encountered during the survey.



6.0 Contaminated Equipment and Disposal

- All samples and liquids exposed to testing chemicals must be stored in an appropriate waste holding container for proper disposal and ***not*** discharged back into the stormdrain.
- Any remaining sample which has not been tested can be placed back into the stormdrain.
- Contaminated testing supplies should be rinsed once with tap water and separated from the remaining equipment. Place the rinse water in the waste container for proper disposal.
- Residuals from the Surfactants analysis must be placed in a Ziploc bag, and secondly contained in a plastic Nalgene container labeled “surfactants waste”. This waste will be transferred in Westford to a holding container and contained in a chemical waste cabinet to later be disposed of appropriately.
- Supplies which need to be used multiple times per field day must be thoroughly cleaned. Wash twice with tap water then a third time using deionized water.
- At the end of the day, properly dispose all chemicals down a sink drain with running water to dilute. If appropriate, the waste container can be emptied directly into a sewer main in the field.

- Before reuse, all used equipment should be thoroughly washed with Liquinox detergent in the office, rinsed three times and allowed to air dry.

Appendix B

Illicit Flow Form

Potential Illicit Flow Details

Date/Time: _____ Sampler initials: _____ Feature # (AECOM ID): _____

Field Logbook #: _____

Responsible person for follow-up documentation: _____

Location: _____

Potential Source according to flow chart (see back page):

☐ Sanitary Sewer Contamination ☐ Natural Water

☐ Washwater Contamination ☐ Tap or Irrigation

☐ Re-test same sample for any parameters on border of values on flow chart. Document both results.

☐ Sample any potential source discharge if possible and if unclear if actual source (ie. water bubbler overflowing)

☐ Add a note in the upstream structure when observered. Even if no flow is seen upstream, please note. Make note to future crews if not able to get to structure that day

☐ Make notes on surroundings (building types, landscaping with irrigation, etc)

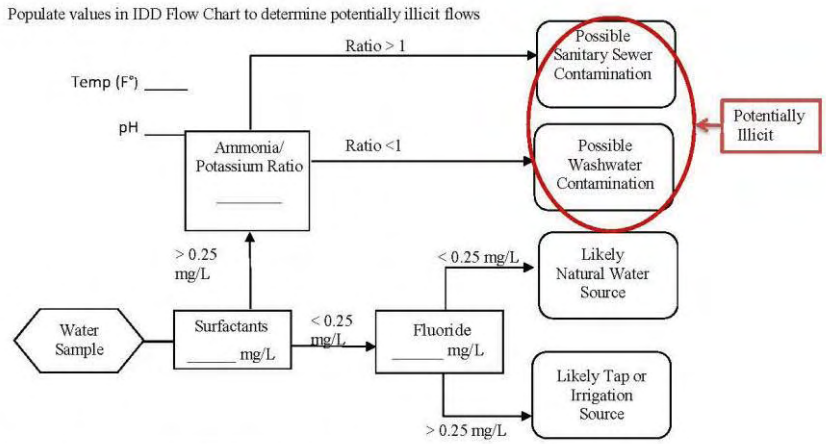
☐ Photograph surroundings and flow

☐ Call office and discuss observations.

Detailed Site Drawing

Be sure to: label the features where flow was observed, label other mapped features, label pipes according to flow direction, potential sources, and include other pertinent information. ***Document entire flow path (source to outfall). Note where flow begins and ends.***

REMEMBER TO TAKE A PHOTO!



Use this space for additional notes and/or site sketches

AECOM
250 Apollo Drive
Chelmsford, MA 01824

978.905.2100 tel
978.905.2101 fax

Memorandum

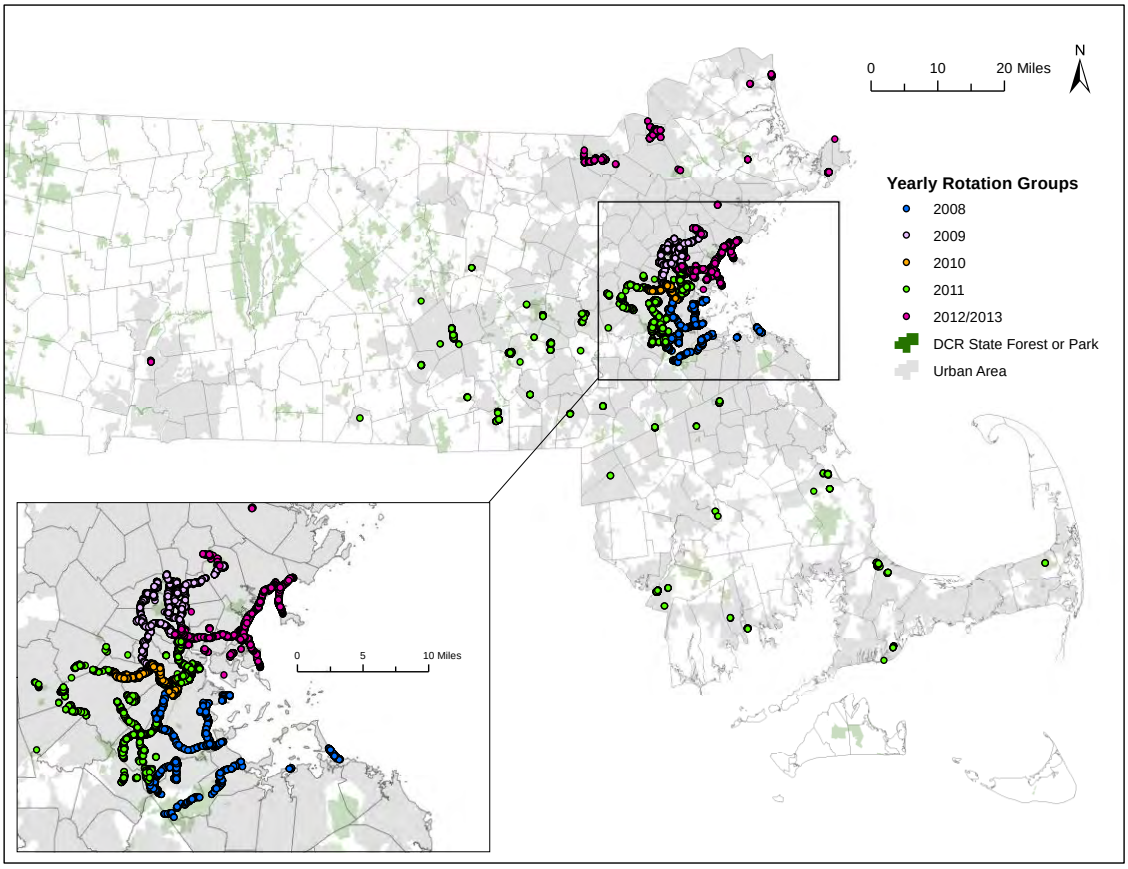
To	Mr. Robert Lowell – MA Department of Conservation and Recreation	Page	1
CC			
Subject	2013 Illicit Discharge Report Addendum		
From	AECOM Environment		
Date	December 16, 2013		

This memorandum provides an addendum to the Illicit Discharge Detection Report, 2012 (IDD Report, 2012) submitted to the Massachusetts Department of Conservation and Recreation (DCR) on May 3, 2013. During 2013 AECOM completed the rotation initiated in Program Year 5 (2012), results from the 2013 portion of the Program Year 5 surveys are outlined herein.

Illicit Discharge Detection Program Year 5 Addendum

AECOM Environment (AECOM) completed the Program Year 5 rotation for DCR in 2013 in support of the Illicit Discharge Detection (IDD) program. The previously established 5 year rotation (Figure 1) was developed in support of DCR's Minimum Control Measure No. 3 of NPDES Small MS4 General Permit. The 5 year rotation ensures that all of DCR's urban stormwater features will be visited at least once every 5 years.

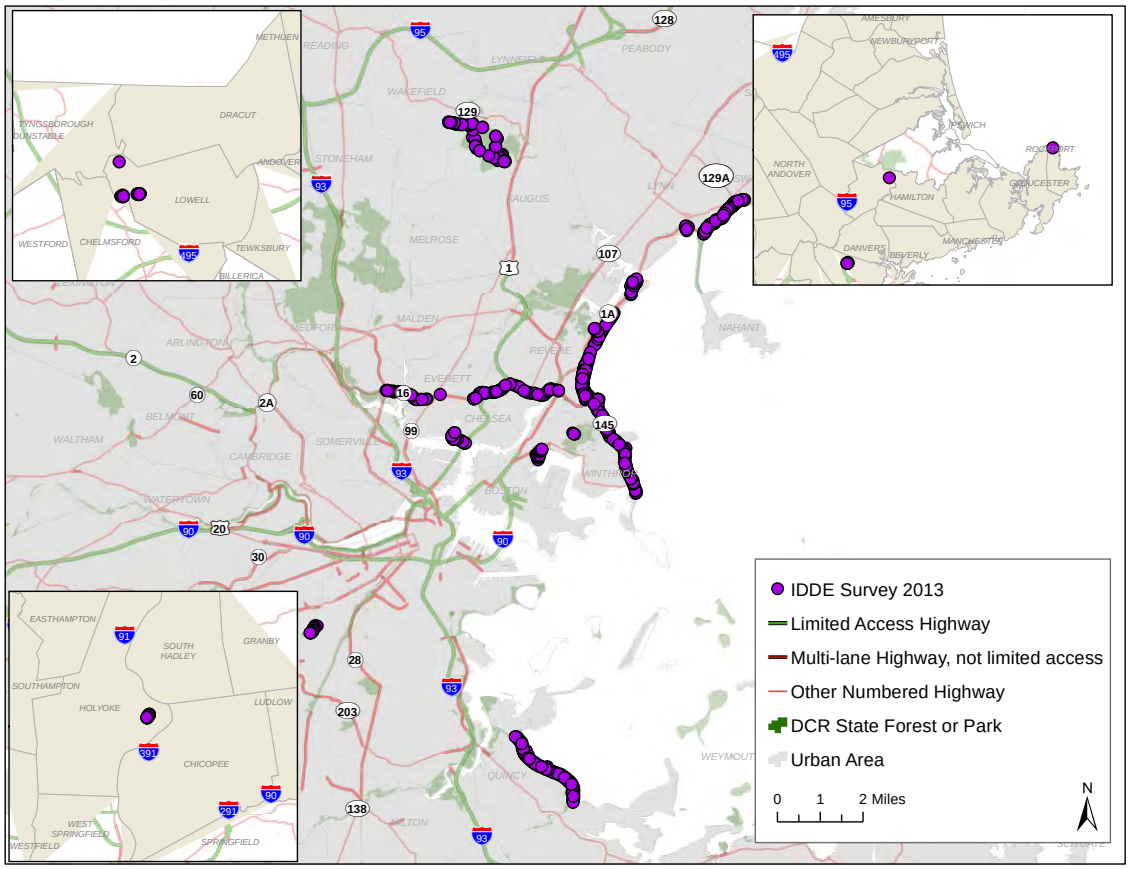
Figure 1 – Yearly Rotation Groups



The abbreviated 2013 field season commenced on April 10, 2013 and continued through the late summer. AECOM performed the 2013 illicit discharge detection investigations according to the methods outlined in the IDD Report, 2012.

Due to the complexity of the roadways assigned to the Program Year 5 rotation the survey area was split into 2 field seasons, 2012 and 2013. During the 2013 field season AECOM completed all areas remaining from 2012. The majority of the survey areas completed in 2013 were located along Revere Beach Parkway, Revere Beach Blvd, Lynn Shore Drive, Winthrop Parkway, Winthrop Shore Drive, and a subset of features within DCR parks in Ashland, Boston, Chelsea, Holyoke, Lowell, Lawrence, Natick, Rockport, Saugus, Topsfield, and Weston. The 2013 survey also included Quincy Shore Drive which has been under construction in previous years (Figure 2).

Figure 2 – Program Year 5 (2013) Survey Area



During the 2013 field season, AECOM field crews investigated 1,316 stormwater features for signs of illicit connections. The survey covered 17 miles of DCR roadway within 24 towns. Table 1 shows the breakdown of stormwater features by type. The stormwater systems were primarily comprised of catch basins, manholes, and outlets but also included other features such as yard drains, drywells, and oil/grit separators.

Table 1 – Summary of Features Investigated in Program Year Five

Feature	Total
Catch basin	746
Manhole	330
Outlet	177
Inlet	32
Other	31
Total	1,316

The AECOM field crews collected stormwater samples from 6 features with dry weather flow and field tested the discharges for a series of analytes according to the IDD protocol, described in the IDD Report, 2012. Of the six samples collected none were considered to be illicit based on field testing results and source determination.

With the completion of Program Year 5 AECOM safely and efficiently completed DCR's 5 year illicit discharge rotation, and investigated a total of 12,985 stormwater features along 220 miles of roadway. The occurrence of illicit discharges was consistently low; Table 2 outlines the low rates seen throughout each program year and the overall rate of occurrence throughout the 5 year program.

Table 2 – Illicit Discharge Occurrence by Program Year

Program Year	Illicit Discharge Occurrence
1	0.19%
2	0.63%
3	0.43%
4	0.28%
5	0.23%
Program Total	0.34%

The IDD protocol developed for this program allowed for GPS data to be collected for the majority of DCR's urban stormwater features throughout Massachusetts. This effort lead to the creation of a comprehensive GIS database with field verified mapping and inspection information for nearly 13,000 stormwater structures, 53 miles of stormwater piping, and 47 detention and retention features. DCR's IDD program is flexible and can be adapted in response to NPDES permit changes to ensure DCR's compliance with future program requirements.

Sincerely,

Kaitlin Sylvester
Kaitlin.Sylvester@aecom.com