Detecting and Eliminating Illicit Discharges to Improve Water Quality in the Lake Memphremagog Basin

Final Report

August 14, 2015

Dye (and wastewater) entering a stream in Barton from a direct sanitary connection on Porter Lane. This connection is scheduled for elimination in 2015.

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1. INTRODUCTION

The goal of the Lake Memphremagog Basin Illicit Discharge Detection and Elimination Project was to improve water quality by identifying and eliminating contaminated, non-stormwater discharges entering stormwater drainage systems and discharging to Lake Memphremagog and its tributaries. The project was administered by the Memphremagog Watershed Association (MWA) under a grant from the Vermont Department of Environmental Conservation (DEC). Stone Environmental, Inc. (Stone) was awarded the contract to perform the field assessments and investigations.

Seven municipalities participated in the project: the Town of Barton, the Village of Orleans in Barton, the Town of Brighton, Newport City, and the Town of Derby and its villages of Derby Line and Derby Village. The geographic scope of the project included the entire extents of the municipal closed drainage systems. Prior to this assessment, the Vermont Department of Environmental Conservation prepared stormwater infrastructure mapping for all of these municipalities. This infrastructure mapping was used to plan the assessment in each municipality and to guide further investigations in systems with suspected illicit discharges.

Between June and December, 2014, Stone assessed stormwater outfalls and certain manholes and catchbasins in each participating municipality for the presence of illicit discharges. A total of 375 stormwater drainage systems were assessed. Of the total, 320 systems were assessed at the outfall. 55 systems were assessed in structures up-pipe from the mapped outfall location because the outfall could not be located, was inaccessible, or was inundated by the receiving waterbody. Field tests were performed for ammonia, free chlorine, common anionic detergents [using the methylene blue active substances (MBAS) method], and optical brighteners. Optical brighteners are fluorescent whitening dyes contained in most laundry detergents. Specific conductance was also measured. Of the 375 systems assessed, 90 were flowing or dripping when inspected.

Among the 375 stormwater drainage systems assessed, contaminants indicating a possible illicit discharge were detected in 69 systems. However, there were two illicit discharges suspected in system NC350 in Newport and three in system BA270 in Barton, for a total of 73 suspected illicit discharges: 17 in Barton, 10 in Derby (Town, Village, and Line), 11 in Orleans, and 35 in Newport City. Table 1 summarizes by municipality the number of systems assessed and the number in which an illicit discharge was suspected. There were no indications of possible illicit discharges in Brighton. A letter was sent to Brighton stating that no illicit discharges were detected and thanking them for their participation.

In the fall of 2014 and spring of 2015, Stone completed investigation of systems with suspected illicit discharges to confirm the presence of illicit discharges and to attempt to determine their sources. Investigations were categorized as either “simple” or “complex” according to the types of contaminants detected and the time expended on the investigation. At the outset of the investigation phase, it was clear that the number of simple and complex investigations that needed to be performed exceeded the maximum numbers specified in MWA’s contract with Stone. Stone was able to complete simple investigations at all systems with suspected illicit discharges as well as more complex investigations

where needed in Barton and Derby. Eight complex investigations could not be completed in Newport City within the scope and budget of the contract. These systems are identified in the Newport City section of this report. They are the subject of a follow-up contract recently awarded to Stone.

This report presents the assessment data and investigation findings for all the systems with suspected illicit discharges.

Table 1. Summary of stormwater drainage systems assessments by town

Town	Systems Assessed	Systems Assessed at Outfall	Outfalls Flowing or Dripping	Suspected Illicit Discharges[1]	Confirmed Illicit Discharges[1]
Town of Barton	60	51	19	17	6[2]
Town of Brighton	35	23	1	0	0
Derby (Town, Village, and Line)	66	60	16	10	4
Village of Orleans	36	30	17	11	1
Newport City	178	156	37	35	2[3]
Total	375	320	90	73	13

1. Systems with suspected hydrocarbon contamination are included in the counts of suspected illicit discharges, but not in the counts of confirmed illicit discharges, if the source appears to be a historic release of which DEC is already aware (for example, systems DT550, OR110, OR320, NC470, NC510)

2. Systems BA300 and BA310 not included in count because the source of optical brightener was not found.

3. Investigations of several systems in Newport City are ongoing under DEC contract 28937.

2. METHODS

2.1 Preparing for the assessment

Preparation for the illicit discharge assessment included obtaining and assembling necessary equipment and supplies; preparing a field data form (Appendix A), field maps, a Health and Safety Plan, and other documents, and organizing these in a project notebook; and meeting with each of the participating municipalities to gather information and plan the project in detail. Large-format field maps were prepared by overlaying DEC's stormwater infrastructure mapping on the best available orthophotography. These maps were consulted in the kickoff meetings and were annotated in the field. The kickoff meeting with each municipality provided an opportunity to collect four key types of information, as presented below.

- Contact information for municipal managers and public works personnel.
- General schedules of road and wastewater and stormwater collection system projects (to avoid conflict with construction activities).
- Locations of any known, suspected, or potential cross connections, combined sewer overflows, and sanitary sewer overflows.
- In-house capabilities of the Public Works or Highway Department to inspect pipelines and perform other advanced investigation techniques.

2.2 Dry weather survey

Stormwater drainage systems were assessed during dry weather to minimize dilution by stormwater runoff. Dry weather was defined as negligible rainfall (less than 0.1 inches) since approximately 12:00 p.m. on the previous day. Stormwater drainage systems with 10 or fewer inlets were typically assessed only at the outfall. Within larger stormwater drainage systems, the effects of dilution must be considered; therefore, selected catchbasins and junction manholes were also assessed. Stormwater structures were accessed along the public right-of-way or from the receiving waterbody, as appropriate. Where access permission was obtained, stormwater structures located on private property were also assessed, particularly if these structures were connected to a municipal drainage system.

Every outfall or other stormwater structure assessed was assigned a unique identifying code. A visual inspection was made of the condition of each discharge point and the area immediately below each discharge point. If present, dry-weather flows were observed for color, odor, turbidity, and floatable matter. Obvious deficiencies in the structure, such as severe corrosion, were noted. Dry weather flows were sampled by hand or using a telescoping pole. At catchbasins and manholes located at junctions in the storm sewer, samples were collected independently from each in-flowing pipe, when possible. Field data were entered on printed assessment forms (Appendix A).

Each dry weather discharge was tested for ammonia, methylene blue active substances (common detergents), and the presence of optical brightener to identify potential illicit discharges from laundry

facilities, leaking sanitary sewers, and cross-connections. Optical brighteners are fluorescent dyes contained in most laundry detergents. Specific conductance was measured as an indication of the dissolved solids content. To detect treated municipal water leakage, samples were also analyzed for free chlorine concentration.

With few exceptions, structures that were not flowing at the time of the initial inspection were assumed not to have illicit connections and no further assessment of these structures was performed. Our general procedure is to provide additional assessment of non-flowing structures only if there is associated evidence of contamination, such as suds, odors, or certain deposits.

2.3 Water analysis methods

The ammonia concentration was tested using Aquacheck ammonia test strips. Samples were tested for methylene blue active substances using CHEMetrics test kit K-9400, a method consistent with APHA Standard Methods, 21st ed., Method 5540 C (2005). Free chlorine analysis was conducted with powdered DPD reagent (Hach Method 8167, equivalent to USEPA method 330.5) and a portable Hach DR/900 colorimeter. Specific conductance was measured using an Oakton model conductivity meter, according to Stone Environmental Standard Operating Procedure (SOP) 5.23.3 (Appendix B).

Optical brightener monitoring was performed at outfalls and selected catchbasins and manholes that were flowing at the time of inspection, according to Stone Environmental SOP 6.38.0 (Appendix B). To test for optical brightener, a cotton pad is placed in the flow stream for a period of 4-10 days, after which the pad is rinsed, dried, and viewed under a long-wave ultraviolet light ("black light"). Florescence of the pad (seen on the right pad in Figure 1) indicates the presence of optical brightener. Pads are held in a sleeve of fiberglass window screen, clipped to the rim of the outfall pipe or secured with fishing line to a rock or other anchor. At catchbasins and manholes located at junctions in the storm sewer, pads are deployed in incoming pipes if possible, but are more often hung from the catchbasin grate or manhole rung into the sump. An advantage of optical brightener monitoring is that some intermittent or dilute wastewater discharges may be detected due to the multiple-day exposure of the pad, whereas the contaminant may not be detected in tests performed on grab samples.

Figure 1. Optical brightener monitoring pads under UV light

Table 2 identifies water quality tests that Stone performed at all discharge points and selected catchbasins and manholes that were flowing at the time of inspection.

Table 2. Water quality tests performed at flowing structures

Parameter	Sample Container	Analytical Method
Ammonia	Plastic vial	Aquacheck ammonia test strips
MBAS detergents (anionic surfactants)	Plastic vial	APHA Standard Methods, 21st ed., Method 5540 C (2005)
Free chlorine	Glass jar	By DPD, Hach Method 8167 (EPA 330.5)
Specific conductance	Glass jar	Stone SOP 5.23.3
Optical brightener	Cotton test pads	Stone SOP 6.38.0

2.4 Advanced investigations

Our IDDE experience has given us an understanding of constituent concentrations likely to indicate presence of an illicit discharge. These benchmark concentrations are summarized in Table 3. Stormwater drainage systems were designated for follow-up sampling and/or investigation where these benchmarks were exceeded. In many cases, systems were resampled at a later date if low concentrations (concentrations near the method detection limit) of ammonia, MBAS detergents, or chlorine were measured; and were not designated for intensive investigation unless elevated concentrations recurred.

Table 3. Benchmark concentrations for determination of illicit discharges

Test	Benchmark	Remarks
E. coli	>= 400 E. coli/100 mL	Undiluted municipal wastewater will generally have *E. coli* levels at least an order of magnitude higher than this benchmark. Pet waste and wildlife sources can also cause elevated *E. coli* levels.
Ammonia	>= 0.25 mg/L	In the absence of other wastewater indicators, investigation is performed when the ammonia concentration is 0.5 mg/L or higher. If other wastewater indicators are present, then the 0.25 mg/L benchmark is used. Decomposing vegetation under anoxic conditions can release ammonia to water, which can be misleading.
Anionic detergents (methylene blue active substances in anionic detergents)	>= 0.2 mg/L	Detection of low concentrations (0.1-0.3 mg/L) of anionic detergents is common at stormwater outfalls. Most detections are not correlated with other wastewater indicators and do not lead to a definite source. These detections may be attributable to outdoor washing. However, concentrations as low as 0.2 mg/L have occasionally led us to significant wastewater sources that might otherwise have been missed; therefore this is a useful test to trigger further sampling or investigation.
Optical brightener	presence	Presence usually indicates contamination by sanitary wastewater or washwater. Exposure of the test pad for 4-10 days means that diluted and intermittent discharges can be detected. Unfortunately, petroleum fluoresces at the same wavelength as optical brighteners. Optical brightener testing in catchbasins and manholes has proven to be our most effective method to bracket sources of contamination within storm sewers.
Free chlorine	> 0.05 mg/L	The field test used for free chlorine analysis is sufficiently sensitive to detect municipal tapwater sources diluted by groundwater or runoff approximately 3 to 10 fold, depending on the strength of the tapwater chlorine residual. Chlorine is a good indicator of tapwater leaks and graywater sources. Chlorine is degraded in the presence of organic materials; therefore it is not a good wastewater indicator.

If a stormwater drainage system was suspected of passing illicit discharges based on the results of the dry weather survey, additional observations and testing were performed within the system to locate or bracket the origin of the contaminated flow. The goal was to bracket the contaminant source between adjacent structures, such as a stormline connecting a catchbasin to a down-pipe manhole. DEC's stormwater infrastructure mapping was used to guide this effort.

To locate or bracket contaminant sources within storm sewer segments, the same testing methods or a subset were used as in the dry weather survey. The most reliable method to bracket sources of wastewater contamination is usually optical brightener monitoring throughout the drainage system. In several instances, we used optical brightener results to narrow the search area for illicit discharges to a specific structure or to the pipe between two structures. The presence and appearance of dry-weather flows were also useful in isolating sources of contamination within storm sewer segments.

Stone worked with each participating municipality to find specific improper connections, leaks, and other problems contributing the contaminated flows observed in the stormwater drainage systems. After bracketing the discharge source as closely as possible using the water quality test methods, Stone met with representatives of each municipality to describe our findings and discuss next steps. Engineering plans were reviewed to identify possible cross-connections between sanitary sewers and stormwater drainage systems, particularly locations where leakage from a sanitary line could be intercepted by the stormwater system. Dye testing was performed in Barton to identify specific improper connections.

The following sections present the findings of illicit discharge investigations in each municipality. No suspected illicit discharges were identified in Brighton; therefore no further investigation occurred. In each of the remaining towns, one or more illicit discharges were confirmed. In nearly all cases, correction of these illicit discharges has occurred or is planned in 2015.

2.4.1 *E. coli* and phosphorus

In the Lake Memphremagog Basin, phosphorus is a significant concern due to its effects on the ecology of Lake Memphremagog. *E. coli* bacteria levels provide an indication of fecal contamination; based on human health concerns, *E. coli* enumeration is recommended for all fresh waters used for contact recreation or for water supply. At discharge points where wastewater contamination was suspected (because of a positive optical brightener test, elevated ammonia, and/or septic odor), water samples were collected for *E. coli* and total phosphorus analysis. DEC's LaRosa laboratory performed both analyses.

Samples for *E. coli* analysis were collected in sterile, plastic 100-mL bottles and analyzed using Quanti-tray. Samples collected for total phosphorus analysis were collected in glass digestion vials provided by the DEC LaRosa laboratory. Total phosphorus was analyzed by DEC's Standard Operating Procedure (SOP) for Determination of Phosphorus by Flow Injection, Revision 6. The preservation and holding time requirements are given in Table 4, below.

Table 4. Laboratory sample analyses

Parameter	Sample Container	Analytical Method	Sample Preservation	Holding Time
Total P	Glass vial (50 mL)	DEC SOP, Revision 6	Cool (4°C)	28 days
E. coli	Plastic (100 mL)	SM 9223B (Colilert Quanti-Tray)	Cool (4°C), sodium thiosulfate	6 hours

At the same time that water samples were collected for *E. coli* and total phosphorus analyses, flow measurements were made to enable calculation of total phosphorus mass loading. Flow was measured by timing the filling of a container of known volume or using the float method.

3. BARTON RESULTS

Illicit discharge detection was performed in Barton during the summer of 2014. Of the 60 systems assessed, nineteen were either flowing or dripping during dry weather. Fifteen systems were designated for further investigation due to detection of one or more contaminants. The status of these investigations is summarized in Table 5 and the systems are described in detail below. In system BA270 there are three branches discharging to a catchbasin on High Street and each branch receives wastewater or washwater. For the purposes of this project, we considered investigations of each branch of system BA270 to be separate advanced investigations.

Table 5. Status of investigations in Barton

Structure ID	Simple AI	Complex AI	Status
BA020	X		Identified a malfunctioning septic system with surfacing effluent flowing to the stormdrain. Problem referred in writing to the Barton Town Health Officer. On July 15, 2015, the problem was referred to enforcement by the DEC project manager.
BA040	X		No chronic illicit discharge.
BA060	X		No chronic illicit discharge.
BA080	X		A small flow of municipal water appears to enter this system from a leak in the distribution system. The Town (Nathan Sicard) was apprised of this finding. Unrelated fuel oil contamination in an adjacent structure was referred to DEC Hazardous Waste Management Program (John Schmeltzer).
BA140		X	No illicit wastewater discharge confirmed. Chlorine detection likely related to transient swimming pool discharge.
BA270-- Pipe A branch		X	Identified a direct sanitary connection from 112 High Street to the stormdrain. Written notice was sent to the Village of Barton on November 13, 2014. The sanitary connection was eliminated in June 2015 and the house was connected to the sewer main.
BA270-- Pipe B branch		X	Identified a corroded sewer pipe elbow at 72 Hubbard Avenue. This elbow appeared to be slowly leaking into a perimeter drain beneath it, which we believe is connected to the municipal stormdrain. Written notice was sent to the Village of Barton on November 13, 2014. In June 2015, the Village of Barton sent the homeowner a letter describing Stone's findings. The homeowner reportedly retained a plumber who did not see a problem. On July 18, 2015 a member of the Barton public works staff inspected the sanitary connection and found it deteriorated but not leaking.
BA270-- Pipe C branch		X	Contamination traced to a catchbasin on the Barton Christian School property. A maintenance person at the school was reportedly dumping mop water into the catchbasin at the corner of the building every evening. The school director stated she would require him to use a sink instead.
BA280	X		Contaminated groundwater entering system from municipal salt storage facility. Not considered an illicit discharge.
BA290	X		No chronic illicit discharge.
BA300		X	Our current explanation for presence of optical brightener is infiltration of groundwater contaminated by a leaking sanitary sewer line. Further investigation is being performed under DEC contract 28937.

Structure ID	Simple AI	Complex AI	Status
BA310		X	Our current explanation for presence of optical brightener is infiltration of groundwater contaminated by a leaking sanitary sewer line. Further investigation is being performed under DEC contract 28937.
BA360		X	Written notice was sent to the Village of Barton on November 13, 2014. Direct sanitary connections were identified from 79 Porter Lane and 82 Lincoln Avenue to the stormdrain. Both sanitary connections were eliminated in July 2015.
BA380	X		No chronic discharge.
BA400	X		No chronic discharge.
BA470	X		No chronic discharge.
BA540	X		No chronic discharge.

3.1 BA020

The BA020 system drains a portion of Lake Street and a few underdrains located on two residential properties (Map BA-1). It discharges just south of 501 Lake Street.

Table 6. Water analysis data for outfall BA020

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA020	7/22/14 9/4/14	Flowing Flowing	0.10 --	0.03 --	0.10 --	386 --	Positive Positive	Clear, no odor --
BA020 CB1	9/4/14	Flowing	--	--	--	--	Positive	Strong sewage odor
BA020 CB1 Pipe A	10/9/14	Flowing	0.10	--	--	--	--	Clear, no odor
BA020 CB1 Pipe B	10/9/14 5/14/15	Flowing Flowing	3.0 --	-- --	-- --	-- --	-- --	Strong wastewater odor Strong wastewater odor
BA020 CB2 Sump	9/4/14	Trickling	--	--	--	--	Negative	--
BA020 CB2 Pipe B	9/4/14	Trickling	--	--	--	--	Negative	--

Findings:

- Optical brightener was detected at the outfall and in the sump of catchbasin CB1, but not in CB2.
- On September 4, 2014, a strong sewage odor was observed at the outfall and catchbasin CB1, but not at CB2.
- A neighbor commented that the septic system at 530 Lake Street is frequently pumped.

- On October 9, 2014, a high ammonia concentration (3.0 mg/L) was measured from Pipe B in catchbasin CB1; ammonia was below detection in flow from CB1 Pipe A. Catchbasin CB1 Pipe B connects to a drop inlet located on the property of 530 Lake Street. A shallow ditch along the driveway was flowing to the drop inlet. This flow appeared to be wastewater.
- Pipe B in catchbasin CB1 was sampled for *E. coli* and total phosphorus analysis on May 14, 2015 (Table 79). The *E. coli* concentration (40 MPN/100 mL) was surprisingly low while the TP concentration was moderately high (339 µg/L). The sample had a wastewater odor.

Conclusion: Based on the optical brightener and ammonia test results and wastewater odor observations, we conclude that there is a malfunctioning septic system at 530 Lake Street that discharges to catchbasin CB1.

Resolution: This matter was referred to the town health officer, Joyce Croteau, on October 10, 2014 by Nathan Sicard, a member of the Barton Village Board of Trustees. The DEC Regional Engineer, Steve Rebillard, was also made aware of this problem. The DEC project manager referred the problem to enforcement on July 15, 2015.

3.2 BA040

The BA040 system drains a portion of Lake Street and discharges to a swale just north of 501 Lake Street (Map BA-1).

Table 7. Water analysis data for outfall BA040

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/22/14	Dripping	0.10	0.08	0.00	--	Negative	Small floating particles, no odor. CB1 Pipe A dripping due to landscape drainage.
9/10/14	Trickling	0.10	0.04	0.00	--	--	--

Findings:

- On July 22, 2014, a low chlorine concentration (0.08 mg/L) was measured at the outfall; this was the only contaminant detected.
- On September 10, 2014, no contaminants were detected at a level of concern.

Conclusion: After repeated testing, we conclude that there is no chronic illicit discharge present in this system.

Resolution: NA

3.3 BA060

The BA060 system drains a portion of Lake Street and discharges just south of the home at 367 Lake Street (Map BA-2).

Table 8. Water analysis data for outfall BA060

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/22/14	Trickling	0.25	0.04	0.00	223	Negative	Small floating particles, no odor.
9/10/14	Trickling	0.10	0.06	0.00	223	--	

Findings:

- On July 22, 2014, a low ammonia concentration (0.25 mg/L) was measured at the outfall.
- On September 10, 2014, no contaminants were detected at a level of concern.

Conclusion: After repeated testing, we conclude that there is no chronic illicit discharge present in this system.

Resolution: NA

3.4 BA080

The BA080 system drains a portion of Lake Street and discharges just north of the home at 367 Lake Street (Map BA-2).

Table 9. Water analysis data for outfall BA080

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA080	7/22/14	Dripping	0.10	0.23	0.20	401	Negative	Clear, no odor.
	9/10/14	Trickling	0.10	0.07	0.00	390	--	Clear, no odor.
	10/1/14	Dripping	0.10	0.06	0.00	381	--	Clear, no odor.
BA080 CB1 Pipe A	10/9/14	Trickling	--	0.00	--	--	--	Clear, no odor.
BA080 CB1 Leak	10/9/14	Trickling	--	0.06	--	--	--	Clear, no odor.
BA080 CB1 Pipe B	10/9/14	Trickling	--	0.00	--	--	--	Clear, no odor.

Findings:

- On July 22, 2014, a moderate chlorine concentration (0.23 mg/L) and low MBAS concentration (0.2 mg/L) were measured at the outfall. Low chlorine concentrations (0.07 and 0.06 mg/L) and no MBAS were measured on two later dates.
- On October 9, 2014, a low concentration (0.06 mg/L) of chlorine was measured in a leak in the wall of catchbasin CB1.
- While investigating system BA080 on October 9, 2014, we opened a manhole at the end of the driveway at #358 Lake Street and observed a strong petroleum odor. This manhole is adjacent to catchbasin CB1 but is not connected with it. The manhole cover is incorrectly marked "water". Nathan Sicard, a member of the Barton Village Board of Trustees, was notified about the petroleum odor. Mr. Sicard began looking into the problem immediately and learned that there had been a spill or release of fuel oil at the property in 2013 and an effort had been made to clean up the fuel. Mr. Sicard indicated that the manhole is actually connected to an abandoned sanitary sewer line.

Conclusion: Based on the clearly elevated chlorine concentration measured at the outfall on July 22, 2014, we suspect there is a municipal water leak entering catchbasin CB1.The strong petroleum odor observed in the adjacent manhole on October 9, 2014 must indicate that the fuel oil release was not entirely cleaned up.

Resolution: The Town of Barton was notified of the suspected water leak in this location on October 9, 2014. The Department of Environmental Conservation Hazardous Waste Management Program (John Schmeltzer) was notified of the petroleum problem on October 11, 2014. We understand that DEC took action to inspect the manhole in question.

3.5 BA140

The BA140 system drains a portion of Lake Street and Vigario Lane. It also drains a pipe that runs to the back of the property at 14 Vigario Lane. The system discharges behind the warehouse at 3 Lake Street (Map BA-3).

Table 10. Water analysis data for outfall BA140

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA140	7/22/14	Flowing	0.25	0.04	0.30	760	Positive	Clear, no odor
	9/4/14	Flowing	--	--	--	--	Negative	--
	9/10/14	Flowing	0.25	0.07	0.10	734	--	Clear, no odor
	10/1/14	Flowing	0.10	0.07	0.10	679	--	Clear, no odor
	10/9/14	Flowing	--	--	--	--	Negative	--
	5/14/15	Flowing	--	--	--	--	--	--

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA140 CB1	9/4/14	Flowing	--	--	--	--	Negative	--
	9/10/14	Flowing	0.40	0.04	0.00	705	--	Clear, no odor
	10/1/14	Flowing	0.10	0.09	0.10	683	--	Clear, no odor
	10/9/14	Flowing	--	--	--	--	Negative	--
BA140 CB2	9/4/14	Flowing	--	--	--	--	Negative	--
BA140 CB3 Upper Pipe A	9/4/14	Flowing	--	--	--	--	Negative	--
	9/10/14	Flowing	0.10	--	--	--	--	Clear, no odor
	10/1/14	Flowing	--	0.02	--	285	--	Clear, no odor
	10/9/14	Trickling	--	--	--	--	--	--
BA140 CB3 Upper Pipe B	9/4/14	Dripping	--	--	--	--	Negative	--
	9/10/14	Dripping	0.10	--	--	--	--	Clear, no odor
	10/9/14	Wet, no flow	--	--	--	--	--	--
BA140 CB3 Sump	9/4/14	Flowing	--	--	--	--	Negative	--
	9/10/14	Flowing	0.10	--	--	--	--	Clear, no odor
	10/1/14	Flowing	--	0.17	--	--	--	Clear, no odor
	10/9/14	Trickling	--	0.02	--	--	Negative	--
BA140 CB4	9/4/14	Trickling	--	--	--	--	Negative	--
	9/10/14	Trickling	0.10	--	--	--	--	Clear, no odor
	10/1/14	Trickling	--	0.04	--	282	--	Clear, no odor

Findings:

- On July 22, 2014, optical brightener and low concentrations of ammonia and MBAS were detected at the outfall. Despite repeated sampling at the outfall, MBAS has not been detected since.
- On September 4, 2014, OB monitoring pads were retrieved from structures throughout the drainage system and none indicated exposure to optical brighteners.
- Low chlorine concentrations (0.07 mg/L) were detected at the outfall on September 10 and October 1, 2014. On October 1, low chlorine concentrations were also measured at CB1 (0.09 mg/L) and a higher concentration (0.17 mg/L) was measured in the sump of CB3. On October 9, 2014, the chlorine concentration in the CB3 sump was below detection.
- During an October 9, 2014 meeting, a representative of the Town indicated that a section of the stormline between CB1 and the outfall had been replaced in July, 2014.
- On May 14, 2015, samples were collected at the outfall for *E. coli* and total phosphorus analysis. Levels of both constituents were very low (Table 79).

Conclusion: We suspect the source of the chlorine in catchbasin CB3 was discharge from a swimming pool in the backyard of 14 Vigario Lane. Chlorine was not detected in CB3 on October 9, 2014, which may indicate the pool had been emptied.

The source of the optical brightener detected at the outfall on July 22, 2014 was not determined. It is possible that the source was eliminated during replacement of the pipe between CB1 and the outfall in July, 2014, or that the construction activities actually caused the detection (i.e., by releasing a small amount of wastewater to the stormdrain). After consistently negative results in repeated testing for optical brightener, we conclude that there is no illicit wastewater discharge into this system.

Resolution: NA

3.6 BA270

The BA270 system drains High Street from Harrison Avenue down to the St. Paul Catholic School, a portion of Hubbard Avenue, and a portion of Water Street (Map BA-4). The system discharges to Willoughby Brook across the street from #23 Water Street. Three branches (A, B, and C) of the system converge at CB6 on High Street. All three branches appeared contaminated.

Table 11. Water analysis data for outfall BA270

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA270	7/30/14 9/4/14	Flowing Flowing	0.10 --	0.04 --	0.10 --	1130 --	Positive Positive	Suds below outfall. Clear, no odor.
BA270 CB6 Pipe A	7/30/14 9/10/14 5/14/15	Flowing Trickling Flowing	0.35 0.40 --	0.07 0.09 --	0.00 0.10 --	617 700 --	Positive – --	Clear, no odor Clear, no odor No contamination evident
BA270 CB7-A	9/4/14	Flowing	--	--	--	--	Positive	--
BA270 CB8-A	9/10/14	Trickling	0.75	0.07	--	670	--	Slight sewage odor
BA270 CB9-A	9/10/14	Trickling	0.75	--	--	--	--	Sewage odor
BA270 CB10-A	9/4/14 10/1/14	Trickling Trickling	0.10 0.10	-- 0.01	-- 0.10	-- 934	Positive --	Clear, sewage odor Clear, no odor
BA270 CB11-A	9/4/14	Flowing	--	--	--	--	Negative	--
BA270 CB6 Pipe B	7/30/14 9/10/14 10/1/14 5/14/15	Flowing Trickling Flowing Flowing	0.10 0.10 0.10 --	0.06 0.05 0.00 --	0.20 0.00 0.20 --	762 757 792 --	Positive -- -- -- --	Clear, no odor Clear, no odor Clear, no odor No contamination evident
BA270 CB7-B	10/9/14	Trickling	--	--	--	--	Positive	--
BA270 CB6 Pipe C	7/30/14 9/10/14 10/1/14	Trickling Trickling Dripping	0.10 0.10 0.00	0.07 0.07 0.03	0.20 0.20 0.10	1800 1601 1345	Positive -- --	Clear, no odor Clear, no odor Clear, no odor
BA270 CB7-C	9/4/14	Dry	--	--	--	--	Positive	--

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
	10/9/14	Dry	--	--	--	--	Positive	
BA270 CB8-C	10/9/14	Dry	--	--	--	--	Positive	--
BA270 CB9-C	10/9/14	Dry	--	--	--	--	Positive	--
BA270 CB10-C	10/9/14	Dry	--	--	--	--	Negative	--
BA270 CB11-C	10/9/14	Dry	--	--	--	--	Negative	--
BA270 CB12-C	10/21/14	Dry	--	--	--	--	Positive	--

BA270 Branch A:

Findings:

- Optical brightener and ammonia results suggested that sanitary wastewater was entering the system between CB9-A and CB10-A on High Street, possibly via an abandoned sanitary line connected to the storm line.
- On November 13, 2014, dye flushed down a toilet at the house at 112 High Street was observed at catchbasin CB9-A (Figure 2 and Map BA-4), confirming a sanitary connection. No dye appeared in the stormwater system after three other buildings on High Street (between #112 and the intersection with Eastern Avenue) were tested.

Figure 2. Dye observed at catchbasin CB9-A after it was flushed at 112 High Street.

Conclusion: A direct sanitary connection existed between 112 High Street and Branch A of the BA270 stormwater drainage system.

Resolution: According to Nathan Sicard, a member of the Barton Village Board of Trustees, the wastewater cross connection was eliminated in June 2015. The house sewer lateral was connected to the sanitary sewer main.

BA270 Branch B:

Findings:

- Optical brightener results suggested that sanitary wastewater or washwater is entering Branch B of the BA270 system above CB7-B.
- Dye testing revealed that the sewer main on Hubbard Avenue is not a source of contamination.
- On November 12, 2014, inspection of the plumbing facilities in the house at 72 Hubbard Avenue revealed a corroded sanitary elbow that appears to be slowly leaking into an opening in the perimeter drain beneath it (Figure 3). We expect that the perimeter drain is connected to catchbasin CB7-B.

Figure 3. Rusted sanitary elbow found slowly leaking to a perimeter drain

Conclusion: We believe the source of the optical brightener detected at catchbasin CB7-B is a leaking sewer pipe fitting in the basement of 72 Hubbard Avenue. This fitting is above a perimeter drain.

Resolution: Written notice was sent to the Village of Barton on November 13, 2014. In June 2015, the Village of Barton sent the homeowner a letter describing Stone's findings. The homeowner reportedly retained a plumber who did not see a problem. On July 18, 2015 a member of the Barton public works staff inspected the sanitary connection and found it deteriorated but not leaking. Apparently the Village

of Barton has concluded there is no significant problem in this location and does not plan further investigation.

BA270 Branch C:

Findings:

- On October 1, 2014, monitoring pads were placed throughout this branch of the BA270 system to isolate the source of optical brightener. These pads indicated that the source of optical brightener was on the property of the Barton Christian School. On October 21, 2014, a monitoring pad was placed in a catchbasin within the school grounds, immediately up-pipe from CB9-C, and optical brightener was detected.
- On November 13, 2014, dye testing was conducted at the Barton Christian School. Dye added to a first floor toilet in the administration office was not observed in the stormwater system.
- On November 13, 2014, the director of the Barton Christian School informed Stone that a custodian uses the catchbasin in question to dispose of mop water every evening. This custodian used an institutional cleaning product manufactured by Tide. The director was unaware that water dumped in the catchbasin flows untreated to surface waters.

Conclusion: The cause of the optical brightener detection was apparently the regular dumping of mop water by a custodian at the Barton Christian School.

Resolution: The Director of the Barton Christian School stated that she would require custodians to stop dumping into any catchbasins on the property (and use a sink instead).

3.7 BA280

The BA280 system drains via a culvert under the driveway of 414 High Street (Map BA-5). A wetland area on the upstream side of the culvert receives flow from an underdrain which apparently originates at 440 High Street and from a swale that parallels the driveway leading to 414 High Street.

Table 12. Water analysis data for outfall BA280

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA280	7/30/14 9/10/14	Trickling Trickling	0.10 0.25	0.05 0.04	0.75 0.60	6,030 6,490	Negative --	Iron staining Iron staining
BA280 Swale	9/19/14 10/9/14	Trickling Trickling	0.25 --	-- --	1.00 0.75	11,490 6,300	-- --	Tested water seeping out of ground in swale
BA280 Underdrain	10/9/14 10/21/14	Trickling Trickling	-- --	-- --	-- 0.5	4,260 4,180	-- --	Sampled seep near mapped underdrain

Findings:

- Moderate MBAS concentrations (0.60 and 0.75 mg/L) and very high conductivity (6,030 and 6,490 µs/cm) were measured on two visits to the outfall.
- On September 19, 2014, the swale was tested where groundwater was first observed seeping to the surface. Moderate MBAS (1.0 mg/L) and exceedingly high conductivity (11,490 µs/cm) were measured in this flow. On October 9, 2014, moderate MBAS (0.75 mg/L) and high conductivity (6,300 mg/L) measured.
- On September 19, 2014, access to the underdrain at MH1 was attempted, but the manhole could not be found and is believed to be buried under fill.
- Groundwater believed to be flowing from the underdrain connected to MH1 and separate from the grass swale was tested on October 9 and 21, 2014. High conductivity (4,180 and 6,300 mg/L) and moderate MBAS (0.50 mg/L) were measured.
- At the high specific conductivity values measured, dissolved solids concentrations have a positive interference on the MBAS test. Adjusted for this interference, the MBAS results recorded are not significant.

Conclusion: We suspect that the source of the dissolved solids (measured as high specific conductivity) at the outfall and in the swale is the salt storage area uphill from the outfall and swale. The salt pile is now covered although spilled salt is present on the ground outside.

Resolution: It is unclear whether either the Town of Barton or DEC is required take any action to address groundwater contamination resulting from salt storage and handling at municipal facilities.

3.8 BA290

The BA290 system drains an upper portion of Lincoln Avenue and High Street. It discharges to a stream behind 153 Lincoln Avenue (Map BA-6).

Table 13. Water analysis data for outfall BA290

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA290	7/30/14	Flowing	0.25	0.02	0.5	1458	Negative	Clear, no odor.
BA290	9/10/14	Flowing	0.1	0.02	0.1	642	--	Foam in scour pool. Clear, no odor.
BA290	10/3/14	Flowing	0.1	0.02	0.1	1205	--	Clear, no odor
BA290 CB4	10/3/14	Flowing	0.1	0.02	0.1	1235	--	Clear, no odor

Findings:

- On July 30, 2014, low ammonia (0.25 mg/L) and low MBAS (0.5 mg/L) concentrations were measured at the outfall.
- No contaminants were detected at the outfall on September 10, 2014 or on October 3, 2014 at the outfall and CB4.
- Moderately high specific conductance in this system likely results from salt storage and handling at the municipal facility on High Street (see description of system BA280).

Conclusion: After repeated testing, we conclude there is no chronic illicit discharge in this system.

Resolution: NA

3.9 BA300

The BA300 outfall is a 4-in. diameter PVC pipe adjacent to the BA290 outfall. It discharges to a stream behind 153 Lincoln Avenue. The outfall was not mapped and there are no visible inlets (Map BA-6). The system appears to be a French drain installed at the toe of the slope along the driveway serving the apartment at 153 Lincoln Avenue.

Table 14. Water analysis data for outfall BA300

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/30/14	Trickling	0.1	0.03	0.5	1004	Positive	Clear, no odor.
9/10/14	Trickling	0.1	0.09	0.2	710	Positive	Clear, no odor.
5/14/15	Dripping	--	--	--	--	--	--
6/18/15	Dripping	--	--	--	--	Negative	Clear, no odor.

Findings:

- On two visits, low MBAS concentrations (0.5 and 0.2 mg/L) were measured at the outfall.
- Optical brightener was detected at the outfall on two occasions in 2014.
- On November 12, 2014, dye testing was performed at 185 Lincoln Avenue and at the apartment at 153 Lincoln Avenue. Dye was not observed at outfalls BA300 or BA310. An inspection of the crawl space plumbing at 185 Lincoln Street did not suggest any cross connections. No one was home at the main residence at 153 Lincoln Avenue on five attempts between November, 2014 and May 2015.
- *E. coli* and total phosphorus concentrations were negligible in samples collected at the outfall on May 14, 2015 (see Table 79).
- Arrangements were made to dye test 153 Lincoln Avenue on June 18, 2015. No connection between BA300 and interior drains was found. Dye flushed down the toilet was observed in a

sanitary manhole and was not observed at the outfall. Neither sewer dye nor optical brightener was detected on a pad placed in the outfall on June 18 and retrieved on June 25, 2015.

Conclusion: The source of intermittent optical brightener detected at this outfall is unknown. Based on the location of the outfall and the lack of direct connections, it appears unlikely that the source of the optical brightener detected in this drain is 153 Lincoln Avenue. An alternate explanation is that the drain intercepts contaminated groundwater from a small leak in the sanitary sewer main on Lincoln Avenue or in the sewer lateral serving 185 Lincoln Avenue.

Resolution: Further investigation of this system will be considered under DEC contract 28937.

3.10 BA310

The BA310 outfall was unmapped and appears to act primarily as a roof drain. It discharges directly behind 153 Lincoln Avenue (Map BA-6).

Table 15. Water analysis data for outfall BA310

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/30/14	Trickling	0.25	0.00	0.2	256	Positive	Clear, no odor.
9/10/14	Dry	--	--	--	--	Positive	Clear, no odor.
5/7/15	Flowing	--	--	--	--	--	--
6/18/15	Dripping	--	--	--	--	Positive	Clear, no odor.

Findings:

- On July 30, 2014, low ammonia (0.25 mg/L) and MBAS (0.2 mg/L) concentrations were measured.
- Optical brightener was detected at the outfall all three times it was monitored.
- On November 12, 2014, dye testing was performed at 185 Lincoln Street and at the apartment at 153 Lincoln Street. Dye was not observed at outfalls BA300 or BA310. An inspection of the crawl space plumbing at 185 Lincoln Street did not suggest any cross connections. No one was home at the main residence at 153 Lincoln Avenue on five attempts between November, 2014 and May 2015.
- *E. coli* and total phosphorus concentrations were negligible in samples collected at the outfall on May 14, 2015 (see Table 79).
- Arrangements were made to dye test 153 Lincoln Avenue on June 18, 2015. Dye flushed down the toilet was observed in a sanitary manhole and was not observed at the outfall. Optical brightener was evident but no sewer dye was detected on a pad placed in the outfall on June 18 and retrieved on June 25, 2015.

- Inspection of plumbing at 153 Lincoln Avenue on June 18, 2015 did not reveal a definite source of contamination. No leaks were seen in the wastewater plumbing. Wastewater lines from the apartment are connected to those in the main house. The building sewer penetrates the foundation on the Lincoln Avenue side of the house (in the opposite direction from the stream). Outfall BA310 is connected to a roof leader and a system of floor drains in the basement. One of these floor drains is located under a lawnmower. Another is next to an oil furnace. It is likely that water flows to these drains under high groundwater conditions, transporting small quantities of oil. However, the pipes leading from these floor drains and roof drain were dry on June 18 while the outfall was dripping. This indicates that groundwater is infiltrating the line.

Conclusion: The source of optical brightener detected at this outfall is unknown. The most likely explanation is that the drain intercepts contaminated groundwater from a small leak in the sanitary sewer main on Lincoln Avenue or in the sewer lateral serving 185 Lincoln Avenue. Given the detection of optical brightener in both BA300 and BA310, the contaminated groundwater explanation appears the most likely. It is also possible petroleum has entered the pipe system via the floor drains and is slowly being released at the outfall.

Resolution: Further investigation of this system will be considered under DEC contract 28937.

3.11 BA360

The BA360 system drains Porter Lane, Harrison Avenue, and portions of Main Street and High Street. It discharges into a concrete channel just south of the Irving Station at 542 Main Street (Map BA-7).

Table 16. Water analysis data for outfall BA360

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA360	7/30/14	Flowing	0.35	0.08	3.00	1331	Positive	Cloudy, odor
	9/4/14	Flowing	--	--	--	--	Positive	--
	9/19/14	Flowing	2.0	0.03	0.20	1394	--	Cloudy, odor
	10/21/14	Flowing	0.35	--	--	--	--	Cloudy, oil odor
	5/14/15	Flowing	--	--	--	--	--	Oil odor
BA360 CB2	9/4/14	Flowing	--	--	--	--	Positive	--
	10/30/14	Flowing	--	--	--	--	--	Sewage odor and gray deposits
BA360 CB2 Pipe A (Porter)	10/30/14	Flowing	0.25	0.00	0.3	1164	--	Sewage odor and gray deposits
BA360 CB2 Pipe B (Main)	10/30/14	Flowing	0.00	0.03	0.2	1687	--	Cloudy, no odor
BA360 CB5	9/4/14	Flowing	--	--	--	--	Negative	--
BA360 CB6	8/6/14	Flowing	--	--	--	--	Negative	--

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
	9/4/14	Flowing	--	--	--	--	Negative	--
BA360 Culvert 1	9/19/14	Trickling	0.10	--	0.10	1228	--	Clear, no odor
BA360 Tunnel Entrance	10/3/14 10/21/14 10/30/14	Flowing Flowing Flowing	0.10 0.10 --	0.06 -- --	0.20 -- --	1815 -- --	Negative Negative --	Clear, sewage odor Sewage odor Sewage odor
BA360 Tunnel Mid	10/21/14	Flowing	--	--	--	--	Negative	Sewage odor
BA360 Tunnel End	10/21/14	Flowing	--	--	--	--	Negative	Sewage odor

Findings:

- Optical brightener was detected at the outfall on July 30 and September 4, 2014. Ammonia was also detected, a low concentration on July 30 and a high concentration (2.0 mg/L) on September 19, 2014.
- No optical brightener was detected at CB5 on Harrison Street or further up-pipe; therefore, the source of wastewater was believed to be on lower Harrison Street, Main Street, or Porter Lane. It was difficult to further isolate the source of wastewater in the system because there are few accessible structures.
- Camera inspection by the Vermont Rural Water Association of the sewer main on Harrison Avenue reportedly did not reveal any leaks.
- On October 3, 2014, a wastewater odor was detected at the structure marked “tunnel entrance” on Map BA-7. Wastewater odor in the tunnel was noted again on October 21, 2014; however, OB monitoring pads placed throughout the tunnel were negative. This suggested a wastewater connection downpipe of the tunnel/railroad crossing from which odors were venting up the pipe.

Figure 4. Drop structure located at the end of the stormwater tunnel.

- Dye testing of the sewer main up Porter Lane did not reveal any sewer leaks entering the stormwater main.

- On October 30, 2014, inspection of catchbasin CB2 revealed a definite wastewater odor and gray material (likely fungal growth) in the sump and in the outlet of Pipe A, which drains the Porter Lane line. MBAS and ammonia were slightly elevated in flow from Pipe A and a corn kernel was present in the sample.
- On November 12, 2014, all accessible buildings on lower Harrison Street and Porter Lane were dye tested. No dye appeared in the stormwater system.
- On November 13, 2014, we gained entry to the house at the end of Porter Lane (79 Porter Lane). This house appeared to be the most likely source based on its proximity to the stormwater line. Dye flushed at the house was observed at catchbasin CB2 (Figure 5) and not in the sanitary sewer, confirming a wastewater connection.

Figure 5. Catchbasin CB2 at the intersection of Main Street and Porter Lane.

Conclusion: A direct sanitary wastewater connection existed between 79 Porter Lane and the BA360 stormwater drainage system.

Resolution: Written notice was sent to the Village of Barton on November 13, 2014. According to Nathan Sicard, a member of the Barton Village Board of Trustees, camera inspection was performed in the first week in June, 2015. Direct sanitary connections were identified from 79 Porter Lane and 82 Lincoln Avenue to the stormdrain. Both sanitary connections to the stormdrain were eliminated in July 2015 and the houses were properly connected to the sanitary sewer main.

3.12 BA380

The BA380 system drains a portion of Water Street and the parking lot at 241 Main Street (Map BA-8). It discharges across the street from 78 Water Street.

Table 17. Water analysis data for outfall BA380

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
8/6/14	Flowing	0.10	0.03	0.60	1405	Negative	Clear, no odor

9/10/14	Flowing	0.10	0.03	0.00	1490	--	Laundry odor in pipe
9/19/14	Flowing	0.10	0.02	0.10	1535	--	Clear, no odor

Findings:

- After repeated testing, we conclude that the moderate MBAS concentration (0.6 mg/L) measured on August 6, 2014 was transient and not significant.

Conclusion: We conclude there is no chronic illicit discharge in this system.

Resolution: NA

3.13 BA400

The BA400 system drains Church Street, Barton Academy, and School Street (Map BA-8). It discharges at the Willoughby Brook bridge crossing on Glover Road.

Table 18. Water analysis data for outfall BA400

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA400 CB1	8/6/14	Flowing	0.25	0.04	0.50	1276	Negative	Clear, no odor
	9/19/14	Flowing	0.10	--	0.10	1400	--	Clear, no odor
	10/3/14	Flowing	0.10	0.06	0.00	1500	--	Clear, no odor

Findings:

- The low MBAS (0.50 mg/L) and ammonia (0.25 mg/L) concentrations measured on August 6, 2014 did not reoccur in repeated sampling.

Conclusion: We conclude there is no chronic illicit discharge in this system.

Resolution: NA

3.14 BA470

The BA470 system drains Elm and Park Streets before discharging into the Roaring Brook behind 144 Elm Street (Map BA-9). The structure closest to the outfall was monitored because the outfall is surcharged.

Table 19. Water analysis data for outfall BA470

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BA470 CB1	8/6/14	Flowing	0.25	0.04	0.20	511	Negative	Clear, no odor

BA470 MH1	9/19/14 9/23/14	Flowing Flowing	0.10 0.10	0.02 0.02	0.00 0.00	500 448	Negative[1] --	Clear, no odor
1. Monitoring pad exposed to flow for only 15 minutes due to need to rebury structure								

Findings:

- Assessment of this system was difficult because the outfall is partially submerged, most of the catchbasins are off-line, and the structure marked MH1 is buried under fill and must be dug up (using heavy equipment) in order to sample it.
- The data collected at manhole MH1 on two dates do not indicate contamination.

Conclusion: We conclude there is no illicit discharge present in this system.

Resolution: NA

3.15 BA540

The BA540 system drains Roaring Brook Road before discharging into Roaring Brook just north of the bridge (Map BA-10).

Table 20. Water analysis data for outfall BA540

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
8/6/14	Trickling	0.25	0.00	0.50	1660	Negative	Clear, no odor
9/19/14	Trickling	0.25	--	0.00	263	--	Clear, no odor
10/3/14	Trickling	0.10	0.03	0.10	125	--	Clear, no odor

Findings:

- The low concentrations of ammonia (0.25 mg/L) and MBAS (0.50 mg/L) measured on August 6, 2014 appear to be have been transient.

Conclusion: After repeated testing, we conclude that there is no illicit discharge in this system.

Resolution: NA

4. BRIGHTON RESULTS

Illicit discharge assessment was performed in Brighton on July 22 and 30, 2014. A total of 35 stormwater drainage systems were assessed. None of the drainage systems were flowing when assessed, although a few were wet or dripping. Erosion was noted at one outfall, BI050. This outfall is located just north of #190 Derby Street/Route 105. Because no illicit discharges were indicated during the initial assessment, no further investigations were performed.

5. DERBY RESULTS

Illicit discharge detection in Derby was performed during the summer of 2014. Of the 66 systems assessed, 16 were either flowing or dripping during dry weather. Ten systems were designated for further investigation due to detection of one or more contaminants. The status of these investigations is summarized in Table 21 and the systems are described in detail below.

Table 21. Status of investigations in Derby Town, Derby Village, and Derby Line

Structure ID	Simple AI	Complex AI	Status
DT020		X	The source of problem is a malfunctioning septic system. Referred to DEC Regional Engineer in a letter dated October 14, 2014. The problem was referred to enforcement by the DEC project manager on July 15, 2015.
DT030	X		The source of problem is a malfunctioning septic system. Referred to DEC Regional Engineer in a letter dated October 14, 2014. The problem was referred to enforcement by the DEC project manager on July 15, 2015.
DT080	X		No chronic illicit discharge.
DT160	X		No chronic illicit discharge.
DT230	X		No chronic illicit discharge.
DT290	X		No chronic illicit discharge.
DT450	X		No chronic illicit discharge.
DT540	X		Further investigation of the DT540 system for possible connections with interior drains in Tivoly Inc. was performed by the facility's engineer. None were identified. Cleaning of siphons appears to have eliminated sanitary sewer overflows on Baxter Avenue at this time; however, the DEC Wastewater Management Division should work with the Village of Derby Line on a maintenance schedule or long term solution.
DT550	X		Soil and groundwater contamination from historic industrial activities may be contributing the petroleum odor observed at the outfall. The DEC Hazardous Waste Management Division (John Schmeltzer) is reportedly aware of the contamination.
DT580	X		The Village of Derby Line Public Works Director stated that the Village will attempt to find and fix the municipal water leak discharging to this system.

5.1 DT020

The DT020 system drains a portion of Hinman Settler Road and discharges to the Clyde River at the bottom of Hinman Settler Road (Map DT-1).

Table 22. Water analysis data for outfall DT020

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
DT020	7/30/14 9/4/14 5/14/15	Flowing Flowing Flowing	0.10 0.10 --	0.10 0.06 --	0.00 0.10 --	435 405 --	Positive Positive --	Clear, slightly foamy, no odor Clear, no odor
DT020 CB1	9/4/14	Flowing	--	--	--	--	Positive	--
DT020 CB3	9/4/14	Flowing	--	--	--	--	Positive	--
DT020 Culvert 1	9/4/14	Flowing	--	--	--	--	Positive	--
DT020 Culvert 2	9/4/14 10/9/14	Dripping Trickling	-- 3.0	-- --	-- --	-- --	Positive --	Strong OB signal Strong wastewater odor

Findings:

- Optical brightener was detected throughout the DT020 system.
- On September 4, 2014, optical brightener monitoring pads were deployed throughout the drainage system and several structures were inspected. Optical brightener was present throughout the flowing portion of the drainage system. The strongest signal was detected at the outlet of culvert #2 (Map DT-1), which drains the property at 110 Hinman Settler Road.
- On October 9, 2014, wastewater effluent was observed seeping from the ground into the road ditch at 110 Hinman Settler Road and a high concentration of ammonia (3.0 mg/L) was measured in this seepage.
- On May 14, 2015, samples were collected at the outfall for *E. coli* and total phosphorus analysis. The *E. coli* concentration was elevated (450 MPN/100 mL) and the phosphorus concentration was low (Table 79). The discharge rate was 179 L/min, which likely means that any wastewater was substantially diluted.

Conclusion: We conclude that there is a malfunctioning septic system at 110 Hinman Settler Road that is discharging wastewater into the DT020 system.

Resolution: A letter detailing these findings was sent on October 14, 2014 to the DEC Regional Engineer, Steve Rebillard. On July 15, 2015, the problem was referred to enforcement by the DEC project manager.

5.2 DT030

The DT030 system drains a small portion of Hinman Settler Road and discharges to the Clyde River at the bottom of Hinman Settler Road (Map DT-1, Figure 6).

Figure 6. DT030 outfall

Table 23. Water analysis data for outfall DT030

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
DT030	7/17/14 9/4/14 5/14/15	Trickling Trickling Trickling	0.10 0.25 --	0.15 0.07 --	0.20 0.10 --	509 528 --	Positive Positive --	Clear, no odor Clear, no odor Wastewater odor
DT030 CB1	9/4/14	Trickling	--	--	--	--	Positive	Sewer odor

Findings:

- Optical brightener was detected at the outfall and in catchbasin CB1. Low concentrations of ammonia, MBAS, and chlorine have also been detected at the outfall.
- A steady flow of water was observed seeping from the yard on the northern end of the property at 31 Hinman Settler Road and discharging into CB1. This water has a wastewater odor.
- *E. coli* and total phosphorus concentrations in samples collected at the outfall on May 14, 2015 were surprisingly low considering that a wastewater odor was observed (Table 79).

Conclusion: Based on repeated testing and observations, we conclude that the house at 31 Hinman Settler Road has a malfunctioning septic system that is discharging into the DT030 system.

Resolution: A letter detailing these findings was sent on October 14, 2014 to the DEC Regional Engineer, Steve Rebillard. The problem was then referred to enforcement by the DEC project manager on July 15, 2015.

5.3 DT080

The DT080 system drains the complex behind Poulin Lumber and Sears along Route 5 and a portion of West Street. It discharges at a rip-rapped bank to the east of 462 West Street.

Table 24. Water analysis data for outfall DT080

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/10/14	Trickling	0.10	0.02	0.20	640	Negative	Clear, no odor
9/4/14	Trickling	0.10	0.03	0.00	142	--	Clear, no odor

Findings:

- On July 10, 2014, a very low concentration of MBAS (0.20 mg/L) was measured.
- No contaminants were detected in follow up sampling.

Conclusion: After repeated testing, we conclude that there is no illicit discharge in this system.

Resolution: NA

5.4 DT160

The DT160 system drains the parking lot in front of Shaw's Supermarket and discharges to the east of the parking lot (Map DT-2).

Table 25. Water analysis data for outfall DT160

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/17/14	Trickling	0.10	0.06	0.60	4,340	Negative	Clear, no odor
9/4/14	Dripping	0.10	0.08	0.10	655	--	Clear, no odor
10/1/14	Dry	--	--	--	--	--	--

Findings:

- Low chlorine concentrations (0.06 and 0.08 mg/L) were observed on two sampling dates, July 17 and September 4, 2014. A low MBAS concentration (0.60 mg/L) was also measured on July 17. Given the very high specific conductance measured on July 17 (presumably from deicing salt), the apparent MBAS detection is explained as a positive chemical interference from dissolved solids.
- There was little flow in this system on July 17 and September 4, 2014 and it was dry when assessed on October 1, 2014.

Conclusion: Based on the low contaminant concentrations measured, the negligible flows observed, and the fact that the system drains a parking lot, we do not suspect a chronic illicit discharge in this system.

Resolution: NA

5.5 DT230

The DT230 system drains a portion of Commons Road and most of the Price Chopper property. It discharges into a retention pond to the southwest of Price Chopper (Map DT-3).

Table 26. Water analysis data for outfall DT230

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
DT230	7/17/14 9/4/14	Dripping Dripping	0.25 0.10	0.08 0.09	0.25 0.10	164 86	Negative --	Clear, no odor Clear, no odor
DT230 CB1	9/4/14	Pipe A dry, Pipe B dripping	--	--	--	--	--	
DT230 CB-B1	9/4/14	Dry	--	--	--	--	--	--

Findings:

- On July 17, 2014, low ammonia (0.25 mg/L) and low MBAS (0.25 mg/L) concentrations were measured at the outfall.
- On July 17, 2014 and September 4, 2014, low chlorine concentrations (0.08 and 0.09 mg/L) were detected.

Conclusion: Low chlorine concentrations at the outfall may have resulted from landscape maintenance or outdoor washing. There are no water lines on Commons Road; therefore, the source of chlorine cannot be a municipal water leak in this area. We conclude that there is no chronic illicit discharge present in the DT230 system.

Resolution: NA

5.6 DT290

The DT290 system drains the parking lot of Northeast Kingdom Human Services at 181 Crawford Road and discharges into a detention pond on the same property.

Table 27. Water analysis data for outfall DT290

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/11/14	Dripping	0.25	0.07	--	--	Negative	Floating particles, no odor
10/1/14	Dripping	0.10	0.02	0.10	149	--	Clear, no odor

Findings:

- On July 11, 2014, low concentrations of ammonia (0.25 mg/L) and chlorine (0.07 mg/L) were detected.
- No contaminants or other indication of an illicit discharge were detected in repeated sampling.

Conclusion: We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

5.7 DT450

The DT450 system drains Dashner Drive and a portion of Elm Street before discharging into a retention basin across the street from 42 Dashner Drive.

Table 28. Water analysis data for outfall DT450

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/11/14	Trickling	0.00	0.13	0.10	354	Negative	Cloudy, suds, no odor
9/4/14	Dry	--	--	--	--	--	Construction completed
10/1/14	Dry	--	--	--	--	--	Construction completed

Findings:

- On July 11, 2014, a moderate concentration of chlorine (0.13 mg/L) was measured, the water appeared cloudy, and suds were observed around the outfall.
- On two follow up visits, no flow was observed at the outfall or in any catchbasins.
- Construction and testing of new fire hydrants in the vicinity of the DT450 system may have contributed to the observed flow and moderate chlorine concentration on July 11, 2014.

Conclusion: We conclude that there is no illicit discharge in this system.

Resolution: NA

5.8 DT540

The DT540 system drains the parking lot and grounds of the Tivoly Inc. manufacturing plant. It discharges to the Tomifobia River west of the Tivoly Inc. plant (Map DT-4).

Table 29. Water analysis data for outfall DT540

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/23/14	Flowing	0.25	0.01	0.10	1639	Negative	Clear, no odor, iron staining
9/4/14	Flowing	0.35	0.01	0.10	1681	--	Clear, no odor, iron staining

Findings:

- Low ammonia concentrations (0.25 and 0.35 mg/L) were measured at the outfall on two dates. No other contaminants were detected.
- John Deguise, Tivoly's environmental engineer, indicated that he would attempt to determine the source of ammonia in the drainage system.
- Mr. Deguise also noted that a municipal sewer manhole on Baxter Avenue regularly overflows to the Tomifobia River during moderate to high intensity rainfall events.
- The sanitary sewer overflow problem at a manhole on Baxter Avenue was confirmed by Brian Fletcher, Village of Derby Line Public Works Director, during an October 9, 2014 meeting. Mr. Fletcher indicated the overflows occur infrequently. According to Mr. Fletcher, the cause of the overflows is a flow restriction in siphons crossing under the Tomifobia River.
- Mr. Fletcher reported on February 18, 2015 that a Canadian company cleaned out the siphons within two weeks following our October 9, 2014 meeting and there were no overflows in the intervening period.

Conclusion: The ammonia concentrations measured are low and may result from air conditioning condensate, from conditions related to historic hydrocarbon releases, or from an unknown cause. Given restricted access to this private facility, we cannot determine if there is an existing connection to the stormwater system.

The sanitary sewer overflows apparently occurring at a manhole on Baxter Avenue require active management.

Resolution: The Tivoly Inc. environmental engineer, John Deguise, stated that no direct connections between interior drains and the stormwater system were identified.

The sewer siphons under the Tomifobia River were cleaned in October 2014 to eliminate or reduce combined sewer overflows. Because overflows in this location may become a chronic problem, we recommend that the DEC Wastewater Management Division work with the Village of Derby Line to develop a routine maintenance plan or a more permanent solution.

5.9 DT550

The DT550 outfall drains an unknown source. The outfall discharges to the Tomifobia River west of the Tivoly Inc. plant (Map DT-4).

Table 30. Water analysis data for outfall DT550

Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/23/14	Flowing	0.25	0.00	0.20	1138	Negative	Clear, no odor
9/4/14	Flowing	0.25	0.02	0.10	1130	--	Clear, oil odor

Findings:

- A very low MBAS concentration (0.20 mg/L) and two low ammonia detections (0.25 mg/L) were measured at the outfall.
- On September 4, 2014, a petroleum odor was observed emanating from a water sample collected at the outfall.

Conclusion: We suspect that soil and groundwater contamination from industrial activities may be contributing the petroleum odor observed at the outfall. The Tivoly Inc. environmental engineer, John Deguise, explained that Vermont DEC (John Schmeltzer) is aware of the petroleum contamination issue.

Resolution: By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.

5.10 DT580

The DT580 system drains portions of Caswell Avenue and Pelow Hill Road before discharging across the border into Canada. This system was assessed at the catchbasin on the U.S. side of the border that is closest to the outfall.

Table 31. Water analysis data for outfall DT580

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
DT580 CB1	7/17/14	Flowing	0.10	0.00	0.30	1394	Negative	Clear, no odor
	9/4/14	Pipe B flowing	0.00	0.02	0.20	1440	--	Clear, no odor
	10/9/14	Flowing	0.00	0.60	--	--	--	Clear, no odor
DT580 CB2	9/4/14	Flowing	0.00	0.03	0.10	1436	--	Clear, no odor
	10/9/14	Flowing	0.00	0.62	0.00	485	--	Clear, no odor
DT580 CB3	9/4/14	Dry	--	--	--	--	--	--
	10/9/14	Dry	--	--	--	--	--	--

Findings:

- On July 17, 2014 and September 4, 2014, low concentrations of MBAS (0.30 and 0.20 mg/L respectively) were measured.
- No contaminants were detected in CB2 and CB3 was completely dry.
- On October 9, 2014, high chlorine concentrations were detected at catchbasin CB1 (0.60 mg/L) and CB2 (0.62 mg/L). A drainage system recently installed on a nearby property and connected to the stormline between CB3 and CB2 is believed to have intercepted flow from a leaking municipal water line. The Director of Public Works, Brian Fletcher, was informed of this finding immediately.

Conclusion: Based on repeated testing, we do not believe there is a chronic wastewater or washwater discharge in this system. However, the water leak identified on October 9, 2014 was significant.

Resolution: The Village of Derby Line Public Works Director stated that the Village will attempt to find and fix the municipal water leak discharging to this system.

6. ORLEANS RESULTS

Illicit discharge detection in Orleans was performed during the summer of 2014. Of the 36 systems assessed, 17 were either flowing or dripping during dry weather. Eleven systems were designated for further investigation due to detection of one or more contaminants. The status of these investigations is summarized in Table 32 and the systems are described in detail below.

Table 32. Status of investigations in Orleans

Structure ID	Simple AI	Complex AI	Status
OR030	X		No chronic illicit discharge.
OR070	X		The Village of Orleans inspected plumbing in houses on Cliff Street and adjacent High Street. A direct laundry connection was discovered from a house at 6 High Street to the Cliff Street stormline. The homeowner had a plumber connect the washing machine to the sanitary sewer and cap the cross-connected line.
OR110	X		Petroleum odors and sheen observed at the outfall and in catchbasins on Main Street are consistent with groundwater contamination at the Irving station (84 Main Street) and/or at 100 Main Street, which are known hazardous waste sites. By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.
OR140	X		No chronic illicit discharge.
OR200	X		No chronic illicit discharge.
OR220	X		Multiple explanations for the low concentrations of chlorine and MBAS are being considered. Further investigation is being performed under DEC contract 28937.
OR240	X		No chronic illicit discharge.
OR260	X		No chronic illicit discharge.
OR320	X		Petroleum odors and sheen observed at the outfall may result from groundwater contamination at the Irving station (84 Main Street) and/or at 100 Main Street, which are known hazardous waste sites. By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.
OR340	X		No chronic illicit discharge.
OR360	X		On October 22, 2014, in a meeting with the Orleans Village Manager, the manager of Village Pizza agreed to prohibit Village Pizza employees from disposing of washwater in the catchbasin on the property.

6.1 OR030

The OR030 system drains portions of Route 5, Irasburg Street, and Prospect Street before discharging to the Barton River on the western side of the Railroad Avenue bridge crossing (Map OR-1).

Table 33. Water analysis data for outfall OR030

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Cond. (µs/cm)	OB Result	Observations
OR030	8/19/14	Flowing	0.10	0.01	0.10	739	Negative	Clear, no odor
OR030 CB5	9/4/14	--	--	--	--	--	Negative	--
OR030 CB6	8/19/14	Pipe A: Flowing Pipe B: Dripping	--	--	--	--	Indeterminate	--
	9/4/14	Pipes A & B: Trickling	--	--	--	--	Negative	--
OR030 CB-A7	9/4/14	--	--	--	--	--	Negative	--
OR030 CB-B7	9/4/14	Pipes A & B: Dripping	--	--	--	--	Negative	--
OR030 CB-AB8	9/4/14	--	--	--	--	--	Negative	--

Findings:

- On the August 19, 2014 assessment date, there was no indication of contamination at the outfall; however, the optical brightener result at catchbasin CB6 was indeterminate, warranting retesting.
- On September 4, 2014, OB monitoring pads were placed throughout the system and no optical brightener was detected.

Conclusion: After repeated testing, we conclude that there is no illicit discharge in this system.

Resolution: NA

6.2 OR070

The OR070 system drains Cliff Street and a portion of North Avenue before discharging to the Barton River just north of the North Avenue sewer pump station (Map OR-2).

Table 34. Water analysis data for outfall OR070

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Cond. (µs/cm)	OB Result	Observations
OR070	8/19/14 8/26/14 9/4/14 5/15/14	Flowing Wet (no flow) Flowing Flowing	0.10 -- -- --	0.04 -- -- --	0.20 -- -- --	517 -- -- --	Positive -- Positive --	Clear, no odor -- -- Clear, no odor
OR070 CB1	9/4/14	Pipe A: Dry Pipe B: Flowing	--	--	--	--	Positive	--
OR070 CB-2B	9/4/14	Pipe A: Dripping Pipe B: Flowing	--	--	--	--	Positive	--
OR070 CB-3B	9/4/14	Flowing	--	--	--	--	Positive	--
OR070 CB-3AB	9/4/14	Dripping	--	--	--	--	Negative	--
OR070 CB-6B Pipe A	9/4/14	Flowing	--	--	--	--	Negative	--
OR070 CB-6B Pipe B	9/4/14	Flowing	--	--	--	--	Positive	--

Findings:

- Strong optical brightener fluorescence was observed on pads placed at the outfall on two occasions. On September 4, 2014, monitoring pads were placed throughout the drainage system and optical brightener was detected in catchbasins up Cliff Street, but not in those along North Avenue.
- A very low total phosphorus concentration (20 µg/L) and no *E. coli* were measured in samples collected at the outfall on May 14, 2014 (Table 79).

Conclusion: During an October 21, 2014 meeting, the Village Manage (John Morley III) and the Wastewater Plant Chief Operator (Tim Willis) stated that the Village would work with the homeowners to pinpoint the illicit connection and correct it.

Resolution: The Village of Orleans inspected plumbing in houses on Cliff Street and adjacent High Street. A May 28, 2015 email communication from John Morley III stated that a direct laundry connection was discovered from a house at 6 High Street to the Cliff Street stormline. The homeowner had a plumber connect the washing machine to the sanitary sewer and cap the cross-connected line.

6.3 OR110

The OR110 system drains Main Street, South Avenue, and the Vermont Liquor Outlet and True Value Hardware properties. The system also drains portions of North Avenue, Cross Street, and Prospect Street. The system discharges beneath the Main Street bridge (Map OR-3).

Table 35. Water analysis data for outfall OR110

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Cond. (µs/cm)	OB Result	Observations
OR110	8/19/14	Flowing	0.25	0.04	0.10	1318	Negative	Clear, oil odor
	9/19/14	Flowing	0.25	--	--	1244	--	Clear, oil odor
OR110 CB5	8/19/14	Pipe A: Flowing Pipe B: Dripping	--	--	--	--	Negative	--
	10/1/14	Flowing	--	--	--	--	--	No oil odor in sump
OR110 CB6	8/19/14	Pipe A: Flowing Pipe B: Dry	--	--	-	--	--	--
OR110 CB8	8/19/14	Pipe A: Flowing Pipe B: Flowing	--	--	--	--	Negative	--
	9/19/14	Pipe A: Flowing Pipe B: Trickle	0.25	--	--	1218	--	Clear, strong oil odor
	10/1/14	Flowing	--	--	--	--	--	Strong oil odor in sump
OR110 CB-8B	10/1/14	--	--	--	--	--	--	No oil odor in sump
OR110 CB9	8/19/14	Pipe A: Flowing Pipe B: Flowing	--	--	--	--	Negative	--
	9/19/14	--	--	--	--	--	--	Oil odor in sump
	10/1/14	Flowing	--	--	--	--	--	Strong oil odor in sump
OR110 CB10	8/19/14	Pipe A: Dry Pipe B: Flowing	--	--	--	--	Negative	--
	9/19/14	Pipe A: Dry Pipe B: Flowing	0.10	--	--	1034	--	Clear, no odor
	10/1/14	Flowing	--	--	--	--	--	No oil odor in sump

Findings:

- On September 19, 2014, the same low ammonia concentration (0.25 mg/L) was measured at the outfall and at catchbasin CB8.
- An oil odor was detected in samples taken at the outfall and catchbasin CB8. A strong oil odor and an oily sheen were observed in the sumps of CB8 and CB9. No oil odor or sheen was detected in the sample or sump of CB10.
- The Vermont ANR Natural Resources Atlas indicates there are hazardous waste sites at the Irving Station (84 Main Street) and at 100 Main Street with soil and groundwater contamination from gasoline and kerosene.

Conclusion: We suspect that petroleum contaminated groundwater from the Irving Station and/or the adjacent property is entering the OR110 system between catchbasins CB8 and CB10.

Resolution: By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.

6.4 OR140

The OR140 system drains a portion of Maple Street before discharging to the Willoughby River just north of the home at 74 Maple Street.

Table 36. Water analysis data for outfall OR140

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
8/19/14	Flowing	0.25	0.07	0.30	568	Negative	Clear, no odor
9/19/14	Flowing	0.10	0.02	0.10	580	--	Clear, no odor
10/1/14	Flowing	0.10	0.03	0.10	583	--	Clear, no odor

Findings:

- On August 19, 2014, low concentrations of ammonia (0.25 mg/L), chlorine (0.07 mg/L), and MBAS (0.30 mg/L) were measured.
- No contaminants were detected on two follow-up sampling dates.

Conclusion: We suspect that the low levels of contaminants measured on August 19, 2014 were transient and that no chronic illicit discharge is present in this system.

Resolution: NA

6.5 OR200

The OR200 system drains the property at 80 Water Street and a portion of Water Street.

Table 37. Water analysis data for outfall OR200

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
OR200	8/19/14	Trickling	0.25	0.07	0.20	1683	Negative	Clear, no odor
	9/23/14	Trickling	0.00	0.02*	0.10	1637	--	Clear, no odor
	10/1/14	Trickling	0.00	0.03	0.10	1596	--	Clear, no odor
OR200 CB1	9/23/14	Trickling	0.10	0.01*	0.20	1830	--	Clear, no odor
	10/1/14	Pipes A&B: Trickling	0.10	0.04	0.10	1700	--	--
OR200 CB2	10/1/14	Dry	--	--	--	--	--	--
* = Total chlorine								

Findings:

- The homeowner stated that the system drains a natural spring on the south side of her property at 80 Water Street.

- On August 19, 2014, low concentrations of ammonia (0.25 mg/L), chlorine (0.07 mg/L), and MBAS (0.20 mg/L) were measured at the outfall.
- No contaminants were detected at the outfall on two subsequent dates.

Conclusion: We suspect that the low levels of contaminants measured on August 19, 2014 were transient and that no chronic illicit discharge is present in this system.

Resolution: NA

6.6 OR220

The OR220 system drains portions of South Street and a gravel road (Figure 7) along the eastern perimeter of the Ethan Allen facility.

The system discharges to the Barton River directly northwest of the sewer pump station behind 16 South Street (Map OR-4).

Figure 7. Eastern side of Ethan Allen facility in area drained by OR220

Table 38. Water analysis data for outfall OR220

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
OR220	8/19/14 9/23/14	Trickling Trickling	0.10 0.10	0.02 0.03*	0.2 0.2	932 966	Negative --	Clear, no odor Cloudy, no odor
OR220 CB1 Pipe A	9/23/14 6/18/15	Trickling Flowing	0.10 0.00	0.03* 0.05	0.1 0.0	933 --	-- --	Clear, no odor Clear, no odor
OR220 CB1 Pipe B	9/23/14 10/1/14 6/18/15	Dripping Dripping Trickling	0.10 0.40 0.00	0.33* 0.13 0.13,0.03	0.5 0.5 0.2	1087 1248 ---	-- -- --	Cloudy, no odor Cloudy, slight odor Cloudy, no odor
OR220 CB2	10/1/14	Wet (no flow)	--	--	--	--	--	--
*= Total chlorine								

Findings:

- On August 19, 2014 and September 23, 2014, the same very low concentration of MBAS (0.20 mg/L) was measured at the outfall.
- On September 23 and October 1, 2014, a low concentration of MBAS (0.50 mg/L) was measured at CB1 Pipe B. Moderate concentrations of chlorine were measured on both dates (0.33 mg/L total chlorine on September 23 and 0.13 mg/L free chlorine on October 1). On October 1, a low ammonia concentration (0.40 mg/L) was also measured.
- On June 18, 2015, both pipes discharging to catchbasin CB1 were sampled. In Pipe B, chlorine was initially detected but was below detection in a second sample. Turbidity in the sample may have resulted in these inconsistent readings.
- Remnants of clay and steel pipes were found in three locations along the toe of the slope between CB1 and CB2. At these and other locations water was seeping from the bank onto the gravel drive below.
- On June 18, 2015, dye was added to a toilet in one of the South Street Apartments, located at the top of the bank. No dye was observed in the OR220 system or at any of the seeps at the toe of the slope.

Conclusion: Based on repeated detection of chlorine and MBAS at CB1 Pipe B and the absence of flow at CB2, we initially suspected an illicit connection from the Ethan Allen manufacturing plant to the stormdrain between CB2 and CB1. However, an Ethan Allen representative confirmed that there are no interior drains in the northern portion of the facility adjacent to the stormdrain. A second explanation considered was that there is a cross connection from the sanitary sewer line to one of the mapped footing drains on the slope below the South Street Apartments. However, this explanation is not convincing because we could not find any intact drains on the slope, only pipe remnants, and the one apartment we visited appeared to be properly connected to the sanitary sewer. Another possibility is that the low concentrations of MBAS and chlorine simply result from measurement errors due to excessive turbidity in the samples.

Resolution: Further investigation of this system will be considered under DEC contract 28937.

6.7 OR240

The OR240 system drains portions of Railroad Avenue and the Ethan Allen property before discharging to the Barton River east of the railroad bridge (Map OR-4).

Table 39. Water analysis data for outfall OR240

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
OR240	8/19/14	Trickling	0.25	0.11	0.30	1660	Negative	Clear, no odor
	9/23/14	Trickling	0.10	0.05*	0.20	1635	--	Clear, no odor
	10/1/14	Trickling	0.10	0.04	0.20	1597	--	Clear, no odor
	10/21/14	Flowing	0.10	0.02	0.20	268	--	Cloudy, no odor
OR240 CB2	9/23/14	Dry	--	--	--	--	--	--
	10/1/14	Dry	--	--	--	--	--	--
*= Total chlorine								

Findings:

- Low concentrations of ammonia (0.25 mg/L) and chlorine (0.11 mg/L) were measured at the outfall on August 19, 2014 but were not observed in subsequent sampling.
- Low MBAS concentrations (0.30 mg/L, 0.20 mg/L, 0.20 mg/L, and 0.20 mg/L) were measured at the outfall on each sampling date. However, we suspect that high dissolved solids content (measured as high specific conductance) interfered with the MBAS analysis.
- All catchbasins in the system were dry.

Conclusion: MBAS detergent concentrations measured at the outfall are believed to have resulted from a positive chemical interference. Elevated chlorine and low ammonia concentrations measured on the first sampling date were not detected on two subsequent dates. Therefore, we conclude that there is no chronic illicit discharge in this system.

Resolution: NA

6.8 OR260

The OR260 system drains the central portion of the Ethan Allen property between the loading docks and rail yard. It discharges to the Barton River at a railroad crossing (Map OR-5).

Table 40. Water analysis data for outfall OR260

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
8/19/14	Trickling	0.25	0.05	0.10	840	Negative	Clear, no odor
9/23/14	Trickling	0.10	0.02*	0.10	521	--	Foam at outfall, no odor
10/21/14	Trickling	0.10	0.02	0.00	491	--	Clear, no odor
*= Total chlorine							

Findings:

- A low concentration of ammonia (0.25 mg/L) was measured at the outfall on August 19, 2014.
- No other contaminants were detected after repeated testing.

Conclusion: After repeated testing, we conclude that there is no illicit discharge in this system.

Resolution: NA

6.9 OR320

The OR320 system discharges to the Barton River at the northern end of the Ethan Allen property (Map OR-3). There do not appear to be any connected stormwater inlets. The outfall pipe (Figure 8) was reportedly replaced sometime between May 2013 and August 2014 after a sinkhole developed nearby due to an old tile drain.

Figure 8. OR320 outfall

Table 41. Water analysis data for outfall OR320

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
8/19/14	Flowing	0.75	0.00	0.20	1594	Negative	Orange floc, iron staining, petroleum odor
9/23/14	Flowing	0.75	0.00*	0.10	1184	--	Orange floc, iron staining, petroleum odor
*= Total chlorine							

Findings:

- Significant iron staining and an oil/gas odor were noted during both sampling visits. The same moderate ammonia concentration (0.75 mg/L) was measured on August 19, 2014 and September 23, 2014.

Conclusion: We suspect this system is conveying petroleum contaminated groundwater from the site of the Irving gas station on Main Street, which is a DEC listed hazardous waste site.

Resolution: By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.

6.10 OR340

The OR340 system drains the residential neighborhood bordered by Water Street and Willoughby Avenue. It discharges to the Barton River just south of the Main Street bridge crossing.

Table 42. Water analysis data for outfall OR340

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
OR340 CB2	8/19/14 10/1/14	Flowing Trickling	0.10 0.00	0.03 0.01	0.20 0.10	876 948	Negative --	Clear, no odor Clear, no odor
OR340 CB6	8/19/14 10/1/14	Trickling Trickling	0.25 0.10	0.02 0.01	0.10 0.10	935 950	Negative --	Clear, no odor Clear, no odor
OR340 CB6-A	8/19/14 10/1/14	Trickling Trickling	0.25 0.00	0.04 0.02	0.10 0.10	810 800	Negative --	Clear, no odor Clear, no odor

Findings:

- A very low MBAS concentration (0.20 mg/L) was measured on August 19, 2014 at catchbasin CB2. No other contaminants were detected. MBAS was not detected in follow-up sampling on October 1, 2014.
- The same low ammonia concentration (0.25 mg/L) was detected on August 19, 2014 at catchbasins CB6 and CB6-A. The ammonia concentration in these structures was below detection on October 1, 2014.

Conclusion: After repeated testing, we conclude that there is no chronic illicit discharge present in this system.

Resolution: NA

6.11 OR360

The OR360 system drains one catchbasin on the Village Pizza property and discharges to the Barton River on the eastern side of the railroad tracks (Map OR-5).

Table 43. Water analysis data for outfall OR360

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
8/19/14	Flowing	0.40	0.00	0.1	918	Negative	Clear, oil odor
10/3/14	Dripping	0.00	0.11	0.1	920	--	Clear, no odor
10/21/14	Trickling	0.1	0.00	0.1	702	--	Clear, no odor

Findings:

- On August 19, 2014, a low concentration of ammonia (0.40 mg/L) was measured at the outfall. During a follow up visit on October 3, 2014, a moderate concentration of chlorine (0.11 mg/L) was measured.
- On both dates, CB1 was dry.

Conclusion: We suspect employees of Village Pizza were dumping washwater to a catchbasin on the property.

Resolution: On October 22, 2014, the Orleans Village Manager met with the manager of Village Pizza, who indicated he would prohibit employees from disposing of washwater in the catchbasin on the property. No connected internal drains were identified.

7. NEWPORT CITY RESULTS

Illicit discharge detection in Newport City was performed during the summer and fall of 2014. Of the 180 systems assessed, 37 were either flowing or dripping during dry weather. Thirty-five systems were designated for further investigation due to the detection of one or more contaminants. Stone was able to complete simple investigations at all systems; however, more complex levels of investigation warranted for eight systems could not be completed within the scope and budget of the contract. Completion of the investigations of these eight systems will be performed under a follow-up contract recently awarded to Stone.

The status of the Newport City illicit discharge investigations is summarized in Table 44 and the systems are described in detail below.

Table 44. Status of investigations in Newport City

Structure ID	Simple AI	Complex AI	Status
NC060	X		No chronic illicit discharge.
NC100	X		No chronic illicit discharge.
NC110	X		No chronic illicit discharge.
NC120		X	We suspect a washwater connection from an adjacent commercial building is entering the drain. Further investigation is being performed under DEC contract 28937.
NC200	X		An ongoing discharge of washwater was confirmed from a funeral home parking lot and garage into a connected catchbasin. This problem was referred to the Newport City Public Works in a meeting held on March 10, 2015.
NC230		X	We suspect a washwater connection from an adjacent commercial building is entering the drain. Further investigation is being performed under DEC contract 28937.
NC270	X		No chronic illicit discharge.
NC290	X		No chronic illicit discharge.
NC310 CB1	X		No chronic illicit discharge.
NC350 MH1 Pipe A		X	The results to date have been inconclusive. Further investigation is being performed under DEC contract 28937.
NC350 MH1 Pipe B	X		The results to date have been inconclusive. Further investigation is being performed under DEC contract 28937.
NC360 CB1		X	The results to date have been inconclusive. Further investigation is being performed under DEC contract 28937.
NC470 CB1	X		We suspect petroleum contaminated groundwater is entering the system from the 1 Gardner Street property. By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.
NC510	X		We suspect petroleum contaminated groundwater is entering the system from the 1 Gardner Street property. By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.
NC520	X		No chronic illicit discharge.

Structure ID	Simple AI	Complex AI	Status
NC580	X		No chronic illicit discharge.
NC620	X		No chronic illicit discharge.
NC640		X	Infrastructure mapping in error. No chronic illicit discharge.
NC660 CB1	X		No chronic illicit discharge.
NC680		X	Possible washwater discharge to catchbasin CB4. Further investigation is being performed under DEC contract 28937.
NC700	X		No chronic illicit discharge.
NC820	X		No chronic illicit discharge.
NC880 CB1		X	We suspect an intermittent washwater discharge somewhere in this system. Efforts to isolate the source have been unsuccessful. Further investigation is being performed under DEC contract 28937.
NC1010	X		We suspect there is a municipal water leak between catchbasin CB1 and the outfall. This issue has been referred to the Newport City Public Works Department.
NC1050		X	Sanitary wastewater flow identified from the property of the Newport City Elementary School. Further investigation was performed under DEC contract 28937 in cooperation with the City.
NC1080	X		No chronic illicit discharge.
NC1100	X		No chronic illicit discharge.
NC1120	X		No chronic illicit discharge. Possible groundwater contamination.
NC1350	X		No chronic illicit discharge.
NC1420	X		No chronic illicit discharge.
NC1480	X		No chronic illicit discharge.
NC1490	X		Dry weather flows from this CSO outfall may be due to a municipal water leak. We recommend Newport City inspect water lines in this vicinity as well as the wastewater pump station for possible leaks.
NC1570 CB1	X		Air conditioning condensation is generally considered an allowable discharge. Given the negligible flow and relatively low contaminant concentrations observed in the system, we conclude that no action is warranted.
NC1580	X		Air conditioning condensation is generally considered an allowable discharge. Given the small flows and relatively low contaminant concentrations observed at the outfall, we conclude that no action is warranted.
NC1720	X		No chronic illicit discharge.

7.1 NC060

The NC060 system drains a single catchbasin located on the Genesis Healthcare property at 35 Bel-Aire Drive. It discharges behind the same property.

Table 45. Water analysis data for outfall NC060

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/16/14	Dripping	0.25	0.01	0.20	1390	Negative	Clear, no odor
10/13/14	Wet, no flow	--	--	--	--	--	--
11/25/14	Trickling	0.00	0.02	0.20	1235	--	Clear, no odor

Findings:

- On June 16, 2014, a low ammonia concentration (0.25 mg/L) and a low MBAS concentration (0.20 mg/L) were measured at the outfall.
- On November 25, 2014, a low MBAS concentration (0.20 mg/L) was measured at the outfall.

Conclusion: The low MBAS concentrations measured on June 16 and November 25, 2014 likely resulted from positive chemical interference by dissolved anions, consistent with the moderately high specific conductance recorded on both dates. We conclude that there is no illicit discharge in this system.

Resolution: NA

7.2 NC100

The NC100 system drains a portion of Scottsdale Road before discharging between the properties at 37 and 71 Scottsdale Road.

Table 46. Water analysis data for outfall NC100

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/16/14	Flowing	0.25	0.03	0.10	682	Indeterminate	Clear, no odor
7/23/14	Flowing	--	--	--	--	Negative	--
10/13/14	Flowing	0.10	0.00	0.00	441	--	Clear, no odor
11/25/14	Flowing	0.00	0.00	0.10	733	--	Clear, no odor. Discharge=15 L/min

Findings:

- On June 16, 2014, a low ammonia concentration (0.25 mg/L) was measured at the outfall and the optical brightener result was indeterminate.
- A second optical brightener test yielded a negative result.
- No contaminants were detected in sampling on October 13 and November 25, 2014.

Conclusion: We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.3 NC110

The NC110 system drains portions of Farrant Street, Lake Road, and Orchard Road. The system discharges to a sediment trap located behind 34 and 84 Farrant Street (Map NC-1).

Table 47. Water analysis data for outfall NC110

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/16/14	Flowing	0.25	0.03	0.20	669	Negative	Clear, no odor
10/13/14	Flowing	0.10	0.02	0.00	591	--	Clear, no odor
11/25/14	Flowing	0.00	0.03	0.10	613	--	--

Findings:

- On June 16, 2014, low ammonia (0.25 mg/L) and MBAS (0.20 mg/L) concentrations were measured at the outfall.
- No contaminants were detected when sampling was repeated on October 13 and November 25, 2014.

Conclusion: We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.4 NC120

The NC120 outfall discharges to the NC110 system within the pipe section immediately above the sediment trap. There are no known surface inlets to this system. The NC120 outfall pipe is oriented toward a commercial building at 84 Farrant Street (Map NC-1).

Table 48. Water analysis data for outfall NC120

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/16/14	Flowing	0.00	0.02	0.60	449	Negative	Clear, no odor
10/13/14	Dripping	0.75	0.00	0.00	600	--	Clear, sewage odor
11/25/14	Flowing	0.00	0.02	0.10	338	--	Clear, iron odor

Findings:

- On June 16, 2014, a moderate MBAS concentration (0.60 mg/L) was measured at the outfall.
- On October 13, 2014, a moderate concentration of ammonia (0.75 mg/L) was detected.
- No contaminants were detected on November 25, 2014.

Conclusion: Based on detections of MBAS and ammonia on separate dates and the orientation of the outfall pipe, we suspect washwater enters this system via one or more interior building drains.

Resolution: This investigation is being completed under a separate contract, in cooperation with the Newport City Public Works Department.

7.5 NC200

The NC200 system drains portions of Main Street, West Main Street, and Clark Street before discharging directly to Lake Memphremagog south of 112 Lake Road.

Table 49. Water analysis data for outfall NC200

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/16/14	Trickling	0.00	0.02	0.20	514	Negative	Clear, no odor
10/13/14	Trickling	0.00	0.05	0.20	376	--	Tan, no odor
11/25/14	Trickling	0.00	0.04	0.30	1260	--	--

Findings:

- On June 16, 2014 and October 13, 2014, the same low MBAS concentration (0.20 mg/L) was measured.
- On October 13, 2014, a car was being washed directly over a connected catchbasin in the parking lot of the Curtis-Britch Funeral Home.
- On November 25, 2014, a low MBAS concentration (0.30 mg/L) was measured and petroleum sheen was apparent on the lake's surface below the outfall. The petroleum was traced to the catchbasin in the parking lot of the Curtis-Britch Funeral Home. Funeral home employees explained there had recently been a small fuel spill from a vehicle in the parking lot and that hearses are washed over the catchbasin in front of the garage almost daily. Stone informed the employees that the catchbasin is connected to a nearby outfall that discharges to Lake Memphremagog. The employees explained that there was no workable alternative because the parking lot slopes to the catchbasin. A floor drain within the garage is also reportedly connected to the catchbasin in question. The employees inquired whether using a non-toxic detergent would solve the problem.

Conclusion: We conclude that the MBAS detected in this system is from regular vehicle washing over a catchbasin in the parking area of the Curtis-Britch Funeral Home.

Resolution: A permanent, structural solution to this chronic problem is needed. In a March 10, 2015 meeting with the City Manager (John Ward) and the Director of Public Works (Tom Bernier), Stone recommended that Newport City work with the property owner to develop a permanent solution.

7.6 NC230

The NC230 system drains portions of Main Street, Governor Drive, Third Street, Summer Street, and Pleasant Street. It discharges directly to Lake Memphremagog across from 477 Main Street (Map NC-2).

Table 50. Water analysis data for outfall NC230

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC230	6/16/14	Trickling	0.25	0.11	0.50	397	Negative	Clear, no odor
	10/13/14	Dripping	0.25	0.82	--	320	--	Cloudy, no odor
	11/25/14	Trickling	0.00	0.09	0.20	1075	--	Clear, no odor
	11/25/14	Trickling	--	0.04	--	--	--	--
CBA, CBB, CBC	11/25/14	Wet, no flow	--	--	--	--	--	--
CBF	6/16/14	Trickling	--	0.02	0.10	--	--	--
	10/13/14	Dripping	0.10	0.06	0.10	106	--	Clear, no odor
CBG Pipe A	11/25/14	Dripping	0.00	0.02	--	--	--	--
CBG Pipe B	11/25/14	Trickling	0.00	0.09	--	--	--	--
	11/25/14	Trickling	0.00	0.00	--	--	--	--
CBH	11/25/14	Wet, no flow	--	0.00	--	--	--	--
CBI	6/16/14	Trickling	--	0.06	0.10	--	--	--

Findings:

- On June 16, 2014, low concentrations of ammonia (0.25 mg/L), MBAS (0.50 mg/L), and chlorine (0.11 mg/L) were measured at the outfall.
- On October 13, 2014, a low concentration of ammonia (0.25 mg/L) and high concentration of chlorine (0.82 mg/L) were measured at the outfall. It is possible this was related to a house being washed between catchbasin CBF the outfall, although there was no apparent runoff to nearby structures.
- On November 25, 2014, low chlorine (0.09 mg/L) and MBAS (0.20 mg/L) concentrations were measured at the outfall. The source of chlorine appeared to be from CBG Pipe B (0.09 mg/L). However, we were unable to isolate a source of contamination on this line above CBG and when CBG Pipe B was resampled an hour later no chlorine was detected.

Conclusion: Given the types of contaminants present and the intermittent pattern in their concentrations, we suspect a washwater contribution to this system in the vicinity of catchbasin CBG, perhaps from a connected floor drain in a commercial building. Given the proximity of CBG to the gas station at the corner of Main Street and 3rd Street, this building is the likeliest source.

Resolution: This investigation will be completed under a separate contract, in cooperation with the Newport City Public Works Department.

7.7 NC270

The NC270 system drains portions of Second Street, Prospect Street, Green Place, Third Street, Cottage Street, and Raymond Avenue. It discharges to a culvert at the bottom of Second Street.

Table 51. Water analysis data for outfall NC270

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC270	6/16/14	Wet, no flow	--	--	--	--	Positive	--
	10/3/14	Dry	--	--	--	--	Negative	--
	11/25/14	Wet, no flow	--	--	--	--	Negative	No odor
	12/9/14	Wet, no flow	--	--	--	--	--	--
	5/7/15	Dry	--	--	--	--	--	--
NC270 CB4	10/3/14	Dry	--	--	--	--	Negative	--
NC270 MH4	10/3/14	Dry	--	--	--	--	Negative	--
NC270 CB5	10/3/14	Dry	--	--	--	--	Negative	--
NC270 CB6	10/3/14	Dry	--	--	--	--	Negative	--
NC270 CB7	10/3/14	Dry	--	--	--	--	Negative	--
NC270 CB1	11/25/14	Wet, no flow	--	--	--	--	Negative	--

Findings:

- Optical brightener was detected on a pad placed at the outfall on June 16, 2014.
- No optical brightener was detected on monitoring pads deployed throughout the system on October 3, 2014.
- Optical brightener monitoring pads placed at the outfall and CB1 on November 25, 2014 were negative.
- No dry weather flow has been observed in this system.

Conclusion: The absence of dry weather flow and the fact that optical brightener did not reoccur at the outfall suggests that there is no chronic illicit discharge in this system.

Resolution: NA

7.8 NC290

The NC290 system drains portions of Coventry Street and Central Street before discharging directly to Lake Memphremagog behind 199 Coventry Street.

Table 52. Water analysis data for outfall NC290

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC290	7/17/14	Flowing	0.25	0.02	0.00	396	--	Debris collected at outfall
	10/13/14	Dry	--	--	--	--	--	--
NC290 MH1	7/17/14	--	--	--	--	--	Neg.	Rotting odor
	11/25/14	Surcharged	--	--	--	--	--	Rotting odor, debris
NC290 MH3	11/25/14	Wet, no flow	--	--	--	--	--	--

Findings:

- On July 17, 2014, a low concentration of ammonia (0.25 mg/L) was measured at the outfall. An OB m pad deployed in the first structure up-pipe from the outfall, manhole MH1, was negative.
- On October 13, 2014 the outfall was dry and on November 25, 2014 there was no flow at accessible points above manhole MH1, which was surcharged by Lake Memphremagog.

Conclusion: We suspect that the low ammonia concentration measured on July 17, 2014 resulted from decomposition of material washed into manhole MH1 from the Lake Memphremagog. We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.9 NC310

The NC310 system drains portions of Fyfe Drive and Bayview Street before discharging to Lake Memphremagog east of the marina at 84 Fyfe Drive. The outfall is inaccessible and partially submerged.

Table 53. Water analysis data for outfall NC310

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC310 CB1	6/17/14	Flowing	0.25	0.06	0.10	83	Negative	Clear, sewer odor in sump
	10/13/14	Dry	--	--	--	--	--	--
	11/25/14	Wet, no flow	--	--	--	--	--	--
NC310 CB2	11/25/14	Wet, no flow	--	--	--	--	--	--

Findings:

- On June 17, 2014, low concentrations of ammonia (0.25 mg/L) and chlorine (0.06 mg/L) were measured in the sump of catchbasin CB1.
- Catchbasin CB1 was dry during a visit on October 13, 2014.

- On November 25, 2014, there was no flow in catchbasins CB1 or CB2 or any of the three off-line catchbasins in the vicinity of the boathouse.

Conclusion: Based on the very low contaminant concentrations found in CB1 on the initial assessment date and the lack of dry weather flow in the system on subsequent dates, we conclude there is no chronic illicit discharge in this system.

Resolution: NA

7.10 NC350

The NC350 system consists of two main branches. Branch A drains a portion of the Lake Memphremagog waterfront north of 100 Main Street. Branch B drains the 70 and 100 Main Street properties and portions of Main Street and Second Street (Map NC-3). Branches A and B converge in the first manhole (MH1) above the outfall. MH1 was assessed because the outfall is partially submerged.

Table 54. Water analysis data for outfall NC350

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC350 MH1 Pipe A	6/17/14	Trickling	0.40	0.21	0.40	209	--	Clear, no odor
	10/13/14	Dripping	0.10	0.07	0.10	76	--	Clear, no odor
	11/25/14	Trickling	0.00	0.01	0.20	--	--	--
	5/7/15	Wet, no flow	--	--	--	--	--	--
NC350 CB-1A	6/17/14	Trickling	--	--	--	--	Negative	--
	5/7/15	Wet, no flow	--	--	--	--	--	No odor
NC350 CB-2A	6/17/14	Wet, no flow	--	--	--	--	--	--
NC350 MH1 Pipe B	6/17/14	Trickling	0.25	0.11	Invalid	5110	--	Clear, no odor
	10/13/14	Dry	--	--	--	--	--	--
	11/25/14	Wet, no flow	--	--	--	--	--	--
	5/7/15	Lake waves	--	--	--	--	--	--
NC350 CB-1	6/17/14	Trickling	--	--	--	--	Positive	--
	10/3/14	Dry	--	--	--	--	Negative	--
	5/7/15	Wet, no flow	--	--	--	--	--	No odor
NC350 CB-2B	10/3/14	Dry	--	--	--	--	Negative	--
	5/7/15	Wet, no flow	--	--	--	--	--	--
NC350 CB-3B	10/3/14	Dry	--	--	--	--	Negative	--
NC350 MH6	5/7/15	Wet, no flow	--	--	--	--	--	No odor

Findings:

- On June 17, 2014, low concentrations of ammonia (0.40 mg/L) and MBAS (0.40 mg/L) and a moderate concentration of chlorine (0.21 mg/L) were measured from Pipe A in manhole MH1.

Low ammonia (0.25 mg/L) and moderate chlorine (0.11 mg/L) concentrations and exceedingly high specific conductivity (5,110 µs/cm) were measured from Pipe B in manhole MH1. Optical brightener was detected in CB1.

- On October 13, 2014, a low concentration of chlorine (0.07 mg/L) was measured at MH1 Pipe A.
- On November 25, 2014, a low concentration of MBAS (0.20 mg/L) was measured at MH1 Pipe A.
- On May 7, 2015, manhole MH1 was surcharged by Lake Memphremagog. There was no flow from Branch A to manhole MH1, at catchbasin CB1, or in the manhole MH6, which is located on Main Street up-pipe from catchbasin CB5. Most mapped stormwater structures in the 100 Main Street lot are either covered over or were beneath parked cars.

Conclusion: The results to date have been inconclusive. Optical brightener and significant chlorine concentrations were detected in June 2014, but there was very little dry weather flow in Branch A and none in Branch B in follow up sampling in the fall of 2014. We speculate that construction activities in the area may have contributed to the contaminants detected on the June 17, 2014 assessment date.

Resolution: Given detection of both optical brightener and a significant concentration of chlorine in June, 2014, this system warrants further investigation. This investigation will be completed under a separate contract, in cooperation with the Newport City Public Works Department.

7.11 NC360

The NC360 system drains a portion of Main Street before discharging to Lake Memphremagog northeast of 70 Main Street (Map NC-3). The first structure up-pipe from the outfall (catchbasin CB1) was assessed because the outfall extends into the lake.

Table 55. Water analysis data for outfall NC360

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC360 CB1	6/17/14	Trickling	0.10	0.13	1.0	9,500	Negative	Strong sewer odor
	10/13/14	Dry	--	--	--	--	--	No sewer odor
	11/25/14	Trickling	--	0.01	0.30	2,180	--	No odor
	5/7/15	Stagnant pool	0.5	0.10	0.30	340	--	No odor
NC360 MH1 Pipe A	6/17/14	Flowing	--	--	--	--	--	--
	11/25/14	Dry	--	--	--	--	--	--
	5/7/15	Wet, no flow	--	--	--	--	--	Wastewater odor
NC360 MH1 Pipe B	6/17/14	Flowing	--	--	--	--	--	--
	11/25/14	Wet, no flow	--	--	--	--	--	--
	5/7/15	Wet, no flow	--	--	--	--	--	Wastewater odor
NC360 MH1 Pipe C	6/17/14	Dry	--	--	--	--	--	--
	11/25/14	Wet, no flow	--	--	--	--	--	--
	5/7/15	Wet, no flow	--	--	--	--	--	Wastewater odor

Findings:

- On June 17, 2014, moderate concentrations of chlorine (0.13 mg/L) and MBAS (1.0 mg/L) and exceedingly high specific conductivity (9,500 µg/L) were measured in catchbasin CB1. A strong wastewater odor was emanating from CB1. There was no wastewater odor in the next up-pipe structure, MH1.
- On October 13, 2014, no flow or wastewater odor was observed in CB1.
- On November 25, 2014, CB1 was trickling and no flow was observed in manhole MH1.
- On May 7, 2015, none of the three pipes entering manhole MH1 were flowing, but a slight wastewater odor was observed. Although catchbasin CB1 was not flowing, samples were collected from the sump for *E. coli* and total phosphorus analysis (Table 79). The *E. coli* concentration was elevated (540 MPN/100 mL) and the total phosphorus concentration was moderate (97 µg/L).

Conclusion: The results to date have been inconclusive. One possible explanation is that there is a leak in the sanitary sewer line running between MH1 and CB1 that passes wastewater to the stormdrain at high flows. This theory is consistent with the elevated ammonia and *E. coli* concentrations in CB1 and with the wastewater odors detected. However, the absence of optical brightener in CB1 is inconsistent with this theory. The exceedingly high specific conductance in catchbasin CB1 is likely attributable to road salt (snow is stored in this portion of the lot).

Resolution: This investigation will be completed under a separate contract, in cooperation with the Newport City Public Works Department.

7.12 NC470

The NC470 system drains portions of East Main Street and Route 5 before discharging to the Clyde River opposite the Waterfront Plaza. The outfall is submerged and the manholes up-pipe from the outfall are not accessible (the cover of MH1 is bolted down and MH2 is paved over). Therefore, catchbasins were assessed up-pipe of these manholes.

Table 56. Water analysis data for outfall NC470

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC470 CB1	6/17/14	Flowing	0.50	0.25	0.20	2770	Negative	Strong oil odor, oil sheen
	7/30/14	--	--	--	--	--	--	Oil sheen
	10/13/14	Trickling	1.0	0.05	0.20	1855	--	Oil odor
NC470 CB2	10/13/14	Trickling	--	--	--	--	--	Strong oil odor
NC470 CB3	7/30/14	Dripping	--	--	--	--	--	Strong oil odor
	10/13/14	Dripping	--	--	--	--	--	Oil odor

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC470 CB3A	10/13/14	Dry	--	--	--	--	--	No odor
NC470 CB4	7/30/14	--	--	--	--	--	--	Oil odor
NC470 CB5	7/30/14	Dry						--

Figure 9. Catchbasin NC470 CB1 at the corner of Causeway Road and Route 191.

Findings:

- On June 17, 2014, a low concentration of ammonia (0.50 mg/L) and a high concentration of chlorine (0.25 mg/L) were measured in catchbasin CB1. A strong oil odor and substantial iron staining were observed in CB1 (Figure 9).
- On October 13, 2014, a moderate ammonia concentration (1.0 mg/L) was detected in CB1. Substantial iron staining and an oil odor were again observed.
- Oil odors were detected in catchbasins CB1, CB2, CB3, and CB4.
- The property at 1 Gardner Street is listed as a hazardous waste site by DEC due to groundwater contamination from underground gasoline storage tanks.

Conclusion: We suspect that the NC470 system is conveying gasoline contaminated groundwater from the 1 Gardner Street property.

Resolution: By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.

7.13 NC510

There are no known surface inlets to the NC510 system. The outfall is located at the southeastern corner of the 1 Gardner Street property (Figure 10). The outfall pipe is aligned with the center of the 1 Gardner Street property.

Table 57. Water analysis data for outfall NC510

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/17/14	Flowing	0.25	0.00	0.10	742	Negative	Clear, oil odor
10/13/14	Flowing	0.50	0.05	0.10	647	--	Clear, slight oil odor
11/25/14	Flowing	0.25	0.00	--	703	--	Iron floc, oil odor

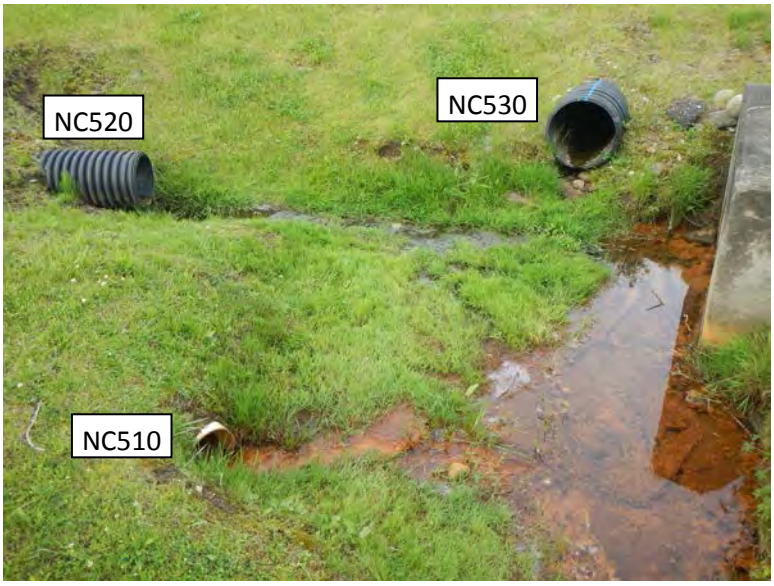


Figure 10. Petroleum contaminated discharge evident at outfall NC510

Findings:

- On three dates, low ammonia concentrations (0.25-0.50 mg/L) were measured. Significant iron staining and floc were observed.
- The property at 1 Gardner Street is listed as a hazardous waste site by DEC due to groundwater contamination from underground gasoline storage tanks.

Conclusion: We suspect that the NC510 system is conveying gasoline-contaminated groundwater from the 1 Gardner Street property.

Resolution: By this report, Stone refers these findings to the DEC Hazardous Waste Management Program.

7.14 NC520

The NC520 system drains a single catchbasin and discharges at the southeast corner of the 1 Gardner Street property (Figure 10). An unmapped pipe enters this catchbasin (CB1) from the direction of the bank building.

Table 58. Water analysis data for outfall NC520

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC520	6/17/14	Flowing	0.10	0.03	0.20	740	Positive	Clear, no odor
	10/3/14	Dry	--	--	--	--	Negative	--
	11/25/14	Flowing	0.00	0.03	--	552	Negative	--
NC520 CB1	10/3/14	Dry	--	--	--	--	Negative	--
	11/25/14	Flowing	--	--	--	--	Negative	--

Findings:

- On June 17, 2014, optical brightener was detected at the outfall.
- Optical brightener was not detected at the outfall or CB1 on two later dates in 2014.

Conclusion: Based on repeated testing, we conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.15 NC580

The NC580 system drains a single catchbasin on Western Avenue before discharging to Lake Memphremagog across from 595 Western Avenue.

Table 59. Water analysis data for outfall NC580

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/23/14	Trickling	0.25	0.02	0.10	2870	Negative	Clear, no odor
10/13/14	Dripping	0.10	--	--	--	--	Clear, no odor
11/25/14	Trickling	0.25	0.04	0.30	2270	--	--

Findings:

- Very low ammonia concentrations (0.25 mg/L) and high specific conductance (>2,000 (µs/cm) were measured at the outfall on dates in June and November, 2014.
- Given the high specific conductance, the low MBAS concentrations measured likely resulted from chemical inference by dissolved solids.

Conclusion: The high specific conductance measured at the outfall on sampling dates in June and November, 2014 likely resulted from accumulated road salt, and the low MBAS concentrations were likely caused by chemical interference from these same salts. We conclude there is no chronic illicit discharge in this system.

Resolution: NA

7.16 NC620

The NC620 system drains a small portion of the 1 Gardner Street property before discharging at property's southeastern corner.

Table 60. Water analysis data for outfall NC620

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC620	11/25/14	Flowing	0.00	0.02	--	1230	--	Clear, no odor
NC620 CB1 Pipe A	6/23/14 11/25/14	Flowing Flowing	0.00 --	0.01 --	0.20 --	1107 --	-- --	Clear, no odor --
NC620 CB1	6/23/14	Flowing	--	--	--	--	Negative	--

Findings:

- On June 23, 2014, a low MBAS concentration (0.20 mg/L) was measured from Pipe A in catchbasin CB1.
- On November 25, 2014, no contaminants were detected at the outfall.

Conclusion: We conclude there is no chronic illicit discharge in this system.

Resolution: NA

7.17 NC640

The NC640 system drains a portion of Herrick Street. This system is mapped as a sanitary sewer repurposed as a separated stormdrain, which discharges offshore in Lake Memphremagog (Map NC-4). However, we were unable to locate any stormwater infrastructure on Herrick Street below catchbasin CB1. Manhole MH2 is mapped as being part of the NC640 system, but it is actually part of the sanitary sewer.

According to Tom Bernier, Director of Public Works, the sanitary sewer on Herrick Street is the original sewer system from which stormwater inputs were eliminated in a 1996 sewer separation project. A new stormline was run from the catchbasin (CB1) at the 90 degree bend in Herrick Street to convey stormwater from upper Herrick Street downhill to Limlaw Hill Road.

Table 61. Water analysis data for outfall NC640

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC640 CB1	6/23/14	Dripping	--	--	--	--	Negative	--

Findings:

- Catchbasin CB1 is the lowest catchbasin on Herrick Street. The inlet pipe to CB1 was dripping and no optical brightener was detected.

Conclusion: Stormwater and sanitary infrastructure mapping appears to be in error. There does not appear to be an old sanitary line repurposed for stormwater on lower Herrick Street. We do not believe there is an illicit discharge in this system at or above catchbasin CB1, the lowest catchbasin on Herrick Street.

Resolution: NA

7.18 NC660

The NC660 system drains a small portion of Glen Road before discharging to Lake Memphremagog across from 31 Glen Road.

Table 62. Water analysis data for outfall NC660

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC660 CB1	6/23/14	Trickling	0.25	0.00	0.20	1160	Negative	Clear, no odor
	10/13/14	Flowing	0.10	0.02	0.10	760	--	Clear, no odor

Findings:

- On June 23, 2014, a low ammonia concentration (0.25 mg/L) was measured.
- No contaminants were detected on October 13, 2014.

Conclusion: We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.19 NC680

The NC680 system drains portions of Glen Road, Weaver Street, and Fern Street before discharging to Lake Memphremagog across from 20 Fern Street (Map NC-5).

Table 63. Water analysis data for outfall NC680

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC680	6/23/14	Trickling	0.50	0.00	0.30	1890	Indeterminate	Orange, slight oil odor
	7/23/13	Trickling	--	--	--	--	Negative	--
	10/13/14	Trickling	0.75	0.01	0.10	1190	--	Cloudy, no odor
	11/25/14	Trickling	0.50	0.00	0.20	1300	Negative	Minor suds, no odor
NC680 CB2	10/13/14	Trickling	0.10	--	--	--	--	--
NC680 CB3	10/13/14	Trickling	1.0	--	--	--	--	--
NC680 CB5	10/13/14	Dry	--	--	--	--	--	--
NC680 CB4 Pipe A	10/13/14	Trickling	1.5	--	0.10	513	--	Cloudy, orange, strong odor
	11/25/14	Trickling	--	--	--	--	--	Iron staining, no odor
	5/7/15	Trickling	--	--	--	--	--	--
NC680 CB4 Pipe B	10/13/14	Trickling	0.50	--	--	440	--	Clear, slight odor
	11/25/14	Trickling	--	--	--	--	--	Iron staining, no odor
	5/7/15	Trickling	--	--	--	--	--	--
NC680 MH2	10/13/14	Dripping	0.10	--	--	--	--	Clear, no odor

Findings:

- On June 23, 2014, a moderate ammonia concentration (0.50 mg/L) and low MBAS concentration (0.30 mg/L) were measured at the outfall. An indeterminate optical brightener result was recorded. Resampling for optical brightener on July 23, 2014 yielded a negative result.
- Bracket sampling on October 13, 2014 for raised concentrations of ammonia isolated the ammonia contamination to catchbasin CB4, both Pipes A and B.
- On November 25, 2014, a moderate concentration of ammonia (0.50 mg/L) and a low concentration of MBAS (0.20 mg/L) were measured at the outfall. Some suds were observed.
- On May 7, 2015, concentrations of *E. coli* (<1 MPN/100 mL) and total phosphorus (42 µg/L) measured at the outfall were very low (Table 79).

Conclusion: Results to date have been inconclusive. It is possible there is a washwater discharge entering pipes CB4.

Resolution: This investigation will be completed under a separate contract, in cooperation with the Newport City Public Works Department.

7.20 NC700

The NC700 system drains the upper Hinman Street before discharging halfway down Hinman Street.

Table 64. Water analysis data for outfall NC700

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/23/14	Flowing	0.25	0.03	0.00	259	Negative	Clear, no odor
11/5/14	Flowing	0.10	0.00	0.00	197	--	Clear, no odor

Findings:

- The system is apparently fed by a spring.
- On June 23, 2014, a low concentration of ammonia (0.25 mg/L) was measured at the outfall.
- On November 5, 2014, no contaminants were detected at the outfall.

Conclusion: Based on repeated sampling, we conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.21 NC820

The NC820 system apparently drains a spring behind 36 Abel Street, winds its way through the properties at 36 Abel Street and 441 Clyde Street, and discharges to the Clyde River across from 405 Clyde Street.

Table 65. Water analysis data for outfall NC820

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC820	6/23/14	Wet, no flow	--	--	--	--	--	Iron staining
NC820 Culvert1	10/3/14	Flowing	0.25	0.08	0.00	352	Negative	Iron staining

Findings:

- On October 3, 2014, low ammonia (0.25 mg/L) and chlorine (0.08 mg/L) concentrations were measured at the entrance to the culvert crossing Clyde Street.

Conclusion: We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.22 NC880

The NC880 system drains portions of the property at 424 East Main Street, Western Avenue, East Main Street, and Autumn Street (Map NC-6). It discharges to a stream behind 120 Hill Street. It was assessed primarily at catchbasin CB1 next to the Subway parking lot.

Table 66. Water analysis data for outfall NC880

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC880 CB1 Upper basin	6/30/14 7/23/14 10/9/14	Trickling Trickling Dry	-- -- --	-- -- --	-- -- --	-- -- --	Indeterminate Positive Negative	-- -- --
NC880 CB1 Pipe B	5/7/15	Trickling	0.0	0.00	0.0	572	--	--
NC880 CB1 Lower basin	10/9/14	--	--	--	--	--	Negative	--
NC880 CB2	6/30/14 11/5/14	Trickling Trickling	0.10 0.35	0.05 0.04	0.50 0.20	1355 91	Negative --	Clear, no odor Tan, no odor
NC880 CB3 Pipe A	11/5/14	Trickling	0.40	--	0.20	--	--	Tan, no odor
NC880 CB5 Pipe B	11/5/14	Dripping	0.25	--	0.40	--	--	Particles, no odor
NC880 CB8 Pipe A	11/5/14	Dripping	0.25	0.20	--	--	--	Tan, no odor

Findings:

- CB1 is odd structure with an upper basin that drains through a grate in the floor to a lower basin that it difficult to access. There are four pipes entering the upper basin. There are no mapped inlets to pipes A and B. Pipe D connects CB1 to CB2 and up-pipe structures.
- On July 23, 2014, optical brightener was detected in the upper basin of catchbasin CB1.
- Low MBAS concentrations ranging from 0.20 mg/L to 0.50 mg/L were detected in CB2, CB3 Pipe A, and CB5 Pipe B. Low ammonia concentrations ranging from 0.25 mg/L to 0.40 mg/L were detected in CB2, CB3 Pipe A, and CB5 Pipe B.
- On May 7, 2014, there was a trickle of flow from Pipe B in CB1 while Pipes A, C, and D were dripping or dry. No *E. coli* were detected and total phosphorus concentrations were very low (42 µg/L) in flow from Pipe B (Table 79).

Conclusion: Although results have been inconsistent, we suspect that there is an intermittent washwater discharge somewhere in this system based on the definite optical brightener detection on July 23, 2014. Efforts to isolate the source have been unsuccessful.

Resolution: This investigation will be completed under a separate contract, in cooperation with the Newport City Public Works Department.

7.23 NC1010

The NC1010 system drains a small portion of Blanchard Avenue before discharging behind 35 Blanchard Avenue.

Table 67. Water analysis data for outfall NC1010

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1010	6/30/14	Flowing	0.10	0.32	0.20	409	Negative	Clear, no odor
	7/23/14	Trickling	0.10	0.15	0.30	375	--	Clear, no odor
	11/5/14	Dripping	0.10	0.18	0.10	398	--	Clear, no odor
NC1010 CB1	11/5/14	Dripping	--	0.05	--	--	--	Clear, no odor

Findings:

- On June 30, 2014, a high chlorine concentration (0.32 mg/L) and a low MBAS concentration (0.20 mg/L) were measured at the outfall.
- On July 23, 2014, a moderate concentration of chlorine (0.15 mg/L) and a low MBAS concentration (0.30 mg/L) were measured at the outfall.
- On November 5, 2014, a moderate concentration of chlorine (0.18 mg/L) was measured at the outfall. No chlorine was detected in CB1.

Conclusion: We suspect there is a water leak between catchbasin CB1 and the outfall.

Resolution: This issue has been referred to Newport City Public Works Department.

7.24 NC1050

The NC1050 system is downstream of the NC1010 outfall and drains a portion of Sias Avenue and the Newport City Elementary School property (Map NC-7).

Table 68. Water analysis data for outfall NC1050

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1050	6/30/14	Flowing	0.10	0.04	0.20	580	Negative	Clear, no odor
NC1050 CB1 Pipe A	6/30/14	Flowing	0.10	0.00	0.20	533	Positive	Clear, no odor
NC1050 CB2 Pipe A	5/7/15	Flowing	0.0	0.04	0.10	525	--	--
NC1050 CB2 Pipe B	5/7/15	Flowing	1.0	0.5	0.02	1232	--	Wastewater odor, toilet paper in sump.

Findings:

- On June 30, 2014, optical brightener was detected in Pipe A entering the first catchbasin (CB1) above the outfall. CB1 Pipe A drains the elementary school property as well as an underdrain behind 110 Sias Avenue.
- On May 7, 2015, samples were collected from the two pipes entering the second catchbasin (CB2) above the outfall. No *E. coli* or ammonia were detected in flow from Pipe A, which drains the north side of the school property, and the total phosphorus (23 µg/L), MBAS, and free chlorine concentrations were below levels of concern. However, flow from Pipe B, which drains the south side of the school, had elevated ammonia, MBAS, and total phosphorus (416 µg/L) concentrations, exceedingly high *E. coli* levels (17,320 MPN/100 mL), and a distinct wastewater odor.
- On June 16, 2015, the storm drainage system around the school was inspected. Toilet paper and feces were observed in a manhole on the south side of the school building, to which an unmapped vitrified clay pipe discharges. From its appearance and alignment, we suspected this pipe was the source of wastewater entering the system.
- Based on the location and alignment of the pipe, it appeared to originate beneath the old wing of the elementary school. Dye testing was therefore performed in every lavatory in the old wing of the school. A toilet in classroom 108 was found to be directly connected via a cross connection to a roof leader. The sink in the lavatory and the project sink in the classroom are presumed to be connected also, as there appears to be a single connection to the roof leader running within the classroom wall. The bathroom in room 108 appears to have been added later than the original construction

Conclusion: A direct connection was identified from a toilet in a classroom in the Newport Elementary School to the stormdrain.

Resolution: This investigation was completed in cooperation with the Newport City Public Works Department. The Public Works Department is currently working with the school to eliminate the connection. Unfortunately, the cross connection appears to be in the ground underneath the school; it may be difficult to correct if they cannot tie it in with the plumbing in an adjacent classroom. In the interim, the bathroom is not in use.

7.25 NC1080

The NC1080 system drains portions of Spring Street and South Avenue before discharging at the southern end of South Street.

Table 69. Water analysis data for outfall NC1080

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1080	6/30/14 7/17/14 11/5/14	Flowing Dripping Dripping	1.0 -- 0.0	0.12 -- 0.00	0.75 -- 0.20	430 -- 110	Negative -- --	Slightly cloudy, no odor -- Tan, no odor
NC1080 CB1	6/30/14	Dry	--	--	--	--	--	--
NC1080 CB2	6/30/14 11/5/14	Flowing Dry	-- --	-- --	-- --	-- --	Negative --	-- --

Findings:

- On June 30, 2014, moderate concentrations of ammonia (1.0 mg/L), chlorine (0.12 mg/L), and MBAS (0.75 mg/L) were measured at the outfall.
- No contaminants were detected above levels of concern and there was negligible flow in the system on follow-up assessment dates in July and November.

Conclusion: Based on repeated sampling, we do not believe there is a chronic illicit discharge in this system. We expect the contaminants detected on the June 30, 2014 were transient, possibly related to outdoor washing.

Resolution: NA

7.26 NC1100

The NC1100 system drains Northern Avenue and portions of Indian Point Street, Young Street, Oak Street, and Concord Avenue. It discharges to a stream south of 158 Indian Point Street.

Table 70. Water analysis data for outfall NC1100

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
6/30/14	Flowing	0.10	0.00	0.40	1270	Negative	Clear, no odor
11/5/14	Trickling	0.10	0.00	0.10	903	--	Clear, no odor

Findings:

- On June 23, 2014, a low concentration of MBAS (0.40 mg/L) was measured at the outfall.
- On November 5, 2014, no contaminants were detected.

Conclusion: We conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.27 NC1120

The NC1120 system drains a small portion of Union Street before discharging to a grass swale at the southern end of Park Avenue. It drains under the railroad tracks.

Table 71. Water analysis data for outfall NC1120

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1120	11/5/14	Trickling	1.0	0.02	0.20	820	--	Iron floc, oil odor
NC1120 CB1 & CB2	6/30/14 11/5/14	Dry Dry	-- --	-- --	-- --	-- --	-- --	-- --

Findings:

- The outfall is buried and could not be assessed, but both catchbasins were dry on June 30, 2014.
- On November 5, 2014, a moderate concentration of ammonia (1.0 mg/L) and a low MBAS concentration (0.20 mg/L) were measured in a pool at the outfall location. It was difficult to determine if the flow sampled was issuing from the buried outfall or was groundwater seeping around telephone poles next to the outfall.

Conclusion: We suspect that the ammonia measured in the vicinity of the buried outfall was due to contaminated groundwater and not from an illicit discharge.

Resolution: NA

7.28 NC1350

The NC1350 system drains portions of Sias Avenue and Paul Street before discharging to a stream north of 489 Sias Avenue.

Table 72. Water analysis data for outfall NC1350

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1350	7/1/14 11/5/14	Flowing Flowing	0.40 0.75	0.00 0.11	0.20 0.00	360 353	Negative --	Iron floc and odor Iron floc and odor
NC1350 CB1 Pipe B	7/1/14 11/5/14	Flowing Flowing	-- 0.75	-- --	-- --	-- --	-- --	Iron staining Iron floc and odor
NC1350 CB2	11/5/14	Dry	--	--	--	--	--	--

Findings:

- On July 1, 2014, low concentrations of ammonia (0.40 mg/L) and MBAS (0.20 mg/L) were measured at the outfall. Iron floc and an iron-like odor were observed.

- On November 5, 2014, moderate concentrations of ammonia were measured at the outfall (0.75 mg/L) and CB1 Pipe B (0.75 mg/L). Iron floc and an iron-like odor were observed.
- All flow in the system appears to be from CB1 Pipe B.
- A long infiltration trench appears to drain into CB2.

Conclusion: We suspect that contaminated groundwater is entering the system.

Resolution: NA

7.29 NC1420

The NC1420 system drains portions of Union Street, Indian Point Street, and Blake Street. It discharges northeast of 642 Union Street.

Table 73. Water analysis data for outfall NC1420

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/1/14	Dripping	0.25	--	--	--	Negative	--
11/5/14	Trickling	0.10	0.01	0.40	147	--	Cloudy, no odor

Findings:

- On July 1, 2014 a low concentration of ammonia (0.25 mg/L) was detected at the outfall.
- On November 5, 2014, a low concentration of MBAS (0.40 mg/L) was detected at the outfall. A trickle of flow was observed in catchbasin CB4 and down-pipe structures.

Conclusion: No optical brightener was detected and concentrations of other contaminants were very low; therefore, we do not believe there is a chronic illicit discharge in this system.

Resolution: NA

7.30 NC1480

The NC1480 system drains a stream and one catchbasin on Bluff Road.

Table 74. Water analysis data for outfall NC1480

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/1/14	Flowing	0.10	0.00	0.20	1721	Negative	Clear, no odor
11/5/14	Flowing	0.10	0.00	0.10	1700	--	Clear, no odor

Findings:

- On July 1, 2014, a low concentration of MBAS (0.20 mg/L) was measured at the outfall.
- No contaminants were detected on November 5, 2014.

Conclusion: Given the very low MBAS concentration measured on the initial assessment date and the lack of any contaminants on the November sampling date, we conclude that there is no chronic illicit discharge in this system.

Resolution: NA

7.31 NC1490

NC1490 is the outfall for a combined sewer overflow at the wastewater pump station located at the intersection of Bluff Road and Prouty Drive (Figure 11).

Table 75. Water analysis data for outfall NC1490

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/1/14	Trickling	0.50	0.06	0.75	5,070	Negative	Iron floc
11/5/14	Trickling	0.50	0.19	0.40	3,000	--	Clear

Findings:

- On July 1, 2014, low concentrations of ammonia (0.50 mg/L) and chlorine (0.06 mg/L), a moderate concentration of MBAS (0.75 mg/L), and very high specific conductivity (5,070 µs/cm) were measured at the outfall. There was a wastewater odor in the area of the outfall.
- On November 5, 2014, a low concentration of ammonia (0.50 mg/L), a moderate concentration of chlorine (0.19 mg/L), a low concentration of MBAS (0.40 mg/L), and a very high specific conductivity (3,000 µs/cm) were measured at the outfall. Again, there was a wastewater odor in the area of the outfall.

Conclusion: This structure is an identified combined sewer overflow. However the presence of dry weather flow requires explanation. One possible explanation that fits these data is that there is a municipal water leak that infiltrates the pipe (contributing chlorine) and flushes out wastewater residues from past overflow events.

Resolution: We recommend Newport City identify the source of the dry weather flows in this structure and correct any leaks in the pump station or municipal water system that may be contributing these flows.

Figure 11. NC1490 outfall

7.32 NC1570

The NC1570 system drains a small portion of the North Country Hospital property before discharging to a wetland north of the property (Map NC-8). The outfall pipe could not be located.

Table 76. Water analysis data for outfall NC1570

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1570 CB1	7/1/14	Trickling	0.25	0.00	0.10	40	Negative	Clear, no odor
	11/5/14	Dry	--	--	--	--	--	--
	6/16/15	Dry	--	--	--	--	--	--

Findings:

- On July 1, 2014 a low concentration of ammonia (0.25 mg/L) was detected at catchbasin CB1.
- The system was dry on November 5, 2014 and June 16, 2015.

Conclusion: Given the location of this system and the presence of ammonia and extremely low specific conductivity in catchbasin CB1, it is likely that air conditioning condensation from the hospital is entering this system.

Resolution: Air conditioning condensation is generally considered an allowable discharge. Given the negligible flow and relatively low contaminant concentrations observed in the system, we conclude that no action is warranted.

7.33 NC1580

The NC1580 system drains a small portion of the North Country Hospital property before discharging to a wetland north of the property (Map NC-8).

Table 77. Water analysis data for outfall NC1580

Structure ID	Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
NC1580	7/1/14 10/9/14 5/7/15	Flowing Flowing Trickle	0.40 -- --	0.02 -- --	0.30 -- --	2068 -- --	Positive Negative --	Clear, no odor -- No odor, iron staining
NC1580 CB1, CB2	10/9/14	Dry	--	--	--	--	Negative	--

Findings:

- On July 1, 2014, low concentrations of ammonia (0.40 mg/L) and MBAS (0.30 mg/L) were measured at the outfall. Optical brightener was detected at the outfall.
- On October 9, 2014, no optical brightener was detected throughout the system.
- On June 16, 2015, no flow was observed at the outfall. However a steady drip was observed from a large air conditioning unit serving an MRI machine housed in a trailer. The dripping water, which evaporated on the pavement, had an ammonia concentration of 6 mg/L. This water clearly would flow to catchbasin CB1 under different conditions.

Conclusion: A source of ammonia was identified in the dripping air conditioning unit. Optical brightener detected on July 1, 2014 did not reoccur and may have resulted from a transient source, such as outdoor washing. Given the high specific conductivity, the MBAS measured on July 1, 2014 likely resulted from chemical interference.

Resolution: Air conditioning condensation is generally considered an allowable discharge. Given the small flows and relatively low contaminant concentrations observed at the outfall, we conclude that no action is warranted.

7.34 NC1720

The NC1720 system drains portions of Glen Road and Hinman Street before discharging to Lake Memphremagog behind 208 Glen Road.

Table 78. Water analysis data for outfall NC1720

Date assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
7/1/14	Flowing	0.25	0.06	0.10	554	Negative	Clear, no odor
11/5/14	Flowing	0.00	0.01	0.10	576	--	Clear, no odor

Findings:

- On July 1, 2014, low concentrations of ammonia (0.25 mg/L) and chlorine (0.06 mg/L) were measured at the outfall.
- On November 5, 2014, no contaminants were detected.

Conclusion: Based on repeated sampling, we conclude there is no chronic illicit discharge in this system.

Resolution: NA

8. P LOADING AND *E. COLI* CONCENTRATIONS

Samples were collected on May 7 and 14, 2015 for *E. coli* and total phosphorus analysis by the Vermont DEC laboratory. If feasible, a discharge measurement was made immediately following sampling. Daily total phosphorus loads were calculated from the concentration and discharge data. These data are presented below (Table 79).

Table 79. E. coli and total phosphorus data for selected drainage systems

System	*Date*	*E. coli* (MPN/100 mL)	TP (µg/L)	Discharge (L/min)	TP loading (g/day)
BA020 CB1-B	5/14/15	40	339	3.8	1.9
BA140	5/14/15	10	22	65	2.1
BA270 CB6-A	5/14/15	5,170	93	3.8	0.5
BA270 CB6-B	5/14/15	120	24	7.7	0.3
BA300	5/14/15	40	30	Dripping	NA
BA310	5/14/15	<1	70	0.08	0.0
BA360	5/14/15	440	65	6	0.6
OR070	5/14/15	<1	20	5.7	0.2
DT020	5/14/15	450	52	179	13.4
DT030	5/14/15	10	43	1.3	0.1
NC360 CB1	5/7/15	540	97	No flow	NA
NC680	5/7/15	<1	42	19.2	1.2
NC880 CB1-B	5/7/15	<1	68	Dripping	NA
NC1050 CB1-A	5/7/15	<1	23	3.7	0.1
NC1050 CB1-B	5/7/15	17,320	416	4.9	2.9

The *E. coli* data from the May 2015 sampling events generally reinforce the interpretations made from earlier data and observations. Sampling points with suspected sanitary wastewater connections (BA270 CB6 Branch A, BA360, DT020, NC360 CB1, and NC1050 CB1 Pipe B) had elevated *E. coli* levels in most cases and *E. coli* levels were low in the other systems. Exceptions were DT030 and BA020 CB1 pipe B, which had surprisingly low *E. coli* concentrations on the date sampled. Despite the low *E. coli* levels found, a definite wastewater odor was observed at the time these samples were collected.

Total phosphorus concentrations were low to moderate (<100 µg/L) at all sampling points except BA020 CB1 pipe B and NC1050 CB1 pipe B, where they were substantially higher. It is interesting that in the case of BA020 CB1 pipe B, the *E. coli* result does not suggest wastewater contamination while the total phosphorus concentration, combined with our observations and the elevated ammonia and presence of optical brightener measured earlier, strongly indicates it.

The opportunities for phosphorus reduction through elimination of these illicit discharges appear minor based on results of the May 7 and May 14 grab samples. In the system with the highest daily loading,

DT020, we must assume that the source of the majority of the measured flow and phosphorus is the road ditch system. A smaller fraction is likely attributable to the malfunctioning septic system. Eliminating the sanitary wastewater connections in NC1050 CB1 pipe B (2.9 g/d), BA020 (1.9 g/L), BA270 CB6 Branch A (0.5 g/L), and BA360 (0.6 g/L) would result in the most significant phosphorus reductions, a total of 5.9 g/d. Based on inflows, we expect the illicit discharges in these systems contribute the majority of the flow and phosphorus. Smaller quantities of P will also be eliminated if the malfunctioning septic systems in DT020 and DT030 are eliminated. These calculated phosphorus load reductions likely significantly underestimate actual load reductions for three of the four points, those where raw sewage discharges are eliminated (BA270 Branch A, BA360, and NC1050). These samples were collected during dry weather. During high flow events, wastewater solids that settle in the stormdrain during low flows are flushed out, resulting in increased phosphorus loading. Given temporal variations in use and flow rates, a greatly expanded monitoring program would be needed to accurately quantify phosphorus loading and changes in loading over more meaningful time intervals (i.e., annual).

For the three stormdrains conveying raw sewage, a more accurate method to estimate P loads is based on per capita P contributions. Based on literature values, P loading for the three directly connected houses is estimated to total 18 g/d (assuming 3-person occupancy and 2 g P/person/day). The Newport Elementary School classroom is used by 25 children during the school year, so the estimate is adjusted to half the daily loading rate for the children and using only the number of school days. Based on these calculations, the total P loading from the school is in the 12 g/d ballpark. Taken together, elimination of these direct wastewater discharges should have eliminated approximately 30 g P/day flowing to Lake Memphremagog.

Reduction of pathogen loading to surface waters is a significant benefit of this project. In particular, the very high *E. coli* concentration (17,320 MPN/100 mL) resulting from wastewater discharge at the Newport Elementary School has been eliminated now that the bathroom is out of use. This system (NC1050) discharges to a small stream which flows a short distance to Lake Memphremagog, outletting near a public beach. Elimination of this and other illicit discharges provides a public health benefit.

9. CONCLUSIONS

A thorough assessment was made of the stormwater drainage systems in seven municipalities in the Lake Memphremagog watershed for the presence of illicit discharges. A total of 375 systems were assessed in 2014. Based on water quality data and our observations during the dry weather surveys, 69 systems were designated as requiring further investigation. Further investigation of these drainage systems confirmed 13 illicit discharges in 11 stormwater drainage systems. Plans are in place to correct the majority of these illicit discharges. Investigations of several systems in Newport City are ongoing under DEC contract 28937.

10. **REFERENCES**

American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 21th edition, Washington D.C., 2005.

Hach Company. Hach Method #8167. Loveland, CO.

Stone Environmental, Inc., SEI SOP 5.23.3: Maintenance and Calibration of the pH/Con 10 Meter. February 24, 2003.

Stone Environmental, Inc., SEI SOP 6.38.0: Optical Brightener Testing, September 11, 2008.

APPENDIX A: ASSESSMENT DATA FORM

Memphremagog Watershed IDDE Project

IDDE ID: _____						
Date: _____	Time: _____			Inspector: _____		
Structure type: _____				Inner diameter (outfall only): _____(in.)		
Material (outfall only):	corrugated metal	concrete	corrugated black plastic	smooth plastic	vitrified clay	other (describe): _____
Flow depth (outfall only):	dry	wet (no flow)	dripping	trickling	Flowing Depth: _____(in.)	
Outfall position:	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_____	
Structural damage:	none	cracking, spalling	corrosion	crushed	other_____	
Obstructions:	none	partially obstructed	fully obstructed	other_____		
Ammonia _____ mg/L			Date OB pad set: _____ NA			
Chlorine _____ mg/L Free or Total			Date OB pad retrieved: _____ NA			
MBAS _____ mg/L						
Specific conductance _____µS/cm						
Sample collected for *E. coli* analysis: YES NO NA			Date: _____ Time: _____			
Sample collected for TP analysis: YES NO NA			Date: _____ Time: _____			
Flow measurement (if *E. coli* and/or nutrients sample collected):						
Comments:						

APPENDIX B: STONE ENVIRONMENTAL INC. SOPS

STANDARD OPERATING PROCEDURE

SEI-5.23.3

MAINTENANCE AND CALIBRATION OF THE pH/CON 10 METER

SOP Number: SEI-5.23.3 Date Issued: 05/14/99

Revision Number: 3 Date of Revision: 02/24/03

1.0 OBJECTIVE

This standard operating procedure (SOP) explains the calibration and maintenance of the Oakton pH/Con 10 meter and the Cole-Parmer pH/Con 10 meter. The meters are identical except for the distributor's names. The meter is manufactured by Cole-Parmer and distributed by Cole-Parmer and Oakton. The operator's manual should be referred to for the applicable procedures described below. The pH/Con 10 meter is used for measuring the pH, conductivity, and temperature of water. The pH/conductivity meters generate and measure data, and thus must meet the requirements of 40 CFR part 160 subpart D.

2.0 POLICIES

1. According to 40 CFR Part 160, Subpart D, Section 160.61, Equipment used in the generation, measurement, or assessment of data and equipment used for facility environmental control shall be of appropriate design and adequate capacity to function according to the protocol and shall be suitable located for operation, inspection, cleaning, and maintenance.
2. Personnel will legibly record data and observations in the field to enable others to reconstruct project events and provide sufficient evidence of activities conducted.

3.0 SAFETY ISSUES

1. If necessary and appropriate, a site-specific health and safety plan shall be created for each study site. A template for creating a proper health and safety plan is provided on the SEI network.
2. If necessary and appropriate, all chemicals are required to be received with Material Safety Data Sheets (MSDS) or appropriate application label. These labels or MSDS shall be made available to all personnel involved in the sampling and testing.

4.0 PROCEDURES

4.1 Equipment and Materials

1. The pH/Con 10 meter, pH/conductivity/ temperature probe. The probe cable has a notched 6-pin connector to attach to probe meter.

2. If necessary and appropriate, standard solutions (e.g., standard pH 4.0 and 7.0, conductivity standards)
3. Clean beakers or other appropriate containers
4. Log or other appropriate medium to record calibration.

4.2 Meter Set-up and Conditioning

1. The pH/Con 10 meter uses a combination pH/conductivity/temperature probe. The probe cable has a notched 6-pin connector to attach the probe meter. Keep connector dry and clean.
2. To connect the probe, line up the notches and 6-pins on the probe connector with the holes in the connector located on the top of the meter. Push down and the probe connector will lock into place.
3. To remove probe, slide up the metal sleeve on the probe connector. While holding onto metal sleeve, pull probe away from the meter. Do not pull on the probe cord or the probe wires might disconnect.
4. Be sure to decontaminate the probe prior to use. The probe shall be tripled rinsed with distilled or deionized water. Further decontamination and cleaning procedures may be called for in special situations or outlined in approved protocols or work plans. This will be documented in field notes or in an appropriate logbook.
5. Be sure to remove the protective rubber cap of the probe before conditioning, calibration, or measurement. If the probe is clean, free of corrosion, and the pH bulb has not become dehydrated, simply soak the probe in tap water for ten minutes before calibrating or taking readings to saturate the pH electrode surface to minimize drift. Wash the probe as necessary in a mild detergent solution. If corrosion appears on the steel pins in the conductivity cell, use a swab soaked in isopropyl alcohol to clean the pins. Do not wipe the probe; this causes a build-up of electrostatic charge on the glass surface. If the pH electrode has dehydrated, soak it for 30 minutes in a 2M-4M KCI boot solution prior to soaking in tap water.
6. Wash the probe in deionized water after use and store in pH 4.0 standard solution or an approved boot solution (per the manufacturer's instruction).

4.3 pH Calibration

1. The meter is capable of up to 3-point pH calibration to ensure accuracy across the entire pH range of the meter. At the beginning of each day of use, perform a 2 or 3-point calibration with standard pH buffers 4.00, 7.00, and 10.00. Calibration standards that bracket the expected sample range should be used. Never reuse buffer solutions; contaminants in the solution can affect the calibration.
2. Press the MODE key to select pH mode. The pH indicator appears in the upper right corner of the display.

3. Dip the probe into the calibration buffer. The end of the probe must be completely immersed into the buffer. Stir the probe gently to create a homogeneous buffer solution. Tap probe to remove any air bubbles.
4. Press CAL/MEAS to enter pH calibration mode. The primary display will show the measured reading while the smaller secondary display will indicate the pH standard buffer solution.
5. Press or keys to scroll up or down until the secondary display value is the same as the pH buffer value (pH 4.00, 7.00 or 10.00).
6. Wait for the measured pH value to stabilize. The READY indicator will display when the reading stabilizes. After the READY indicator turns on, press ENTER to confirm calibration. A confirming indicator (CON) flashes and disappears. The meter is now calibrated at the buffer indicated in the secondary display.
7. Repeat steps 3, 5, and 6 using a second or third pH standard
8. Press CAL/MEAS to return to pH measurement mode.

4.4 Conductivity Calibration

1. Select a conductivity standard with a value near the sample value expected. The meter should be calibrated by the user(s) at the beginning of each day of use.
2. Pour out two separate portions of your calibration standard and one of deionized water into separate clean containers.
3. Press MODE key to select Conductivity. The ΦS or mS indicator will appear on the right side of the display.
4. Rinse the probe with deionized water, and then rinse the probe in one of the portions of calibration standard Record the calibration standard on the per-use maintenance form or other appropriate medium.
5. Immerse the probe into the second portion of calibration standard. The meter's auto-ranging function selects the appropriate conductivity range (four ranges are possible). Be sure to tap the probe to remove air bubbles. Air bubbles will cause errors in calibration.
6. Wait for the reading to stabilize. The READY indicator lights when the reading is stable. Press the CAL/MEAS key. The CAL indicator appears above the primary display. The primary display shows the measured reading and the secondary display shows the temperature. Record the initial calibration standard on the per-use maintenance form or other appropriate medium.
7. Press the or keys to scroll to the value of your conductivity standard Press and hold the or keys to scroll faster. The meter automatically compensates for temperature differences using a factor of 2.00% per BC.

8. Press ENTER key to confirm calibration. Upon confirmation, the CON indicator appears briefly. The meter automatically switches back into Measurement mode. The display now shows the calibrated, temperature compensated conductivity value. However, if the calibration value input into the meter is different from the initial value displayed by more than 20% , the ERR annunciator appears in the lower left corner of the display

4.5 Temperature Calibration/Verification

1. The built-in temperature sensor is factory calibrated. Therefore, no additional calibration is necessary. However, the temperature may be verified against another working thermometer. However, if errors in temperature readings are suspected or if a replacement probe is used. Refer to the operating instructions if temperature calibration is necessary.

4.6 General and Annual Maintenance

Individual users are responsible for the calibration, cleaning, repair, and maintenance of the instrument.

Routine inspection and maintenance schedules vary from each piece of equipment. Typically there are minor maintenance needs each piece of equipment will need to undergo prior to use in the field (such as cleaning or conditioning). Always consult the manufacturer's instructions for general maintenance.

Specific per use maintenance needs for the pH /Con 10 meter include but are not limited to:

1. Inspect probe for physical damage and debris
2. Inspect meter for physical damage and debris
3. Clean probe w/ mild detergent
4. Rinse probe in distilled water
5. Clean conductivity pins with isopropyl alcohol (if necessary)
6. Condition probe
7. Calibrated to pH 7.0
8. Calibrated to pH 4.0
9. Calibrated to pH 10.0

The pH /con 10 meter shall be stored in a clean dry place, usually the padded box that it came in. Care should be given to keep the instrument from dust and contamination.

Wash the probe in distilled water after use, and store in pH 4 solution.

All maintenance, repairs, and calibrations are to be documented on an equipment maintenance log or other appropriate medium. Follow the checklist provided on the equipment maintenance log for regular use maintenance needs. Any maintenance must include documentation of whether the maintenance was routine and followed the SOP or not.

Equipment logs shall be brought to the field for documenting use and calibration. The logs will be returned to the office after each field use and filed in the equipment records filing cabinet.

In the event of failure due to breakage or loss of parts, an attempt will be made to repair or replace the necessary parts by the field personnel who discover the malfunction. All repairs will be documented in field notes and/or on a non-routine maintenance log. If the instrument is rendered "out of service" or "broken", it should be tagged as such. If further repair is necessary, return the instrument to the manufacturer following proper shipping procedures.

Non-routine repairs must include documentation of the nature of the defect, how and when the defect was discovered, and any remedial action taken in response to the defect.

5.0 RESPONSIBILITIES

1. All personnel will legibly record data and observations (including phone conversations) in accordance with this SOP to enable others to reconstruct project events and provide sufficient evidence of activities conducted.
2. Prior to use and after use, all equipment will be appropriately cleaned, decontaminated, calibrated (if necessary) and stored in accordance with the manufacturer's instructions and this SOP.

6.0 DEFINITIONS

1. *Decontamination* – Procedures followed to ensure cross contamination does not occur between sampling points or that potential contamination of equipment does not pose a hazard to sampling personnel.
2. *EPA* the U.S. Environmental Protection Agency.
3. *FIFRA* the Federal Insecticide, Fungicide, and Rodenticide Act as amended.
4. *Maintenance* – Actions performed on equipment to standardize and/or correct the accuracy and precision of a piece of equipment to ensure that the equipment is operating within the manufacturer's specifications and standard values.
5. *Study* means any experiment at one or more test sites, in which a test substance is studied in a test system under laboratory conditions or in the environment to determine or help predict its effects, metabolism, product performance (pesticide efficacy studies only as required by 40 CFR 158.640) environmental and chemical fate, persistence, or residue, or other characteristics in humans, other living organisms, or media. The term "study" does not include basic exploratory studies carried out to determine whether a test substance or a test method has any potential utility.

7.0 REFERENCES

40 CFR Part 160 Good Laboratory Practice Standards, August, 1989.

8.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

None

9.0 AUTHORIZATION

Revised by: _____ Date: _____

Michael Nuss, Staff Scientist

Approved by: _____ Date: _____

Christopher T. Stone, President

10.0 REVISION HISTORY

Revision number 1:

1. Changed title and references to Oakton in Sections 1.0 and 2.0 to enable this standard operating procedure to apply to both the Oakton pH/Con 10 meter and the Cole-Parmer pH/Con 10 meter, as these are identical meters.
2. Added instructions about cleaning and re-hydrating the probe to Section 3.1.
3. Added Section 9.0.
4. Reformatted.
5. Minor word editing.

Revision number 2:

1. Changed the title.
2. Removed sections 7.0 (Measurement) and 8.0 (Maintenance/Repairs).
3. Added section called (General and Annual Maintenance).
4. Minor editing.
5. Reformatted.

Revision number 3:

1. Minor wording edits in Section 1.0, Objective.
2. Updated style to match SEI Style Guide – font and text. Reformatted using MS Word
3. Added standardized section headers: 2.0 Policies, 3.0 Safety, 5.0 Responsibilities, 6.0 Definitions, 7.0 References, 8.0 Tables, Diagrams, Flowcharts and Validation data. Authorization moved to Section 9.0, andSection10.0 Revision History.
4. Deleted section on logs being given to the QAU.
5. Other minor wording edits.

STANDARD OPERATING PROCEDURE

SEI-6.38.1

OPTICAL BRIGHTENER TESTING

SOP Number: SEI-6.38.1 Date Issued: 09/11/08

Revision Number: 1 Date of Revision: 03/18/13

1.0 OBJECTIVE

Optical brighteners are a class of fluorescent dyes used in almost all laundry detergents. Many paper products also contain optical brighteners. When optical brightener is applied to cotton fabrics, they will absorb ultraviolet (UV) rays in sunlight and release them as blue rays. These blue rays interact with the natural yellowish color of cottons to give the garment the appearance of being "whiter than white". Optical brightener dyes are generally found in domestic wastewaters that have a laundry effluent component. Because optical brighteners absorb UV light and fluoresce in the blue region of the visible spectrum, they can be detected using a long wave UV light (a "black" light).

Optical brightener monitoring can be used to indicate the presence of wastewater in stormwater drainage systems, streams, and other water bodies. Since optical brighteners are removed by adsorption onto soil and organic materials as effluent passes through soil and aquifer media, optical brightener monitoring may also be used to identify incompletely renovated wastewater effluent in groundwater at wastewater dispersal sites.

To test for optical brightener, a cotton pad is placed in a flow stream for a period of 4-10 days, after which the pad is rinsed, air dried, and viewed under a long range UV light. Florescence indicates the presence of optical brightener. Optical brighteners may be monitored in a wide range of structures and flow streams. For example, monitoring pads may be placed in stormwater outfall pipes, within catchbasins and manholes, or in any other man-made or natural water conveyance. Optical brightener pads may be placed in dry pipes or other dry structures to monitor possible intermittent flow streams. However, the more common application is to monitor discharge points that are flowing under dry weather conditions.

2.0 POLICIES

1. According to Stone's Corporate Quality Management Plan, Stone shall have standard operating procedures in writing setting forth study methods that management is satisfied are adequate to ensure the quality and integrity of the data generated in the course of a study.
2. Personnel will legibly record data and observations in the field to enable others to reconstruct project events and provide sufficient evidence of activities conducted.

3.0 SAFETY ISSUES

1. If necessary and appropriate, a site-specific health and safety plan shall be created for each study site. A template for creating a proper health and safety plan is provided on the SEI network.
2. Care must always be taken when approaching a sampling location. Do not, under any circumstances, place yourself in danger to collect a sample.
3. If necessary and appropriate, all chemicals are required to be received with Material Safety Data Sheets (MSDS) or appropriate application labels. These labels or MSDS shall be made available to all personnel involved in the sampling and testing.

4.0 PROCEDURES

4.1 Equipment and Materials

1. Untreated cotton pad measuring approximately 10 cm by 10 cm (e.g., VWR cat no. 21902-985 or equivalent).
2. Fiberglass or nylon screen to enclose the cotton pad (sewn or stapled).
3. Monofilament fishing line (approximately 20 to 50 lb. test).
4. Binder clips of various sizes.
5. Field notebook, sample collection form, or other acceptable medium for recording field data.
6. Protective gloves if contamination is suspected in the water to be sampled, or if cold weather may be hazardous with wet hands.

4.2 Sampling Procedure and Sample Handling

4.2.1 Optical Brightener Pad Assembly

To assemble an optical brightener monitoring pad, place an untreated cotton pad measuring approximately 10 cm by 10 cm (e.g., VWR cat no. 21902-985) in an envelope made of a screen material. A light fiberglass screen is preferred. The pad may be folded in half to double its thickness. Sew, staple, or otherwise secure all open sides of the screen envelope to enclose the pad.

4.2.2 Optical Brightener Pad Placement

1. Secure the pad at the monitoring point using high test nylon fishing line (20 - 50 lb. test), a binder clip, or both. The pad may be attached to any convenient anchor, provided the pad is as well exposed to the flow stream as possible and the anchor point appears stable enough to resist the force of high flow events. When sampling culverts or stormwater outfall pipes, the pad may be clipped directly to the inner rim of the outfall. The pad should lie flat against the bottom surface of the pipe. The pad may also be hung from a catchbasin grate or manhole rung.

2. If a suitable anchor is not present, a heavy object may be placed in the flow stream or channel to anchor the pad. For example, a pad may be anchored in a stream by tying it to a concrete block.
3. Two or more optical brightener monitoring pads may be placed at monitoring points if appropriate. If more than a single pad is used, the pads should be anchored so that they do not become entangled.
4. Record the date each pad is deployed and any other relevant information in a field logbook or on a specified sample collection form.

4.2.3 Optical Brightener Pad Retrieval and Handling

1. After a 4-10 day period of exposure, optical brightener pads should be collected. The collection of each pad should be recorded in a field logbook or on a specified sample collection form.
2. Any object inserted in a pipe or other structure to anchor the pad should be removed.
3. Pads should be placed in individually labeled, re-sealable plastic bags. The sample label should indicate the monitoring point identification.
4. The pad should be removed from the screen envelope using scissors to cut open the envelope. The pad should be gently rinsed using cold tap water. Lightly squeeze out excess water with a clean hand. Do not wring out the pad. When processing the pads be aware that you may spread dye from one pad to another with your hands. Wear disposable gloves.
5. The pad should then be returned immediately to the labeled bag.
6. Pads should be air dried. The pad may be hung on a line to dry within the labeled bag. If a re-sealable plastic bag is used, cut the bottom corners of the bag to allow airflow to the pad.

4.3 Optical Brightener Analysis

1. When the pad is dry, expose the pad under a high quality long range UV light in a room that is completely dark. A non-exposed and an exposed pad are used as controls and compared to each test pad as it is exposed to the UV light.
2. There are three qualitative results: Positive, Negative, and Indeterminate. A pad will very definitely glow (fluoresce) if it is positive. If it is negative it will be noticeably drab and similar to the control pad. All other tests are indeterminate. Pads may be sorted into the basic categories: positive test, negative test, and indeterminate. Further, for positive tests, the pads may be sorted into categories by the relative strength of the fluorescence. A pad that is fluoresces brightly over most or all of its surface may be considered a strongly positive test, whereas a pad on which fluorescence appears patchy or faint may be considered a weakly positive test. Indeterminate results generally dictate that the test be repeated.
3. In some instances, only a portion of the pad or simply the outer edge will fluoresce after being exposed to optical brightener. This can be caused by many factors but is usually the result of an uneven exposure to the dye in the flow stream due to sedimentation or the way the pad was

positioned in the water. Regardless, as long as a portion of the pad fluoresces, it should be considered positive.

4. Since paper and cotton dust is so pervasive, it is common to see fluorescent fibers or specks on the test or control pads. These should be ignored and not used to indicate a positive result.
5. With the lights back on, record the identification number and the test result for each pad.
6. It is advisable to have a second reader perform the pad observations independently. The results are then compared. Any conflicting interpretations may be resolved though repeated observation of the pad in question, or a by a third observer.

5.0 RESPONSIBILITIES

1. All personnel will legibly record data and observations (including phone conversations) in accordance with this SOP to enable others to reconstruct project events and provide sufficient evidence of activities conducted.

6.0 DEFINITIONS

1. *Study* means any experiment at one or more test sites, in which a test substance is studied in a test system under laboratory conditions or in the environment to determine or help predict its effects, metabolism, product performance (pesticide efficacy studies only as required by 40 CFR 158.640) environmental and chemical fate, persistence, or residue, or other characteristics in humans, other living organisms, or media. The term "study" does not include basic exploratory studies carried out to determine whether a test substance or a test method has any potential utility.

7.0 REFERENCES

40 CFR Part 160 Good Laboratory Practice Standards, August, 1989.

MASS Bay Program. 1998. An Optical Brightener Handbook.
http://www.thecompass.org/8TB/pages/SamplingContents.html

8.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

None

9.0 AUTHORIZATION

Revised by: _____ Date: _____

Dave Braun, Project Scientist/Water Quality Specialist

Approved by: _____ Date: _____

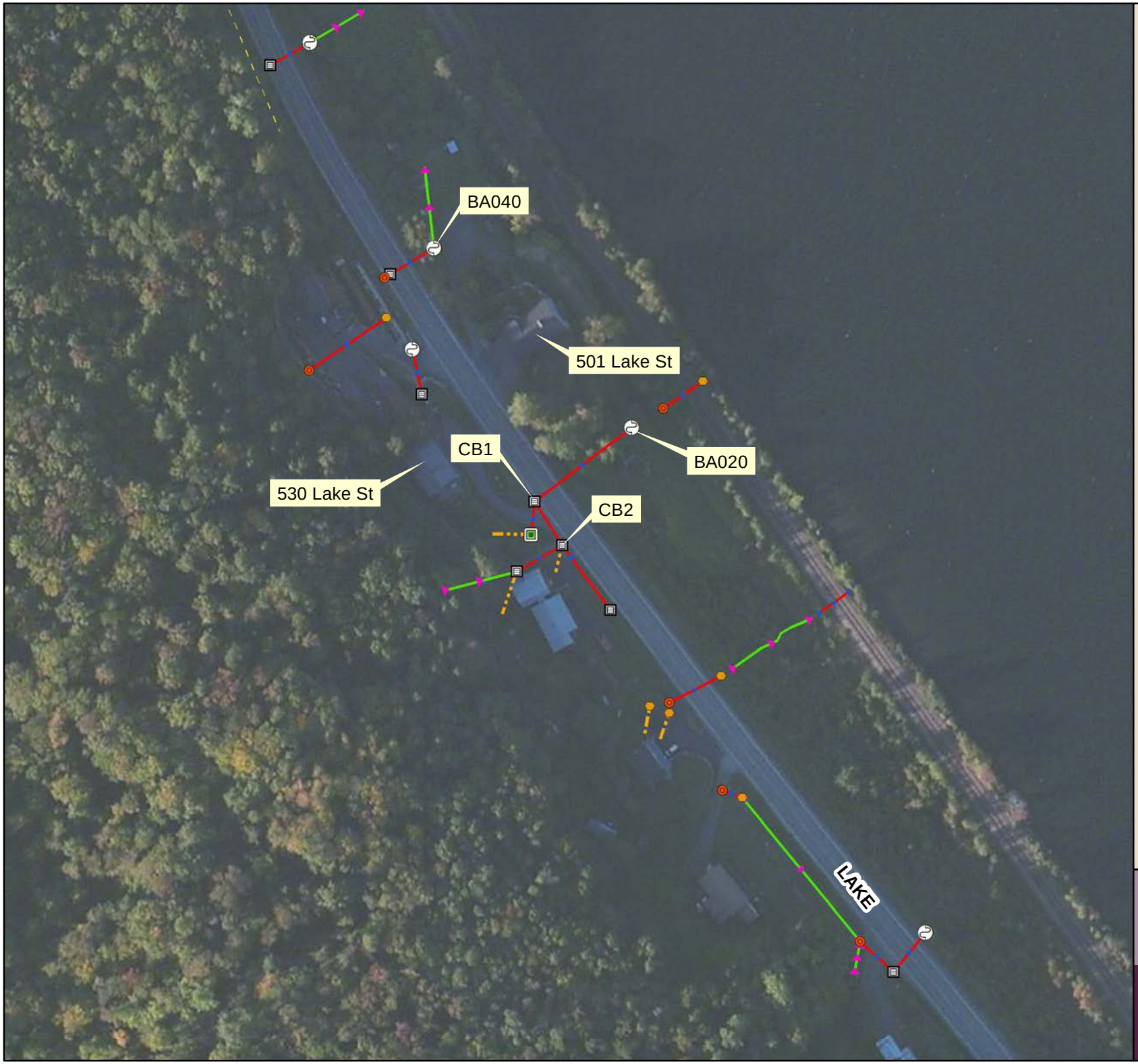
Christopher T. Stone, President

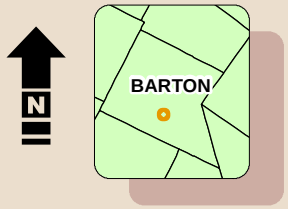
10.0 REVISION HISTORY

Revision number 1:

1. Minor clarifications and rewording throughout.
2. Changed 4-8 day pad exposure period to 4-10 day exposure period.
3. Changed description of indeterminate results.
4. Added use of binder clips to secure pads.
5. Updated procedure for processing exposed pads.

APPENDIX C: MAPS





0 80 160 Feet

Legend

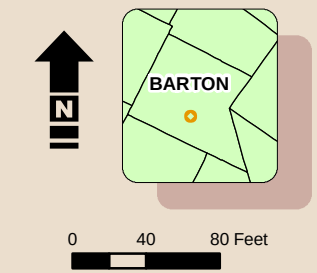
- Catchbasin
- Culvert inlet
- Culvert outlet
- Junction Box
- Outfall
- Storm line
- Sanitary line
- Swale
- Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-1
Systems BA020 and BA040
Barton, VT

Memphremagog Basin IDDE



Legend

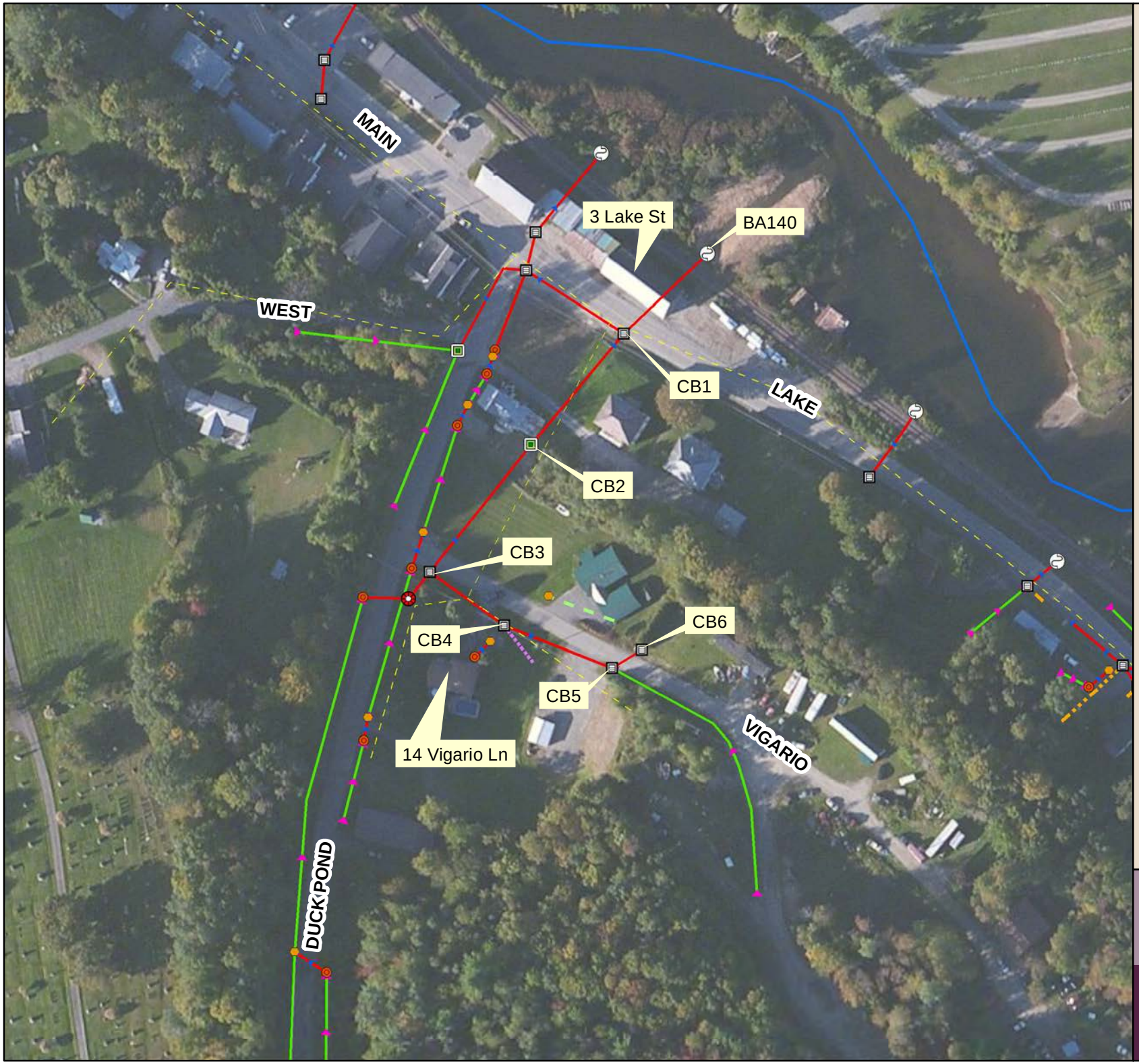
- Catchbasin
- Culvert inlet
- Culvert outlet
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Footing drain
- Under drain

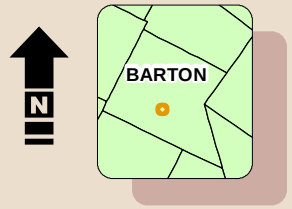
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-2
Systems BA060 and BA080
Barton, VT

Memphremagog Basin IDDE





Legend

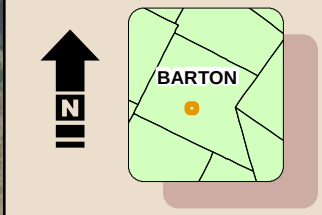
- Catchbasin
- Culvert inlet
- Culvert outlet
- Junction Box
- Stormwater Manhole
- Outfall
- Storm line
- Sanitary line
- Swale
- Footing drain
- Under drain
- Roof drain
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-3
System BA140
Barton, VT

Memphremagog Basin IDDE



Legend

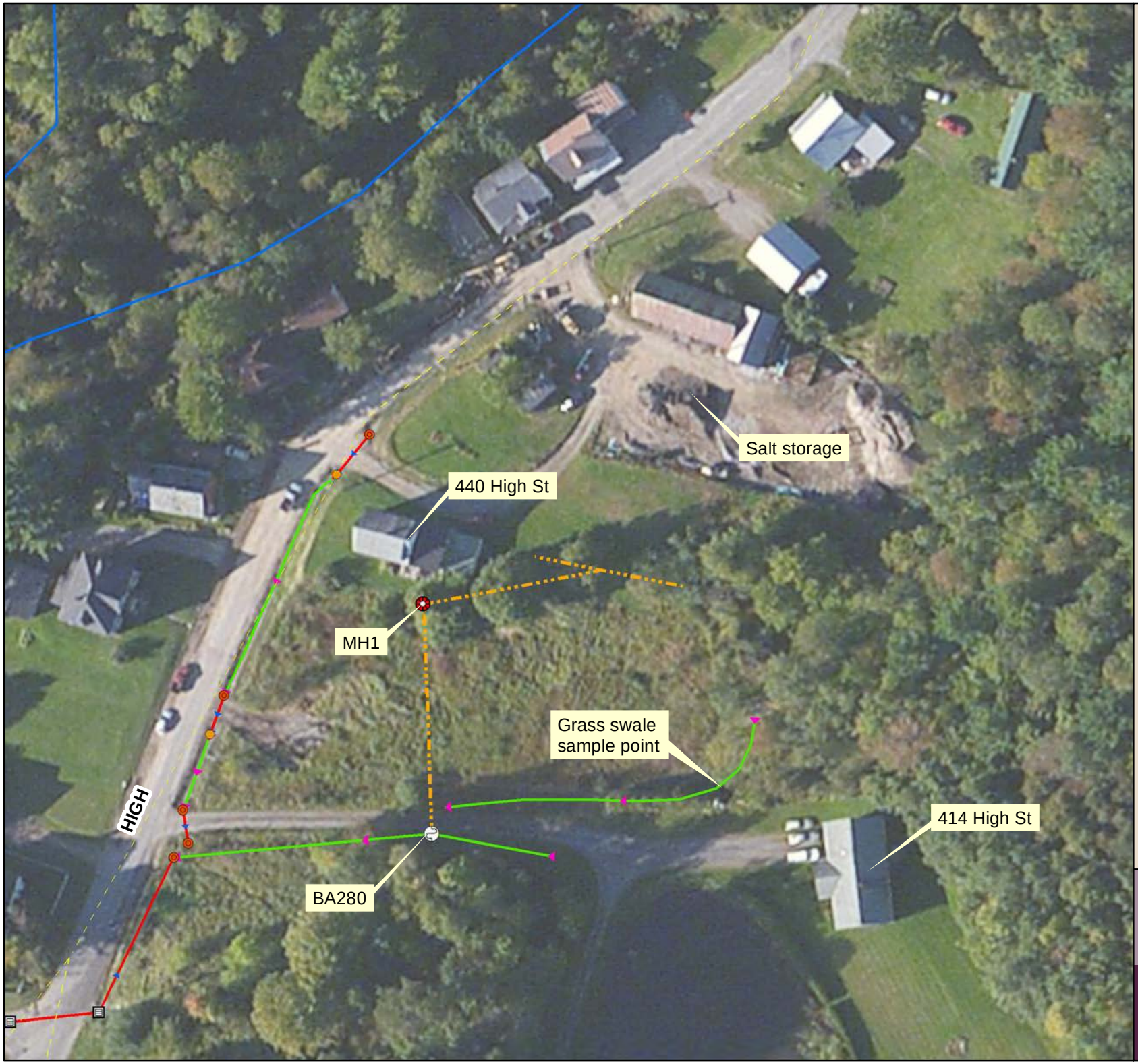
- Catchbasin
- Culvert inlet
- Culvert outlet
- Stormwater Manhole
- Combined sewer MH
- Outfall
- Storm line
- Sanitary line
- Swale
- Footing drain
- Under drain
- Tunnel (storm)
- Stream

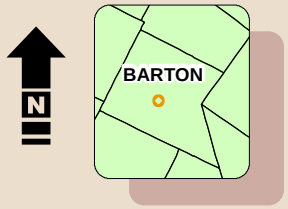
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-4
System BA270
Barton, VT

Memphremagog Basin IDDE





0 50 100 Feet

Legend

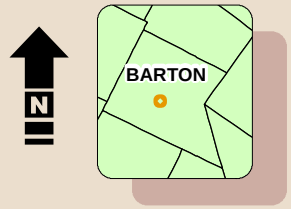
- Catchbasin
- Culvert inlet
- Culvert outlet
- Stormwater Manhole
- Outfall
- Storm line
- Sanitary line
- Swale
- Under drain
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-5
System BA280
Barton, VT

Memphremagog Basin IDDE



Legend

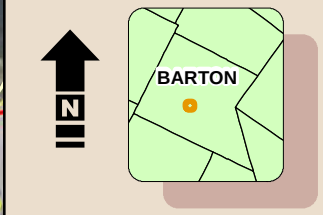
- Catchbasin
- Culvert inlet
- Culvert outlet
- Stormwater Manhole
- Outfall
- Storm line
- Sanitary line
- Swale
- Footing drain
- Under drain
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-6: Systems BA290, BA300 and BA310 Barton, VT

Memphremagog Basin IDDE



Legend

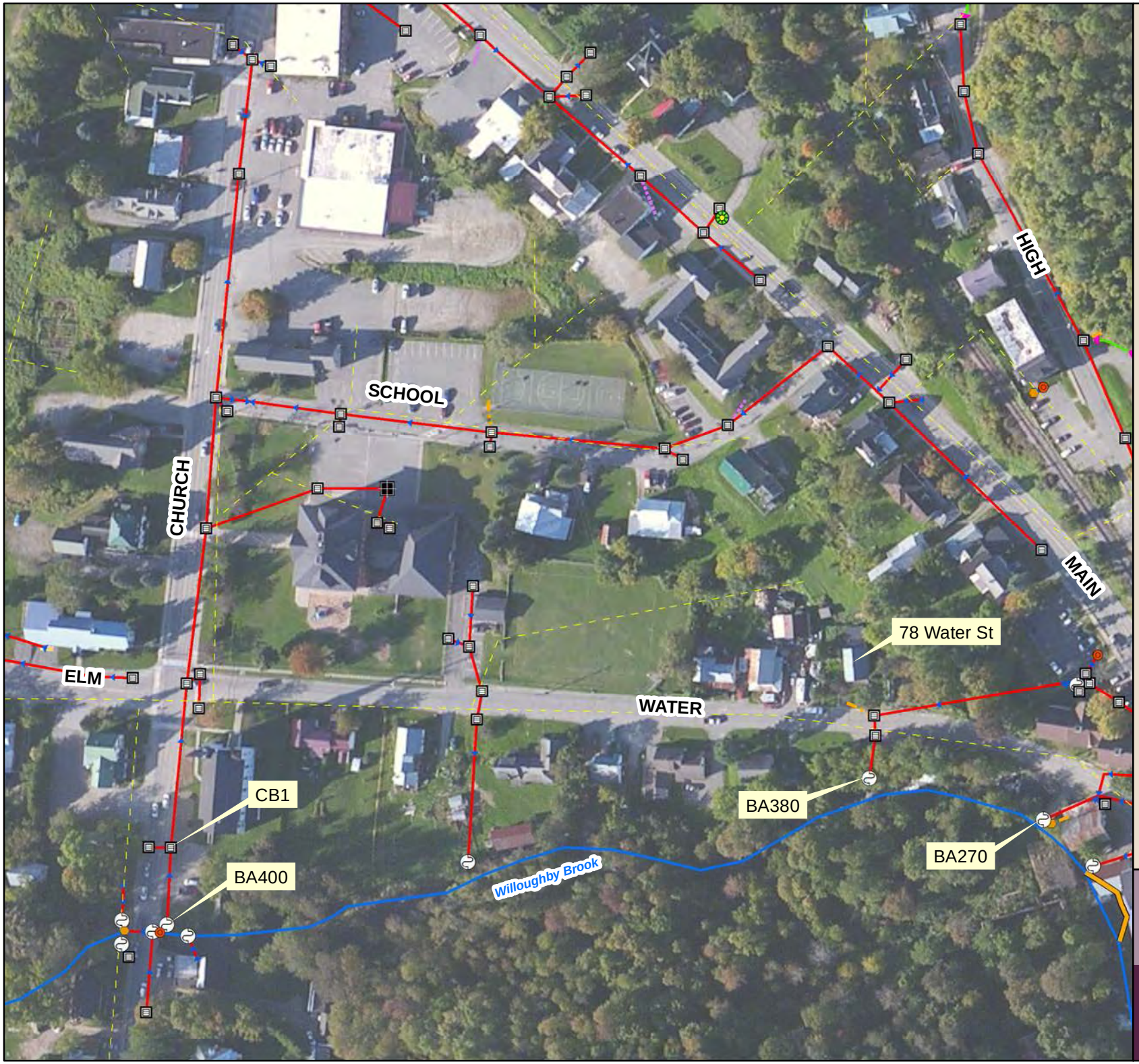
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Stormwater Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Combined sewer
- Sanitary line
- Swale
- Footing drain
- Under drain
- Tunnel (storm)
- Stream

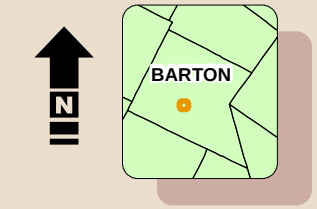
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-7:
System BA360
Barton, VT

Memphremagog Basin IDDE





0 100 200 Feet

Legend

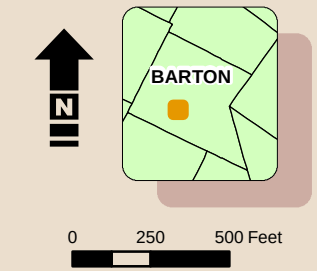
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Combined sewer MH
- Outfall
- Storm line
- Sanitary line
- Swale
- Footing drain
- Under drain
- Trench drain
- Tunnel (storm)
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-8: Systems BA 380 and BA400 Barton, VT

Memphremagog Basin IDDE



Legend

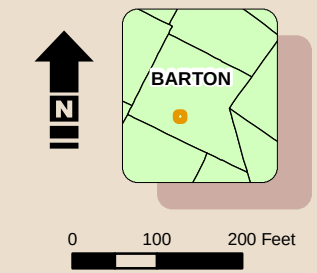
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Stormwater Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Combined sewer
- Sanitary line
- Swale
- Footing drain
- Under drain
- Trench drain
- Tunnel (storm)
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-9: System BA470 Barton, VT

Memphremagog Basin IDDE



Legend

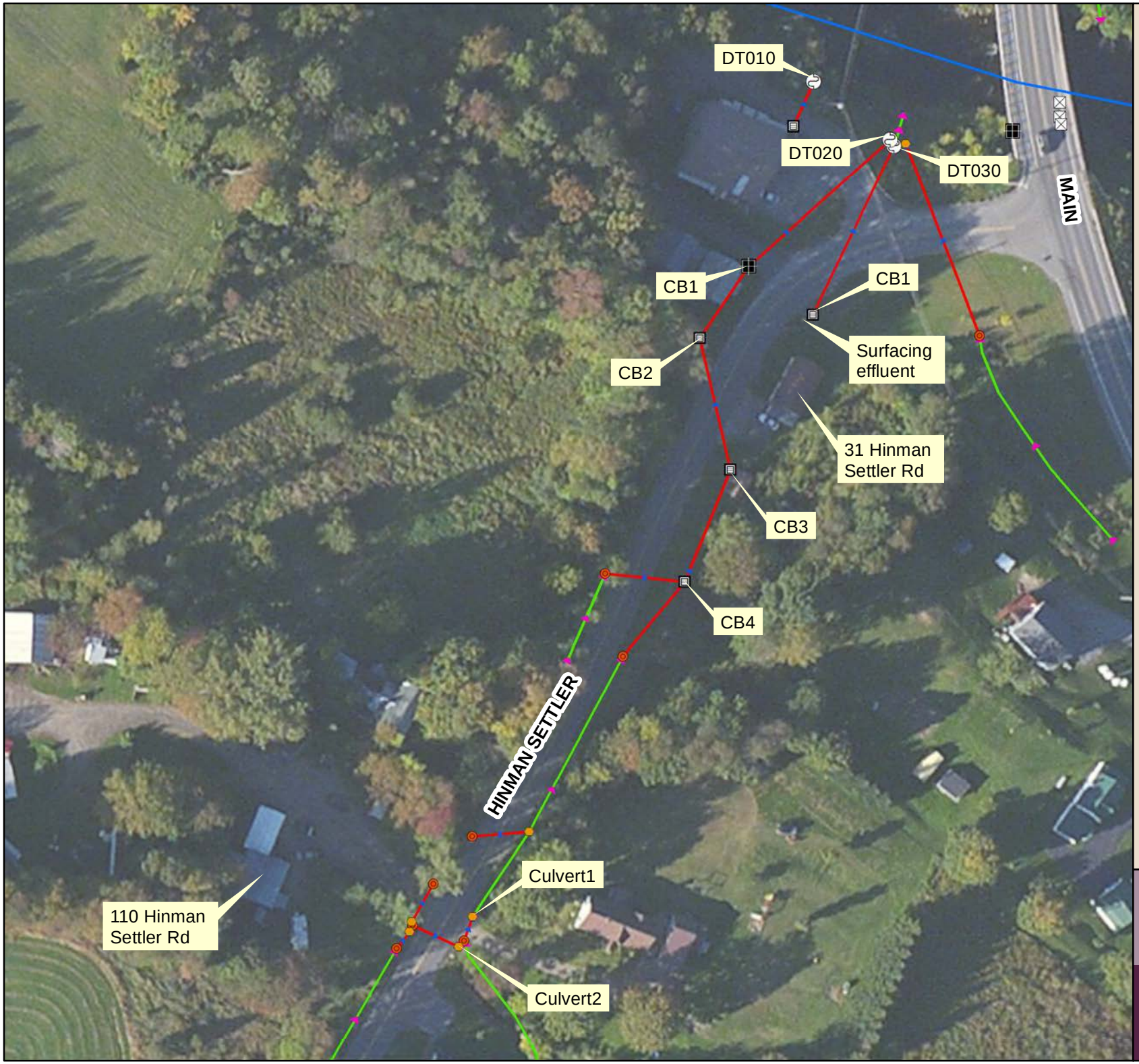
- Catchbasin
- Culvert outlet
- Drop Inlet
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Stream

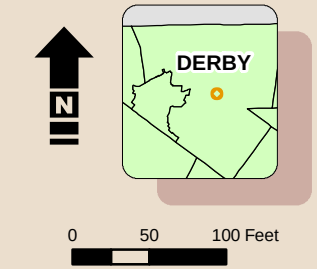
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BA-10:
System BA540
Barton, VT

Memphremagog Basin IDDE





Legend

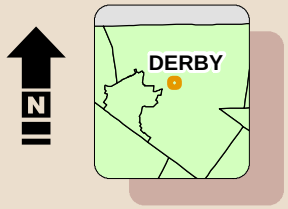
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Grate/Curb Inlet
- Outfall
- Storm line
- Swale
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map DT-1
Systems DT020 and DT030, Derby, VT

Memphremagog Basin IDDE



0 80 160 Feet

Legend

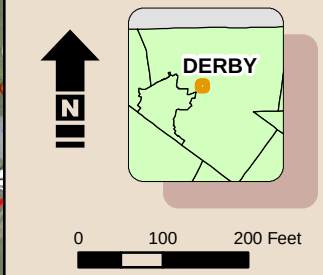
- Catchbasin
- Culvert inlet
- Culvert outlet
- Stormwater Manhole
- Outfall
- Storm line
- Swale
- Footing drain
- Roof drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map DT-2
System DT160
Derby, VT

Memphremagog Basin IDDE



0 100 200 Feet

Legend

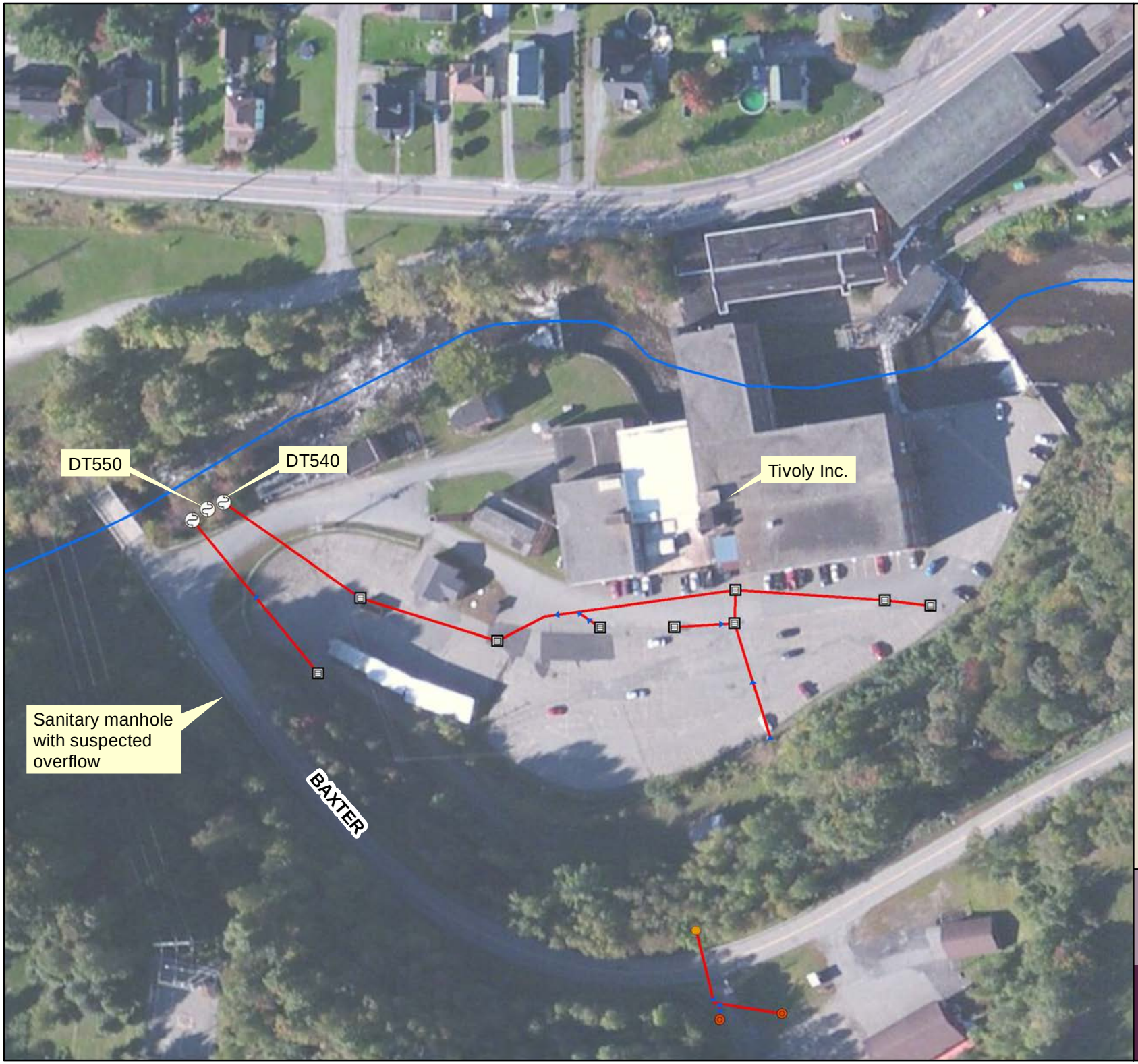
- Catchbasin
- Culvert inlet
- Culvert outlet
- Outfall
- Storm line
- Swale
- Under drain
- Roof drain
- Trench drain
- Stream

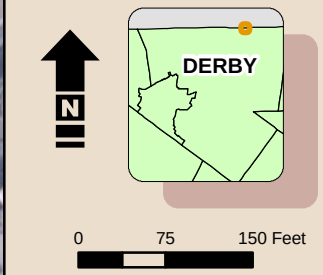
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map DT-3
System DT230
Derby, VT

Memphremagog Basin IDDE





Legend

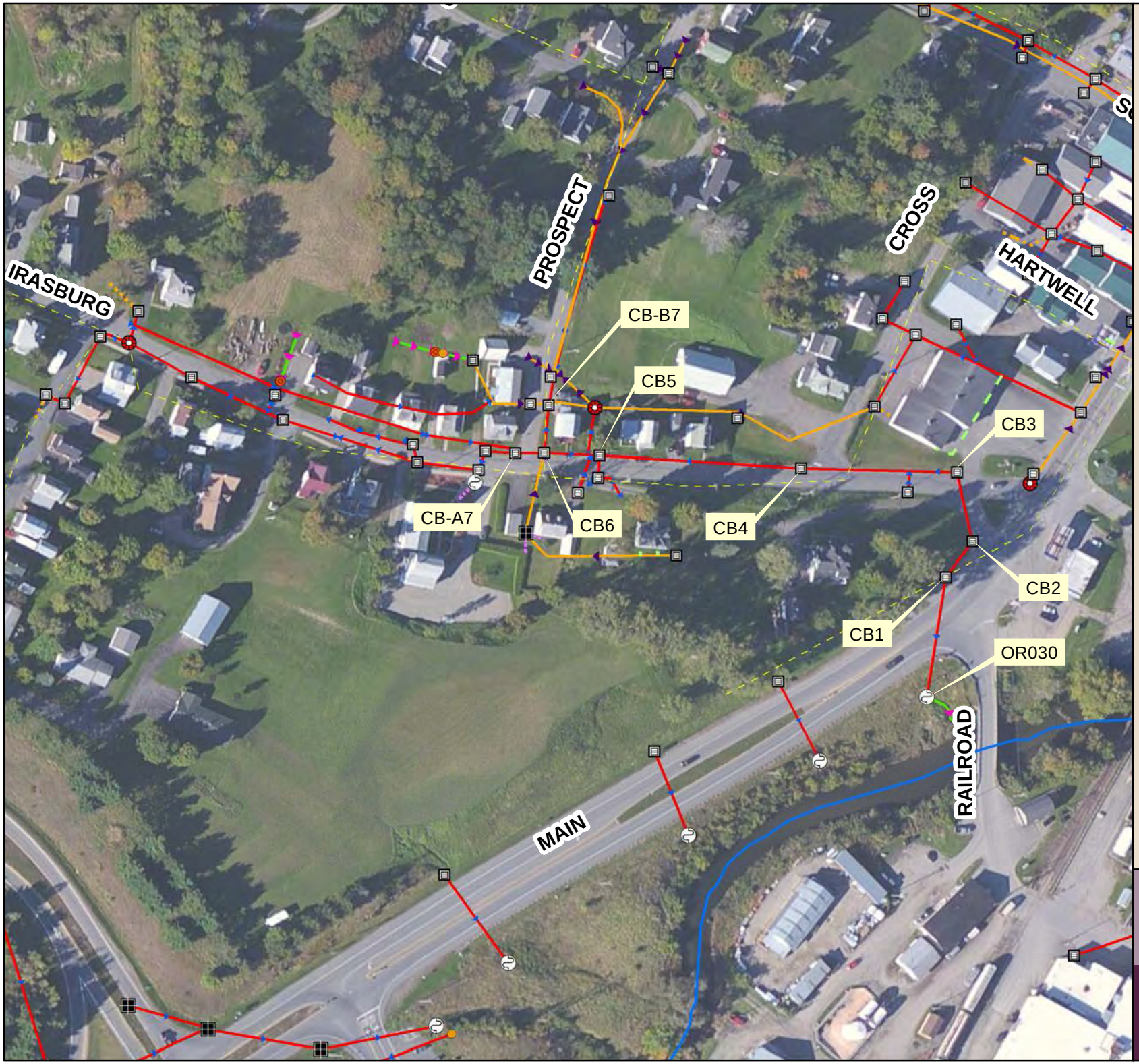
- Catchbasin
- Culvert inlet
- Culvert outlet
- Outfall
- Storm line
- Stream

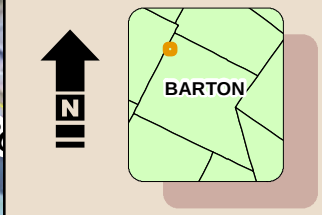
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map DT-4
Systems DT540 and DT550
Derby, VT

Memphremagog Basin IDDE





0 100 200 Feet

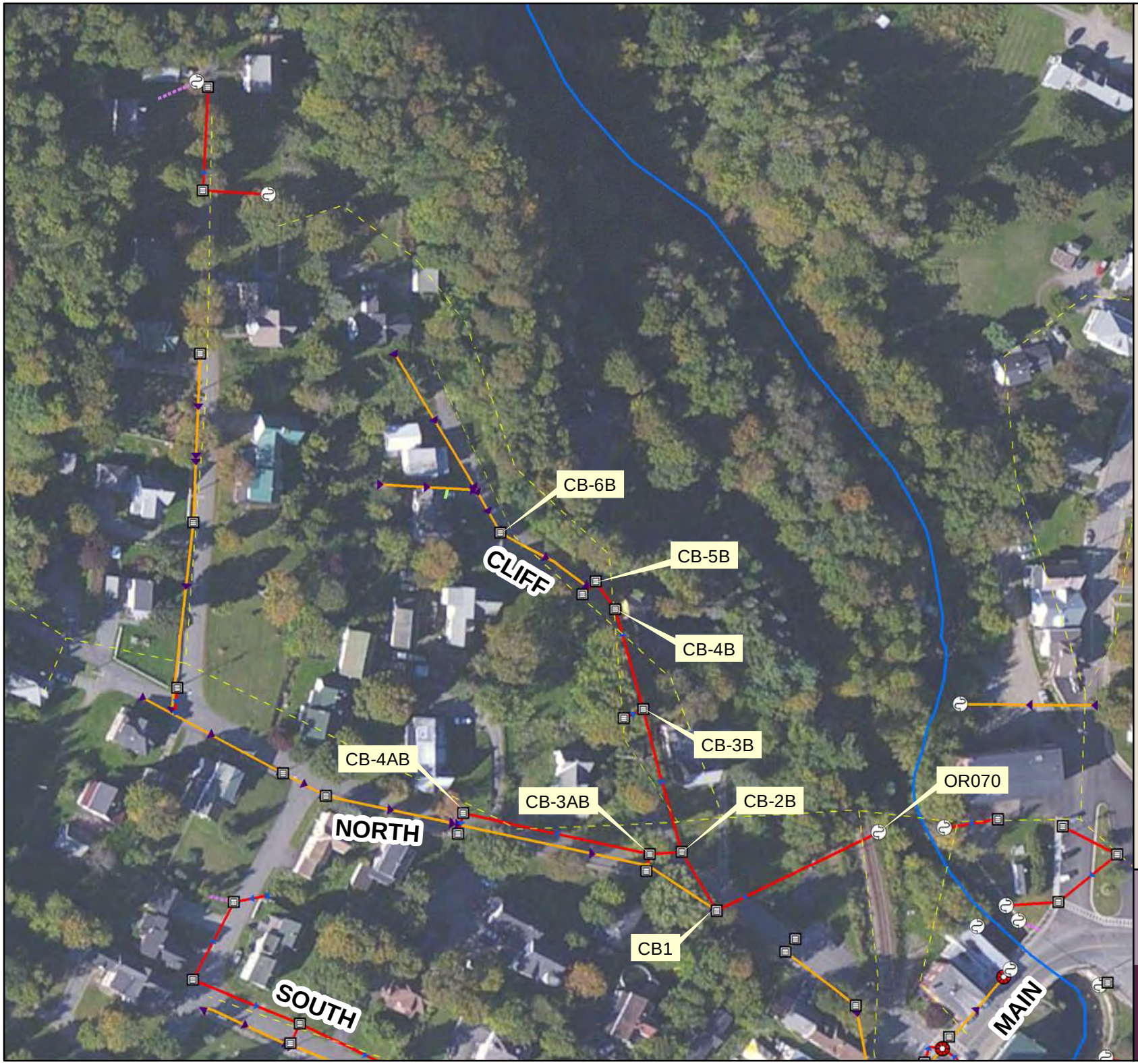
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Stormwater Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Footing drain
- Under drain
- Roof drain
- Stream

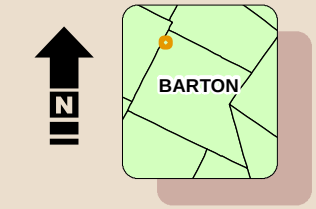
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map OR-1
System OR030
Orleans, VT

Memphremagog Basin IDDE





0 80 160 Feet

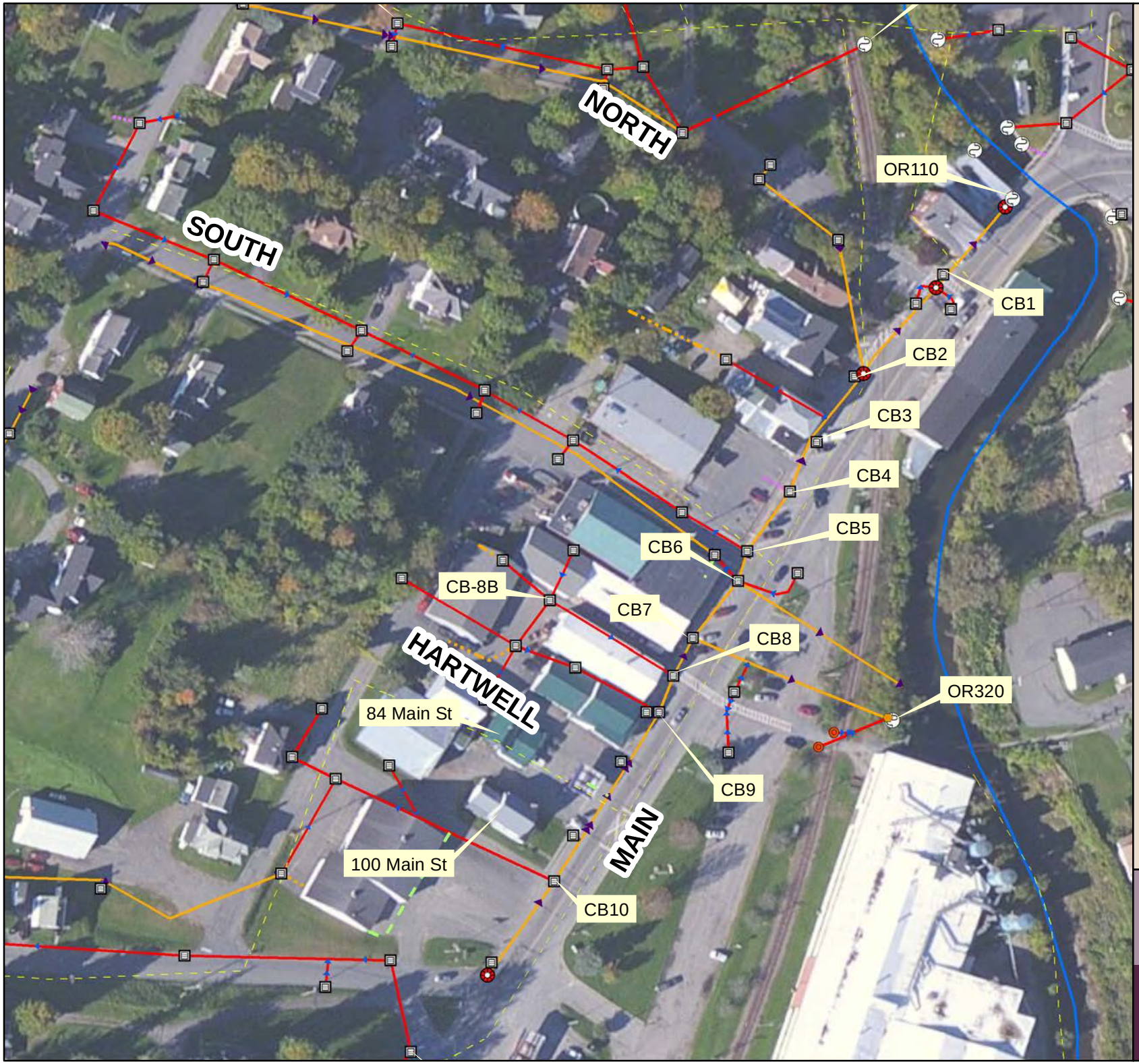
- Catchbasin
- Stormwater Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Footing drain
- Under drain
- Roof drain
- Stream

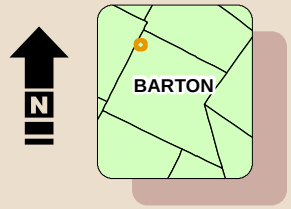
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

Stone Environmental Inc

Map OR-2
System OR070
Orleans, VT

Memphremagog Basin IDDE





0 75 150 Feet

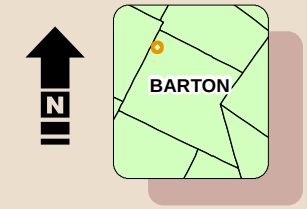
- Catchbasin
- Culvert inlet
- Culvert outlet
- Stormwater Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Footing drain
- Under drain
- Roof drain
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map OR-3
Systems OR110 and OR320
Orleans, VT

Memphremagog Basin IDDE



0 60 120 Feet

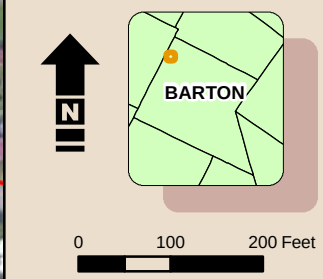
- Catchbasin
- Drop Inlet
- Outfall
- Storm line
- Sanitary line
- Swale
- Under drain
- Roof drain
- Trench drain
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map OR-4
Systems OR220 and OR240
Orleans, VT

Memphremagog Basin IDDE



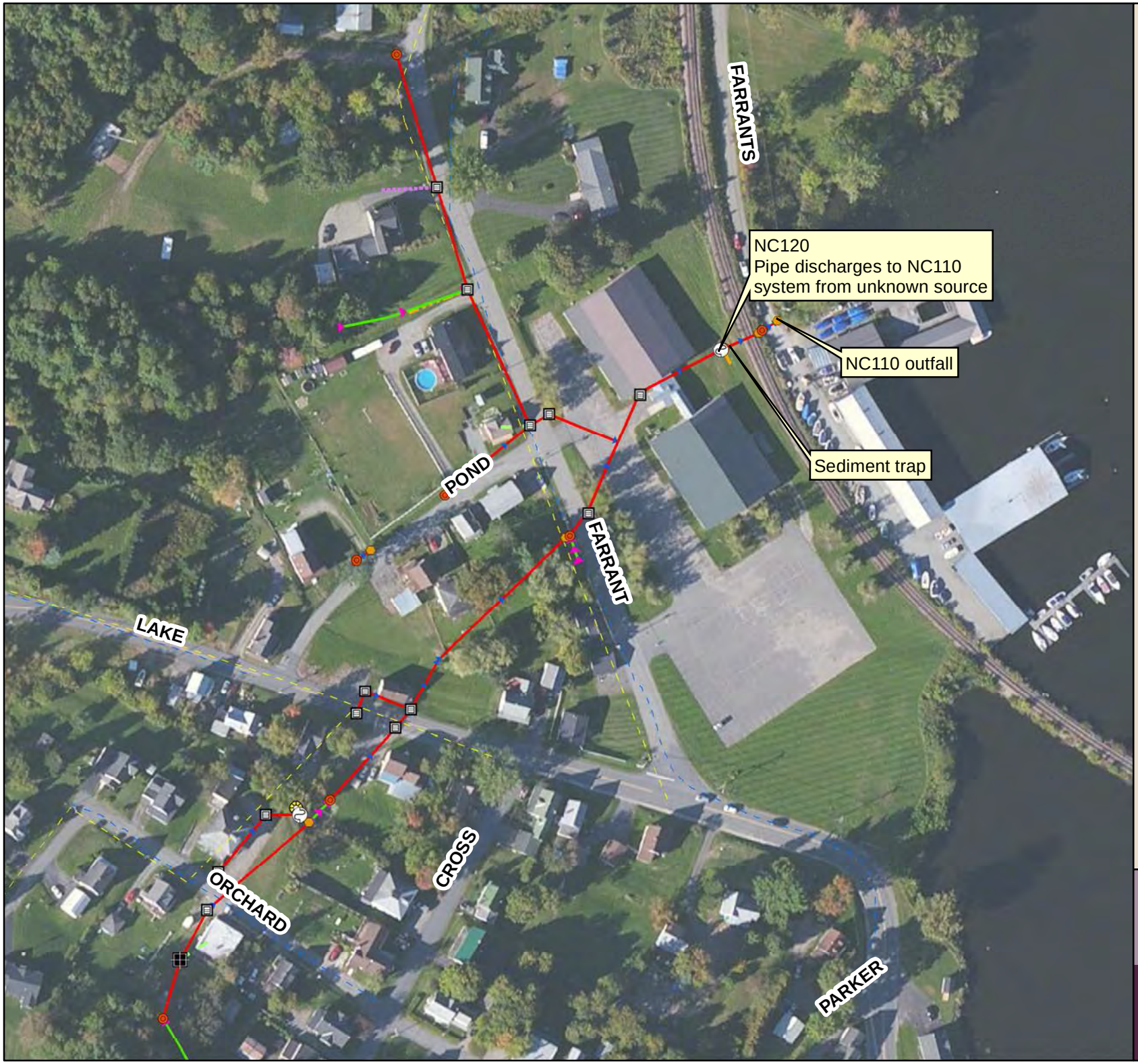
- Catchbasin
- Culvert inlet
- Culvert outlet
- Outfall
- Storm line
- Sanitary line
- Swale
- Trench drain
- Stream

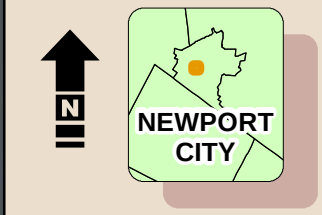
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map OR-5
Systems OR260 and OR360
Orleans, VT

Memphremagog Basin IDDE





0 100 200 Feet

Legend

- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Drop Inlet
- Existing, Outfall
- Existing, Sanitary Manhole
- Newport City Water System
- Existing, Footing drain
- Existing, Roof drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-1
Systems NC110 and NC120
Newport City, VT

Memphremagog Basin IDDE

N

NEWPORT CITY

0 240 480 Feet

Legend

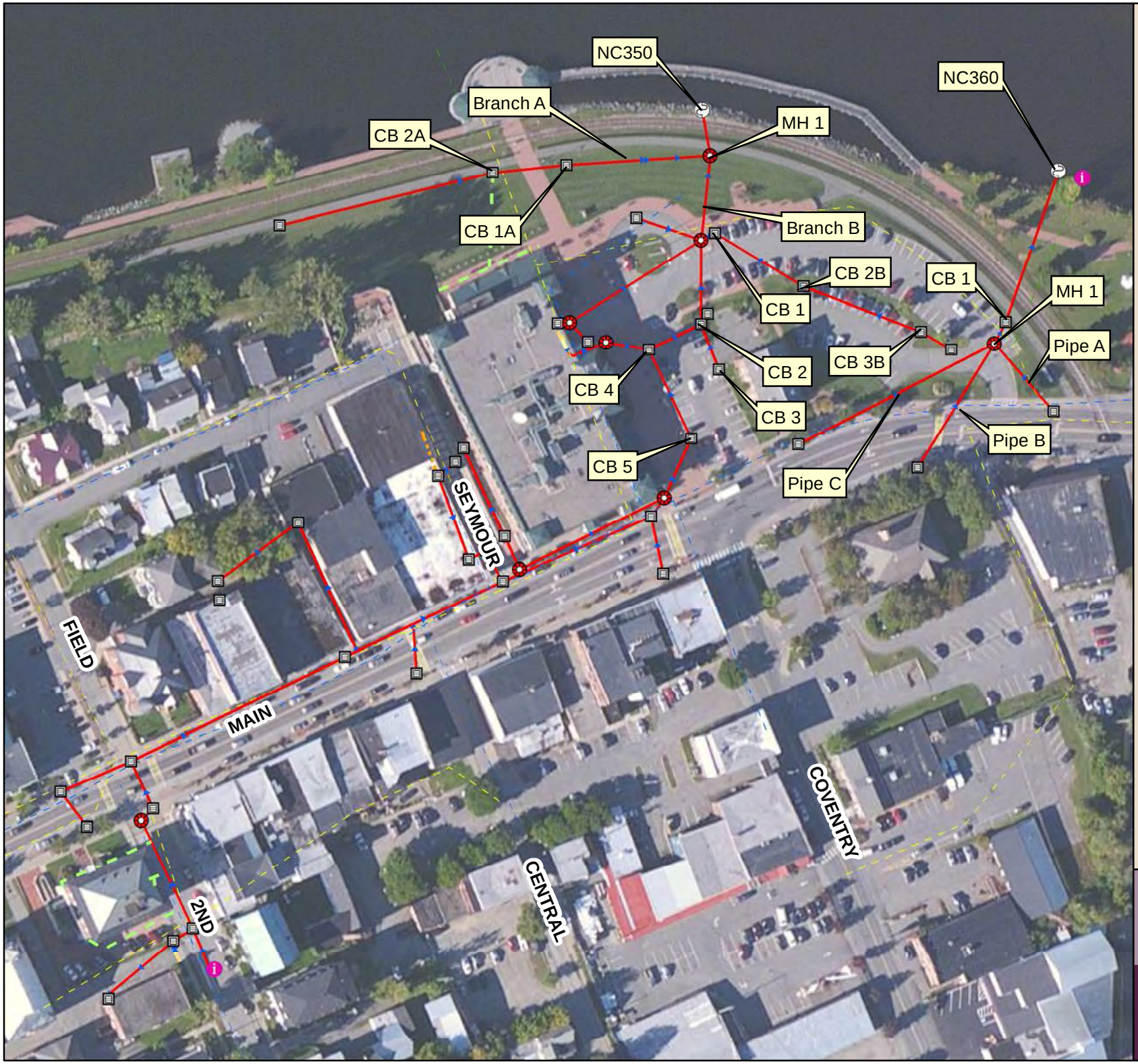
- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Drop Inlet
- Existing, Outfall
- Existing, Stormwater Manhole
- Newport City Water System
- Abandoned, Storm line
- Existing, Footing drain
- Existing, Roof drain
- Existing, Sanitary line
- Existing, Storm line
- Storm line (old Sanitary line)

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-2
System NC230
Newport City, VT

Memphremagog Basin IDDE



N

NEWPORT CITY

0 80 160 Feet

Legend

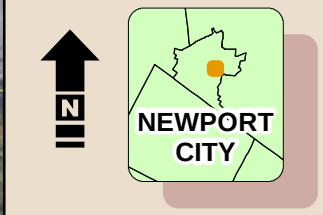
- Existing, Catchbasin
- Existing, Information Point
- Existing, Outfall
- Existing, Stormwater Manhole
- Newport City Water System
- Abandoned, Sanitary line
- Existing, Roof drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Trench drain
- Existing, Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-3
Systems NC350 and NC360
Newport City, VT

Memphremagog Basin IDDE



Legend

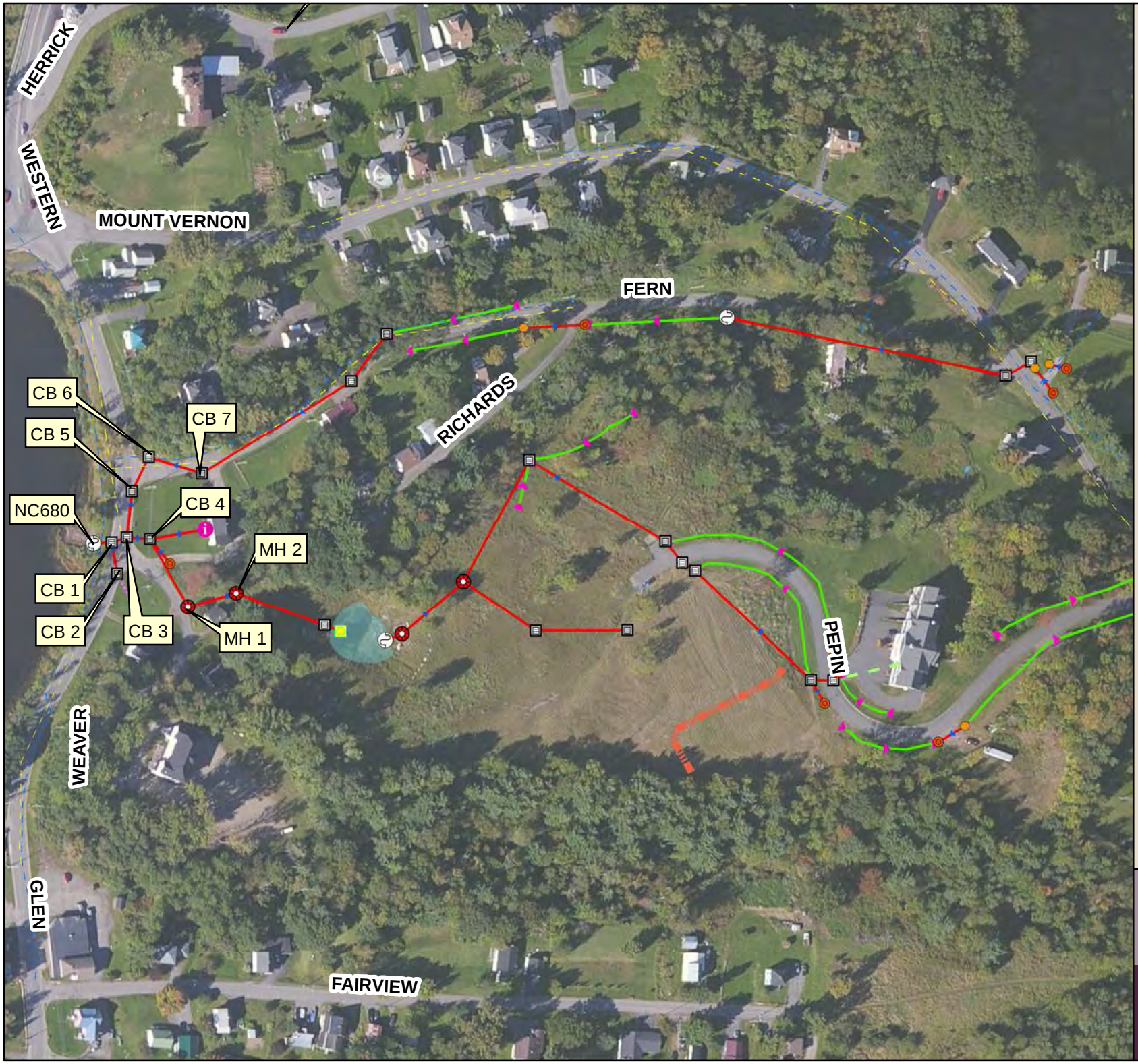
- Existing, Catchbasin
- Existing, Outfall
- Existing, Stormwater Manhole
- Newport City Water System
- Existing, Sanitary line
- Storm line (old Sanitary line)
- Existing, Under drain

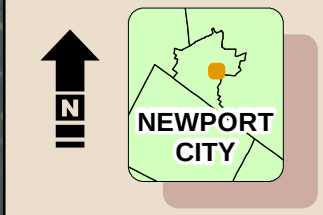
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-4
System NC640
Newport City, VT

Memphremagog Basin IDDE





0 150 300 Feet

Legend

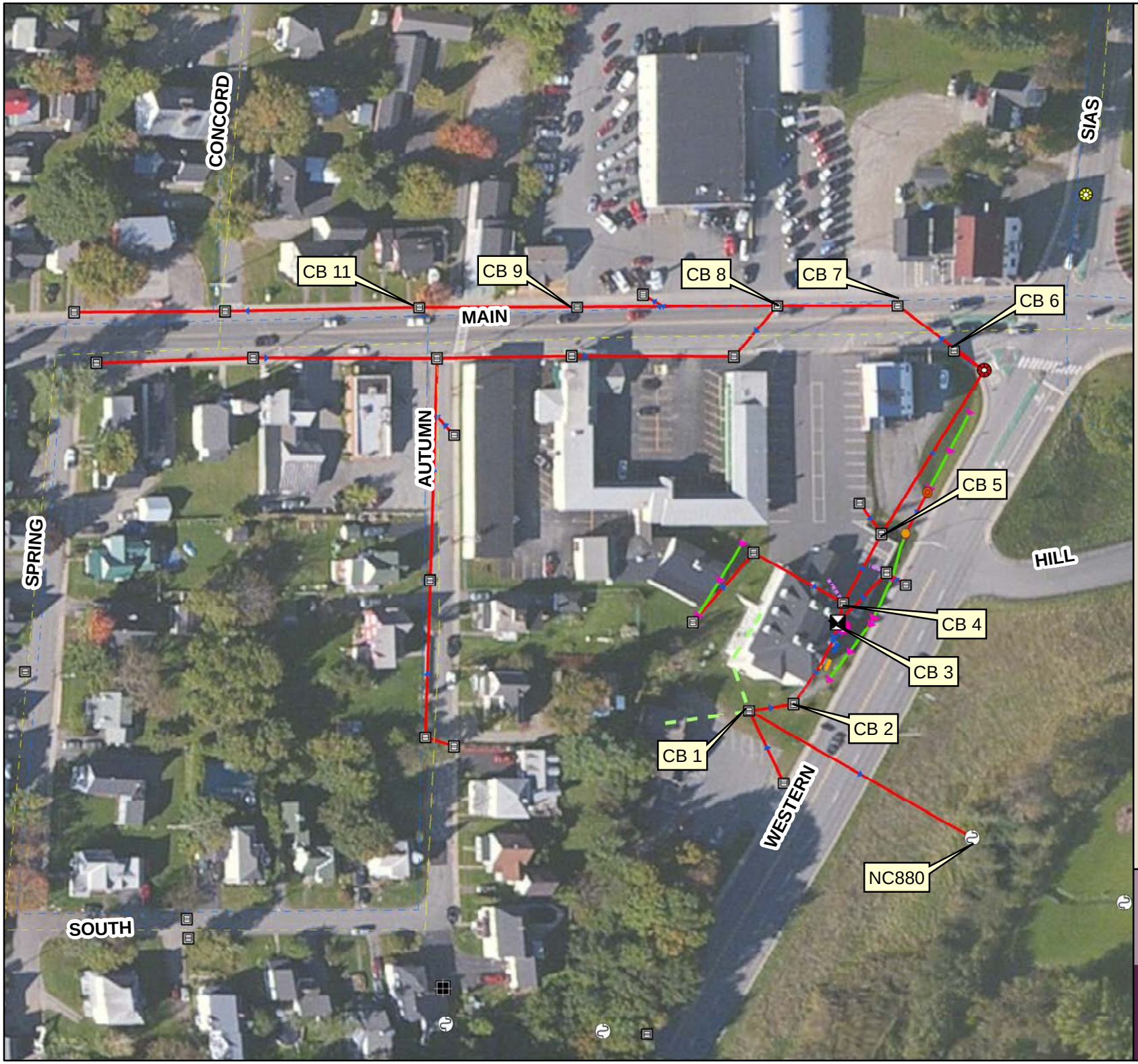
- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Information Point
- Existing, Outfall
- Existing, Pond outlet structure
- Existing, Stormwater Manhole
- Newport City Water System
- <Null>, Infiltration pipe
- Existing, Footing drain
- Existing, Roof drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing Stormwater Polygon

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-5
System NC680
Newport City, VT

Memphremagog Basin IDDE



N

NEWPORT CITY

0 100 200 Feet

Legend

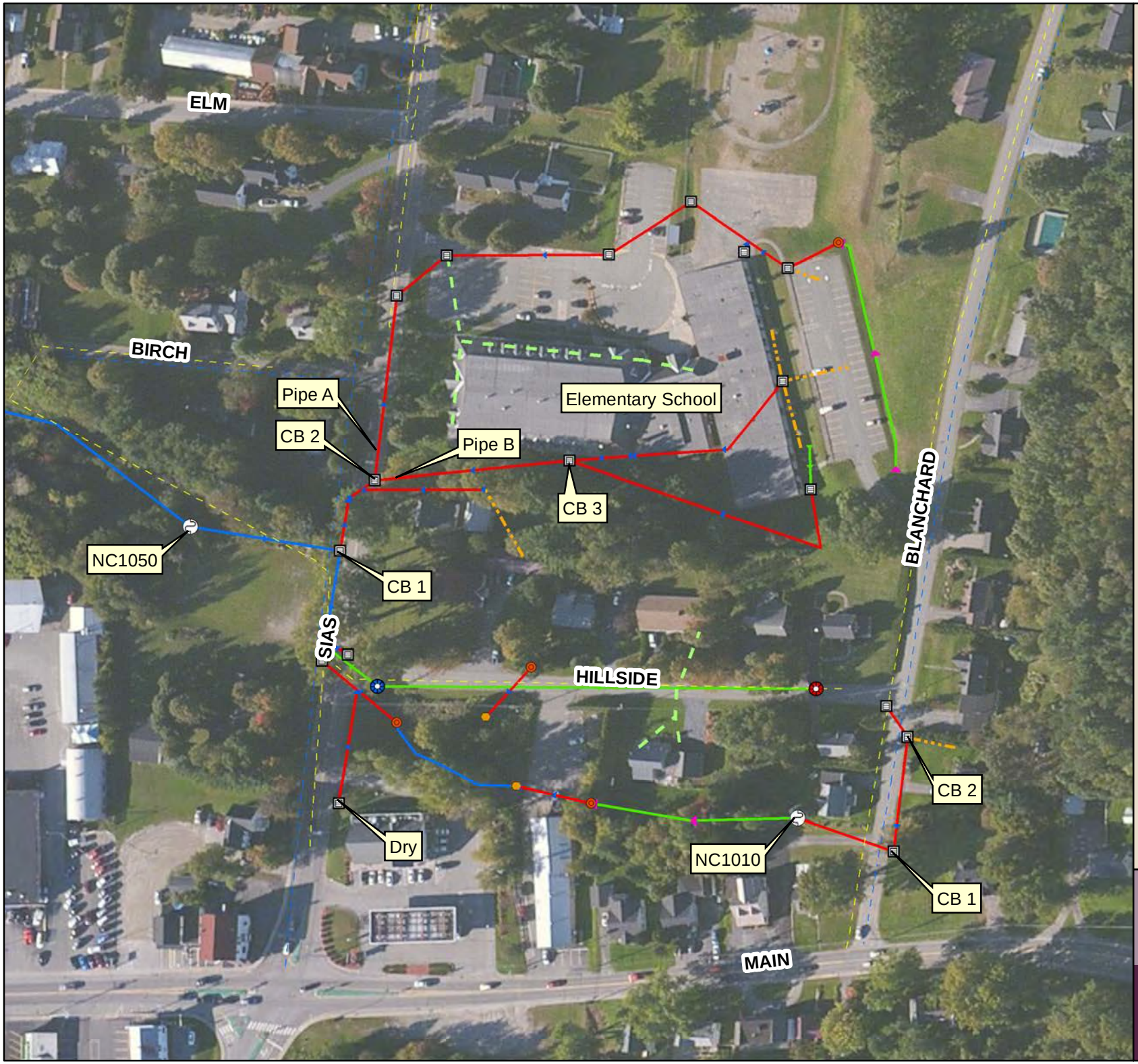
- Existing, Stormwater Manhole
- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Drop Inlet
- Existing, Information Point
- Existing, Outfall
- Existing, Sanitary Manhole
- Treatment feature (see notes)
- Newport City Water System
- Existing, Emergency spillway
- Existing, Footing drain
- Existing, Roof drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-6
System NC880
Newport City, VT

Memphremagog Basin IDDE



N

NEWPORT CITY

0 125 250 Feet

Legend

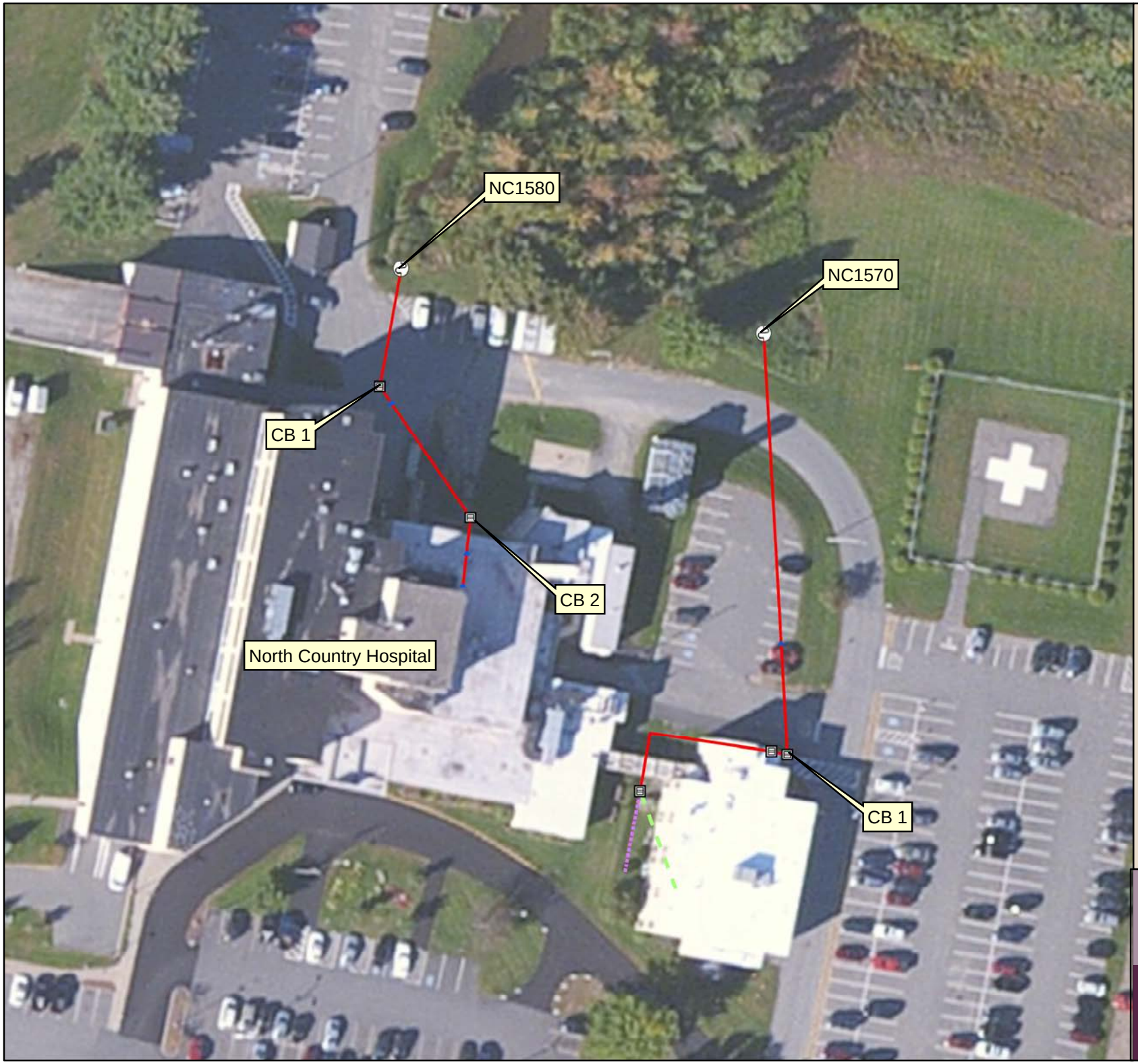
- Abandoned Manhole
- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Outfall
- Existing, Stormwater Manhole
- Newport City Water System
- Abandoned, Storm line
- Existing, Roof drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Stream
- Existing, Swale
- Existing, Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map NC-7
System NC1050
Newport City, VT

Memphremagog Basin IDDE



N

NEWPORT CITY

0 50 100 Feet

Legend

- Existing, Catchbasin
- Existing, Outfall
- Existing, Footing drain
- Existing, Roof drain
- Existing, Storm line

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

Stone Environmental Inc

Map NC-8
NC1570 and NC1580
Newport City, VT

Memphremagog Basin IDDE