Monitoring of stormwater system outfalls in Cabot, VT

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Introduction

Stormwater drainage systems are designed to collect and transport rainwater and snowmelt away from developed areas such as roads, parking lots, and buildings. Water flowing through such drainage systems empties into streams and rivers at outfall pipes at the end of storm system lines as shown in Figure 1 below.

Figure 1. Typical stormwater system outfall after a rainstorm.

During dry periods, the stormwater system should also be dry unless it also conveys diverted streams, groundwater, or an allowable, temporary discharge resulting from such activities as water line flushing, individual car washing, lawn/landscape irrigation, pumping of water out of crawl spaces, air conditioner condensation, draining of de-chlorinated swimming pool water, and firefighting.

Sometimes stormwater systems carry illicit types of discharge, especially in municipalities with older sanitary sewers and stormwater systems. These problematic discharges can result from direct or indirect connections with the stormwater lines. Examples of direct connections include wastewater piping or shop drains intentionally or unintentionally connected to the stormwater system and cross-connections between the sanitary sewer line and the stormwater system. Indirect discharges can occur when sanitary sewer lines leak into stormwater lines, or when failed septic systems infiltrate into the stormwater system.

Illicit discharge into streams and rivers reduces their water quality. Water quality monitoring efforts by The Friends of the Winooski River in partnership with the Vermont Department of Environmental Conservation have documented elevated levels of phosphorous and the bacterial species *Escherichia coli* (*E. coli*) in the Winooski River, particularly where it flows through settled areas. This species is found in the lower gut of mammals and is used as an indicator for fecal matter and the potential presence of disease-causing organisms. Sources of *E. coli* include untreated sewage, manure, pet waste, and wild animal waste. Illicit discharges into stormwater system outfalls can therefore be the source of *E coli* found in waterways. In addition, the catch basins, pipes, and outfalls of closed-drainage stormwater systems are designed for conveyance—not for pollutant removal. Once pathogens, nutrients, sediment, hydrocarbons, and other pollutants reach the stormwater system, they are efficiently conveyed to the Winooski River.

Detecting and eliminating cross-connections and other illicit discharges is thus an effective strategy for improving water quality in the river. Although sediment transport in closed drainage systems is not usually caused by illicit discharges, the sediment loading and erosion associated with outfalls can substantially impact water quality by affecting turbidity and phosphorus levels. Chlorides from road salts and hydrocarbons from gasoline or oil leaks and spills are other examples of pollutants that can be transported to waterways via the stormwater system.

The Vermont Department of Environmental Conservation (VT DEC) recently mapped the stormwater systems, both town-owned and private, in the towns of Plainfield, Marshfield and Cabot. In order to detect any non-stormwater discharges and locate potential sources of *E. coli* and other pollutants, Friends of the Winooski River staff visited and assessed the mapped outfall locations in these three towns during the summer of 2013. This effort was funded under the State of Vermont Ecosystem Restoration Program as part of an Integrated Field Assessment (IFA) to collect data on a variety of water resource and water quality issues. The goal of the IFA is to provide the Towns of Cabot, Marshfield and Plainfield with specific recommendations to better protect water resources and town infrastructure. This report describes the results of the assessments of the public outfalls in the town of Cabot.

Methods

Since the goal of this study was to detect non-stormwater discharges, outfall assessments were conducted on dry days when there had been no rain for at least 24 hours. Using the VT DEC maps of Cabot outfalls, outfall pipes were located and, when possible, an assessment made. Data recorded for each outfall included notes concerning any obvious pollutant discharges (oily substances, sewage smells, discolored liquids, foams, sediment, etc.), the type and condition of pipe, and erosion at the outfall site. The field observation form used is shown in Appendix A. If an outfall was flowing or dripping, the flow was observed for color, odor, turbidity, and floatable matter and an approximately 250 mL sample was taken. This sample was then assessed for four water quality parameters: chlorine, ammonia, detergents, and conductivity. These parameters were measured because they can indicate the presence or absence of specific types of discharge such as treated water or wastewater. Chlorine tests were performed using Hach DPD total chlorine reagent foil pillows for 10mL samples and a Hach DR 890 colorimeter. Ammonia levels were measured using Hach AquaCheck water quality test strips, and detergent levels were found using a Chemetrics detergent test kit. Conductivity was measured using an OakTon PC 300 multimeter. All tests were performed in the field within 1 hour after the samples were taken with the exception of conductivity, which was measured within 48 hours.

For flowing or dripping outfalls, an optical brightener detection pad ("OB pad") was affixed to the inside bottom of the outfall and left in place for 6 days. These pads consist of an untreated cotton pad placed inside a mesh bag. Optical brighteners are present in most laundry soaps and bind to the cotton in these pads. After the bags were retrieved, they were rinsed, dried, and placed under a long wave UV ("black") light. When viewed under UV-light, optical brighteners fluoresce and serve as an indicator of possible domestic wastewater contamination. In one case where a wet outfall was almost completely obstructed by sediment, an OB pad was instead lowered into the catch basin (street drain) immediately up the stormwater system line from the outfall.

The data collected for all the outfalls and catch basins were categorized to produce a comprehensive table of information pertaining to each outfall (see Appendix B). The naming

convention for the samples was based on the town where the assessments were done (using "C" for Cabot), the type of structure (outfall, catch basin, or culvert), and a sequential number system counting by tens. Hence, C-O-010 is the first structure tested in Cabot and is an outfall, and C-O-070 is the seventh structure tested. Structures with suspected illicit discharges were flagged for follow-up investigation.

Exceptions to Screening Process

There were a few exceptions to this process of our evaluation of outfalls in Cabot. One outfall (C-O-050) at the intersection of Danville Hill Road and Main Street was being replaced during the time of the assessments and was not inspected, and three mapped outfalls (C-O-080, C-O-170, and C-O-190) could not be found. Outfall C-O-180, while flowing, was too damaged to get a clean sample from, and the flow from outfall C-O-010 could not be sampled since the outfall was partially submerged in water and could therefore have been contaminated by backflow.

Results

Overview of Results

Of the 16 mapped public outfalls in Cabot (shown on the map in Appendix C), 12 were found and assessed. Three outfalls could not be located, and one was under construction at the time of our assessments. A table summarizing all the data associated with the outfall structures is included in Appendix B. Three private outfalls (C-O-120, -130, and -140) are not included in this report.

While five of these outfalls were flowing despite dry weather, only three were tested for water quality. Two (C-O-010 and C-O-190) could not be sampled because a clean water sample was unobtainable (see detailed results, Appendix B, and results for specific outfalls, next section). The three tested outfalls were found to have acceptable levels of ammonia, detergents, chlorine, and conductivity except for C-O-040, which tested high for conductivity (see detailed results in Appendix B and the results for specific outfalls below). The discharge from this outfall also had a strong, musty/organic chemical odor and foam was observed in the water below the outfall pipe. Optical brightener pads left in all three sampled outfalls tested negative for the presence of the optical brighteners found in laundry detergent.

The assessments found one damaged public outfall. The bottom of outfall C-O-190, located across Main Street from Cabot Creamery, was severely corroded. This outfall was flowing at the time of the assessments, but the discharge did not make it to the end and instead flowed out below the pipe. Outfall C-O-170 may also have been damaged to the extent that it was unrecognizable. We were unable to locate this outfall, but did find sections of rusted corrugated metal in the riprap on the slope in the vicinity of its mapped location.

Four outfalls appeared to be contributing sediment to the Winooski River, either by causing erosion on slopes below the outfall, or by transporting sediment from other areas up the stormwater system, or both. Outfalls C-O-010, C-O-060, C-O-070, C-O-150 had varying levels of erosion below the outfall pipes. C-O-020 and C-O-030, both near the Post Office, were partially obstructed with sediment that appeared to originate upstream of the outfall, but since these outfalls empty into a swale at a distance from the Winooski, it is unclear if any of the sediment they are transporting makes it to the river. Erosion was also noted on the steep slope where C-O-170 (not located) was mapped.

Results for Specific Outfalls and Catch Basins

1. <u>Outfalls that were damaged</u>

One public outfall was found to be damaged. Another may be crushed by and buried under riprap armoring on the steep bank where it is mapped, but could not be unambiguously located (see section 5 below).

Cabot outfall C-O-190 (Main Street across from Cabot Creamery)

Location: On the northwest side of Main Street near Cabot Creamery Building B.

Description: Large corrugated metal pipe 36 inches in diameter. Drains Cabot Creamery's western parking lot and a section of Route 215.

Damage: This corrugated metal outfall pipe is severely corroded along the bottom a few feet from the end of the pipe. Flow to this outfall is running through the holes left by the corrosion and goes underneath rather than to the end the pipe. No water sample could be obtained since the flow seeps directly onto the ground.

2. <u>Outfalls that were partially or completely obstructed with sediment</u>

Two outfalls were partially obstructed with sediment.

Cabot outfall C-O-020 (Route 215 at the Post Office)

Location: Northwest side of Route 215 (Main St), just south of the Post Office parking lot and north of C-O-030.

Description: Corrugated black plastic pipe 15 inches in diameter. The northernmost of two outfalls at this location. Empties into a swale at a distance from the river.

Obstruction: The outfall pipe is approximately ¼ full of sediment. Drains Route 215 and the residential driveway across Route 215 from the Post Office. The 2nd catch basin (situated at the bottom of this driveway) up the stormwater system line

from this outfall was also partially full of sediment.

Cabot outfall C-O-030 (Main Street at the Post Office)

Location: Northwest side of Route 215, just south of the Post Office parking lot, and south of C-O-020.

Description: 12-inch concrete outfall that drains a short line originating in a drop inlet on the other side of Route 215. Empties into a swale at a distance from the river.

Obstruction: Outfall is about half-full of sediment.

3. <u>Outfalls that appear to be causing erosion and contributing sediment to nearby streams</u>

Four outfalls appear to be causing erosion. Sediment from eroded banks affects water quality by increasing turbidity and the levels of nutrients such as phosphorous.

Cabot outfall C-O-010 (Southeast side of Route 215 north of Cabot Village)

Location: Southeast side of Route 215 in the field across from Larry's Garage.

Description: 15-inch smooth plastic pipe that drains the driveway in front of Larry's Garage and a section of Route 215. Submerged in outflowing water; could not be sampled for water quality.

Erosion description: Incision through the field below the outfall.

Cabot outfall C-O-060 (Whittier Hill Road and Main Street)

Location: Outfall on the northwest side of Main Street northwest of its intersection with Whittier Hill Road.

Description: 24-inch corrugated metal. Drains Danville Hill Road and Main Street.

Erosion description: Some scouring below this outfall and some sediment deposit below that.

Cabot outfall C-O-070 (Whittier Hill Road and Main Street)

Location: The northwest side of Main Street west of its intersection with Whittier Hill Road.

Description: 30-inch concrete pipe that drains Glinka Road, the back side of the senior center, and Main Street.

Erosion description: Small incision below outfall plus some scouring.

Cabot outfall C-O-150 (Main Street near Elm Street)

Location: The northwest side of Main Street west of the Elm Street bridge.

Description: Corrugated black plastic outfall 16 inches in diameter. Drains Main Street and the neighborhood across Main Street.

Erosion description: Substantial gully on the steep slope below the outfall.

4. <u>Outfalls and other structures flagged for other reasons</u>:

Cabot outfall C-O-040 (Main Street)

Location: Behind the red house across from Cabot Commons.

Reason for flag: Discharge from this steadily flowing outfall had a strong musty/faintly organic chemical odor and exhibited iron staining, possibly from iron-reducing bacteria. Conductivity of the sample taken from this outfall was higher than normal at 1065 micro-Siemens per centimeter (µS/cm). Foam was observed in the river below. OB and other water quality tests were normal. This outfall is at the end of a long, complicated line that drains the Cabot school grounds.

Foam in the water below outfall C-O-040

Cabot outfall C-O-050 (Main Street north of Whittier Hill Road)
Location: On the northwest side of Main Street north of the crosswalk near the hardware store.

Description: Large outfall that drains the brook along Glinka Road.

Reason for flag: This outfall could not be inspected because it was being replaced at the time of the assessments. The line that leads to this outfall crosses the line that drains Danville Hill Road and the Commons, and should be inspected when construction in complete.

Cabot outfall C-O-070 (Whittier Hill Road and Main Street)
Location: The northwest side of Main Street west of its intersection with Whittier Hill Road.

Reason for flag: Although the colorimeter reading for the water sample from this outfall was zero, the chlorine test looked slightly pink after adding the reagent.

Unmapped pipe 1
Location: Near water level on the slope between C-O-060 and C-O-070.

Reason for flag: Small PVC pipe is not on the DEC map.

Unmapped pipe 2
Location: Low on the slope where C-O-170 was mapped (across from Cabot Creamery loading dock).

Reason for flag: Dripping small metal pipe is not on the DEC map.

5. Outfalls that could not be located

Three outfalls mapped by the DEC could not be found.

Cabot outfall C-O-080 (Main and Elm Streets)
Location: On the northwest side of Main Street northeast of the intersection with Elm on the slope below the gravel parking lot, very close to the house.

Comments: There was a lot of discarded brush and debris on this slope that may have obscured this outfall. The catch basin up the line (on the other side of Main Street) could not be located either, so it may be that the entire line has been removed.

Cabot outfall C-O-170 (Main Street across from Cabot Creamery)
Location: On the northwest side of Main Street across from Cabot Creamery loading dock.

Comments: This outfall, which should be a large pipe that drains a large section of the Cabot Creamery and the hill behind (which is very wet), could not be located. There is

slipping riprap and erosion on the steep slope where this outfall was mapped that may have slid down and crushed or obscured this outfall. Some pieces of corrugated metal were found among the riprap that may be the remnants of a crushed, damaged outfall. Flowing water was observed amidst the riprap. A small footing drain (flowing) was also seen at this location (see Unmapped pipe 2, above.) An OB pad set in the catch basin (flowing) immediately above this outfall tested negative for optical brighteners.

Cabot outfall C-O-180 (Main Street across from Cabot Creamery)

Location: On the northwest side of Main Street directly across from the Cabot Creamery processing plant.

Comments: This outfall is connected to only one catch basin on a very short stormwater system line. The bank where it should be located has been armored with a good deal of loose, small riprap that is sliding down the very steep slope. This riprap, or the thick vegetation on this slope, may have obscured this outfall.

Summary and Recommendations

Outfall monitoring in the town of Cabot by the Friends of the Winooski River during the summer and fall of 2013 resulted in these major findings (summarized in Table 1 and shown in detail in Appendix B):

Five of the public outfall pipes were flowing despite dry weather. Water quality tests of two of these outfalls indicate that the levels of ammonia, detergents, chlorine and conductivity were either negative or within an acceptable range. A third outfall, C-O-040, had a high conductivity reading, high flow, a musty/petroleum-like odor, foam below it, and orange deposits. The presence of orange deposits, perhaps from iron-reducing bacteria, may be consistent with a high concentration of iron ions in the discharge from this outfall, which could help explain the high conductivity reading. While the other water quality tests of this outfall were normal, we recommend continued monitoring of this outfall. A brief inspection of the catch basins up the line from this outfall did not reveal anything abnormal, but did indicate there is a good deal of ground water entering this outfall via the footing drains and swales around the school buildings. OB pads left in the three sampled outfalls and a few of the catch basins up the line from C-O-040 tested negative for the presence of optical brighteners, indicating these stormwater lines appear to be free of laundry detergents/sewage. Two unmapped pipes were observed on the Winooski riverbank, at least one of which was flowing. No water quality tests were made on these pipes, so it is unknown whether these pipes carry illicit discharge.

Most of the inspected public outfalls in Cabot appeared to be in good condition. One, C-O-190, on the riverbank across Main Street from the Creamery, however, was severely corroded on the bottom, allowing water to flow through and below it before reaching the end of the pipe. Two outfalls near the Post Office were also partially obstructed with sediment. Cleaning out these two lines, however, will probably only serve to temporarily remove the obstruction. A more permanent solution would involve reducing stormwater flow (see below), erosion above these outfalls, and the amount of road sand in the runoff from Route 215.

Four outfalls appeared to be causing erosion, particularly outfall C-O-150. This outfall, located directly above the Winooski River, appeared to be associated with the formation of a gully in the riverbank below it. Sediment from eroded banks carries phosphorous into streams and rivers, which in turn transport it to lakes and ponds. Elevated phosphorous reduces water quality of streams, rivers, ponds, and lakes and can cause algal blooms that further reduce water quality. Both sediment transport and erosion can be addressed by stemming the amount and velocity of stormwater running through a stormwater line. Stormwater flow can be reduced by encouraging property owners and the town to reduce paved and bare areas, convert lawn to perennials or woody plants, install rain gardens, disconnect gutters and footing drains from the stormwater system, and redirect gutters to vegetated areas and away from pavement.

Four of the town's 16 mapped public outfalls were not assessed. Three (two across Main Street from Cabot Creamery, and one near the Main Street/Elm Street intersection) could not be located and may be covered with brush, debris, or riprap. The third, between the hardware store building and Cabot Village Store, was being replaced during the assessments and could not be inspected. These locations should be revisited, preferably before leaf-out so vegetation does not obscure the outfalls.

Table 1. Summary of problem outfalls and catch basins:

Structure ID	Location	Problem	Follow-up recommended
C-O-010	Southeast of Main Street across from Larry's Garage.	Flow from this outfall appears to be causing an incision to form below.	Take steps to reduce flow from the stormwater system up the line from this outfall.
C-O-020 and C-O-030	Northwest of Main Street just south of the Post Office.	Outfalls are partially obstructed with sediment.	Clean out the outfalls and the lines if flow becomes a problem. Encourage property owners on the opposite side of Main Street to reduce flow into the stormwater system.
C-O-040	Northwest side of Main Street across from the commons.	High steady flow. Discharge has strong odor, high conductivity, orange deposits. Foam below outfall.	Encourage the school and other properties up the line to capture some of the ground water in rain gardens or the like. Repeat water quality tests occasionally.
C-O-050	Large outfall near crosswalk in front of general store.	Not assessed since it was being replaced Summer 2013.	Revisit this outfall for a full assessment now that construction has been completed.
C-O-060	Northwest side of Main Street northwest of the Whittier Hill Road intersection.	Scouring under the outfall may be contributing sediment to the river.	Encourage property owners on the opposite side of Main Street to reduce flow into the stormwater system. Install a water-dissipating apron below the outfall.
C-O-070	Northwest side of Main Street west of the Whittier Hill Road intersection.	Erosion beneath the outfall may be contributing sediment to the river. Chlorine test was slightly pink despite colorimeter reading of 0.	Encourage property owners on the opposite side of Main Street to reduce flow into the stormwater system. Install a water-dissipating apron below the outfall. Reinforce the bank below if necessary. Retest for water quality.
C-O-080	Northwest side of Main Street northeast of Elm Street	Could not be located. May be under debris piled on the slope or may have been removed.	Remove pile of debris, see if outfall still exists, and assess if so.
C-O-150	Northwest side of Main Street west of its intersection with Elm St.	A significant gully has formed beneath this outfall.	Encourage property owners on the opposite side of Main Street to reduce flow into the stormwater system. Reinforce the bank below to stem erosion.
C-O-170 and C-O-180	Main Street across from Cabot Creamery	Could not be located. May be crushed or covered by riprap.	Revisit in Spring to find these outfalls (esp C-O-170, which should be large and flowing), replace or repair if damaged, and do water quality assessment.
C-O-190	Northwest side of Main Street near Cabot Creamery Building "B".	Metal outfall pipe is severely corroded on the bottom. Flow through the ground below this pipe.	Replace this outfall pipe and test the flow for water quality.

Structure ID	Location	Problem	Follow-up recommended
Unmapped pipes (2)	**One on the slope between C-O-060 and C-O-070 approximately behind 3053 Main Street, and one low on the slope across from the Cabot Creamery loading dock**	**Not on the DEC maps.**	**Revisit these pipes to test for water quality.**

General recommendations:

- **Revisit locations of the two outfalls across from Cabot Creamery in the spring before leaf-out to find missing outfalls C-O-170 and C-O-180. Repair or replace if necessary, and test water quality if flowing.**
- **Remove brush pile on the slope between the Elm Street Bridge and the first house upstream. Try to find the outfall (C-O-080) mapped to this location and assess.**
- **Assess C-O-050 (between the hardware and Cabot Village stores) now that it has been replaced.**
- **Install water-dissipating aprons or reinforce banks below the outfalls that appear to be causing erosion.**
- **Remove the sediment partially obstructing outfalls C-O-020 and C-O-030 (and the stormwater lines above them) near the post office if flow through these outfalls seems to be slowed or backs up.**
- **Revisit the two unmapped pipes (across from Cabot Creamery near where C-O-170 is mapped and behind 3053 Main Street between C-O-060 and C-O-070) and, if flowing, test for water quality.**
- **Revisit C-O-040 for further water quality monitoring.**
- **Encourage community and property owner efforts to reduce stormwater flow, especially in areas drained by outfalls with erosion and sediment problems. Methods for reducing stormwater runoff involve increasing stormwater infiltration on individual properties. Examples of strategies to enhance infiltration are reducing bare and paved areas, converting lawn to perennial gardens or woody shrubs and trees, redirecting gutters away from bare or paved areas and toward vegetation, and disconnecting gutters from the stormwater system. Erosion can also be reduced by retrofitting outfalls.**
- **Discourage community members and road crews from discarding brush and debris on the slopes above the river.**

Appendices

Appendix A. Outfall monitoring field observation form

IDDE ID:				**DEC ID Cross Ref.:**	
Date:	**Time:**			**Inspector:**	
Structure type:				**Inner diameter (outfall only)**	**in.**
Material (outfall only):	**corrugated metal**	**concrete**	**corrugated black plastic**	**smooth plastic**	**other (describe):**
Flow depth (outfall only)::	**dry**	**Wet (no flow)**	**dripping**	**Flowing depth**	**(in.)**
Pipe position (outfall only):	**Free flow**	**partially submerged**	**submerged**	**If partially submerged, surcharged? YES NO**	
Erosion at outfall	**none**	**If present, describe:**			
Discharge characteristics (observations on color, turbidity, and odor of flow):					
Floatables:	**none**	**sheen**	**sewage**	**suds**	**other**
Deposits or staining:	**none**	**sediment**	**oily**	**iron staining**	**other**
Damage to structure:	**none**	**cracking, spalling**	**corrosion**	**crushed**	**other**
Obstructions:	**none**	**partially obstructed**		**fully obstructed**	**other**
OB pad set? YES NO			**Date OB pad retrieved**		
Ammonia mg/L			**Specific conductance µS/cm**		
Total chlorine mg/L			**Free chlorine mg/L**		
Anionic surfactants mg/L					
Sample collected for *E. coli* analysis: YES NO NA			**Time:**		
Sample collected for N analysis: YES NO NA			**Time:**		
Flow measurement (if *E. coli* and/or nutrients sample collected):					
Comments:					

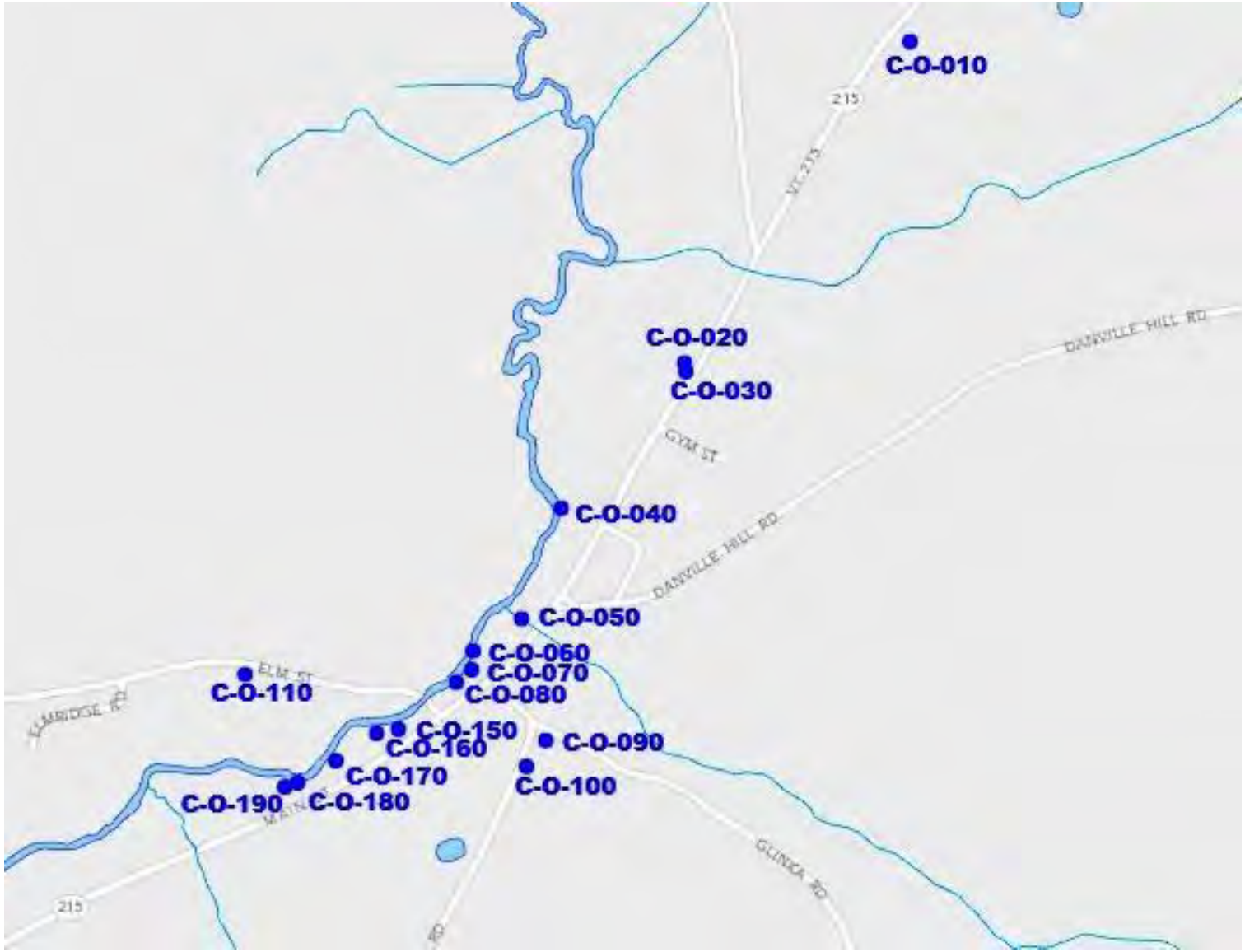
Appendix B. Table of results

Structure ID	Date assessed	ID1	ID2	Pipe diam. (in.)	Pipe material	Dry, Wet, Dripping, or Flowing?	Flow depth (in.)	Pipe position	Erosion	Erosion description	Discharge characteristics	Floatables
C-O-010	9/19/13	AD	SW	15	smooth plastic	flowing	0.5	partially submerged	Y	small incision	clear, no smell	none
C-O-020	9/19/13	AD	SW	15	corrugated black plastic	wet	0	free flow	N	na	na	na
C-O-030	9/19/13	AD	SW	12	concrete	wet	1 (standing)	partially submerged	N	na	clear, no smell	none
C-O-040	9/19/13	AD	SW	24-32	corrugated black plastic	flowing	1	free flow	N	na	clear, strong odor	suds
C-O-050	9/19/13	AD	SW									
C-O-060	9/19/13	AD	SW	24	corrugated metal	wet	0	free flow	Y	some scouring	na	na
C-O-070	9/19/13	AD	SW	30	concrete	flowing	0.5	free flow	Y	some plus scour hole	clear with some algae	none
C-O-080	9/19/13	AD	SW									
C-O-090	9/19/13	AD	SW	6	smooth green plastic	dry	na	free flow	N	na	na	na
C-O-100	9/19/13	AD	SW	6	smooth green plastic	wet	0	free flow	N	na	na	na
C-O-110	9/19/13	AD	SW	15	corrugated black plastic	flowing	0.5	free flow	Y	some incision	clear, oily sheen	none
C-O-150	10/2/13	AS	SW	16	corrugated black plastic	dry	na	free flow	Y	significant gully	na	na
C-O-160	10/2/13	AS	SW	6	smooth green plastic	dry	na	free flow	N	na	na	na
C-O-170	10/2/13	AS	SW						Y			
C-O-180	10/2/13	AS	SW									
C-O-190	10/2/13	AS	SW	36	corrugated metal	flowing	na	free flow	N	na	na	na

Table of results, continued

Structure ID	Deposits/ Stains	Damage	Obstructions	OB pad set?	Date OB pad retrieved	OB Result	Ammonia (mg/L)	Sp. conductance (µs/cm)	Total Chlorine (mg/L)	MBAS detergents (mg/L)	Comments
C-O-010	sediment	none	partially obstructed	N	na	na	na	na	na	na	Across from Larry's Garage, slow flow, standing water in 1st upstream cb, 2nd upstream cb dry
C-O-020	sediment	none	partially obstructed	N	na	na	na	na	na	na	Post Office parking. Outfall is 1/4 full of sediment, 2nd cb upstream is partially obstructed with sediment.
C-O-030	sediment	none	partially obstructed	N	na	na	na	na	na	na	Post Office parking. Outfall is 1/2 full of sediment, drop outlet above is damp, wet, maybe flowing
C-O-040	iron reducing bacteria?	none	none	Y	9/25/13	negative	0	1065	0	0.125ppm	High flow. Long complicated line that includes school. CB's 1, 2, 3 & 4 up line are all running, 3rd has several inlet pipes connected (not on map), 4th cb has algae and smell.
C-O-050				N							This culvert was being replaced on 9/19 & 10/2
C-O-060	iron reducing bacteria?	none	none	N	na	na	na	na	na	na	Some sediment is deposited below
C-O-070	algae	none	none	Y	9/25/13	negative	0	363	0	0	Drains Glinka Rd. Chlorine test looked slightly pink although colorimeter reading was 0.
C-O-080				N							Couldn't find this or cb upstream. OF might be covered w/debris; cb may be covered with stone wall. Footing drain in wall where cb used to be?
C-O-090	none	none	partially obstructed w/ turf	N	na	na	na	na	na	na	Drains perimeter drain around senior housing bldg
C-O-100	none	none	partially obstructed w/ turf	N	na	na	na	na	na	na	Drains perimeter drain around senior housing bldg
C-O-110	iron reducing bacteria	none	none	Y	9/25/13	negative	0.25	306	0.07	0	Elm St. Flows into wetland area. Oily sheen on surface of water below OF
C-O-150	none	none	none	N	na	na	na	na	na	na	Halfway up the hill.
C-O-160	none	none	none	N	na	na	na	na	na	na	At top of the hill, near corner of bldg.
C-O-170		crushed?		N							Could not be found. Flowing water and crushed, rusted corrugated metal amidst the sliding riprap. This outfall should be large and drain Cabot Creamery property. There's a very small (dripping) metal pipe at the bottom of the hill. CB above OB neg
C-O-180				N							Could not be found. Return when vegetation is less dense. CB above tested neg for OB 10/25/13
C-O-190	none	corrosion	none	N	na	na	na	na	na	na	Flow below rusted-out outfall.

Appendix C. Map of Cabot town outfalls



The locations of Cabot Village outfalls and culverts monitored in this study. The structures were numbered in the order in which they were assessed. Outfalls C-O-120, -130, and -140 were located on private property and are not included in this report.