Detecting and Eliminating Illicit Discharges in St. Johnsbury to Improve Water Quality

Final Report

August 14, 2015

Sanitary wastewater discharging to the Passumpsic River from an overflow structure in St. Johnsbury on December 9, 2014. This overflow occurred during dry weather due to an obstructed sewer pipe. The problem was quickly corrected when brought to the attention of the Town.

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1. INTRODUCTION

The goal of the St. Johnsbury 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 the Passumpsic and Sleepers Rivers and their tributaries. The project was administered by the Caledonia County Natural Resources Conservation District (CCNRCD) 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.

The geographic scope of the project included the entire extent of the municipal closed drainage system in St. Johnsbury. Prior to this assessment, the Vermont Department of Environmental Conservation prepared stormwater infrastructure mapping. This infrastructure mapping was used to plan the assessment and to guide further investigations in systems with suspected illicit discharges.

Between May and July, 2014, Stone assessed stormwater outfalls and certain manholes and catchbasins for the presence of illicit discharges. Stone assessed 122 separate stormwater drainage systems. Additionally, 10 combined sewer overflow structures were assessed for presence of contaminated dry weather flows. 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.

Appendix A presents the results of the initial assessment phase, together with an overview map of the Town of St. Johnsbury indicating systems in which contaminants were detected during the initial assessment phase. These results and other interim findings were presented to the St. Johnsbury Town Manager, John Hall, and Public Works Director, Hugh Wescott, in a meeting on November 19, 2014.

Among the 132 systems assessed, contaminants indicating a possible illicit discharge were detected in 35 systems. There were three illicit discharges suspected in systems SJ510 and SJ1000, for a total of 39 suspected illicit discharges. 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. This report presents the assessment data and investigation findings for all the systems identified as requiring further investigation.

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 B), field maps, a Health and Safety Plan, and other documents and organizing these in a project notebook; and meeting with the St. Johnsbury Town Manager, John Hall, and Public Works Director, Hugh Wescott, to 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 meetings were an opportunity to collect information regarding:

- 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 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 B).

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 C).

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 C). 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 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 1 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 1. 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 2. Stormwater drainage systems were designated for follow-up sampling and/or investigation where these benchmarks were exceeded.

Table 2. 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. The presence and appearance of dry-weather flows were also useful in isolating sources of contamination within storm sewer segments.

After bracketing the discharge sources as closely as possible using the water quality test methods, Stone met with the Town Manager and Public Works Director on November 19, 2014 to describe our findings and discuss next steps. In the investigations phase, engineering plans were reviewed and dye testing was performed to try to identify specific improper connections. Many systems were sampled repeatedly to establish conclusively whether or not a chronic illicit discharge exists. After repeated sampling, most of the systems flagged for advanced investigation were determined not to have an illicit discharge. The sewer separation and road resurfacing projects, which were ongoing for nearly the entire 2014 field season, are believed to have resulted in low levels of contaminants as well as visual indications of contamination (suds, turbidity) and certain odors in many of these systems. These indicators were found less often after construction activities ended.

2.4.1 *E. coli* and nitrogen

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 total nitrogen and *E. coli* analyses. DEC's LaRosa laboratory performed both analyses. Nitrogen was analyzed because it is a significant concern in the Connecticut River basin due to its effects on the ecology of Long Island Sound. The Sleepers and Moose Rivers join the Passumpsic River in St. Johnsbury, which flows to the Connecticut River. *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.

Samples for *E. coli* analysis were collected in sterile, plastic 100-mL bottles and analyzed using Quanti-tray. Samples collected for total nitrogen analysis were collected in HDPE plastic vials provided by the DEC LaRosa laboratory. Total nitrogen was analyzed by SM 4500-N C Modified. The preservation and holding time requirements are given in Table 3, below.

Table 3. Laboratory sample analyses

Parameter	Sample Container	Analytical Method	Sample Preservation	Holding Time
Total N	Plastic vial (50 mL)	SM 4500-N C Modified	Cool (4°C), sulfuric acid	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 nitrogen analyses, flow measurements were made to enable calculation of total nitrogen mass loading. Flow was measured by timing the filling of a container of known volume or using the float method.

3. RESULTS

Illicit discharge detection was performed in St. Johnsbury during the summer of 2014. Of the 132 systems assessed, 39 were designated for further investigation due to detection of one or more contaminants. The status of these investigations is summarized in Table 4 and the systems are described in detail below. Maps referenced in the descriptions are included in Appendix D. In both SJ510 and SJ1000 the initial assessment data suggested that three illicit discharges could be present. For the purposes of this project, we considered investigations of each branch of these systems to be separate advanced investigations.

Table 4. Status of investigations in St. Johnsbury

Structure ID	Status
SJ010	Suspected washwater discharge to the stormdrain via interior drains in the Green Mountain Mall. Stone recommends that this issue be referred to enforcement by the DEC project manager.
SJ040	No chronic illicit discharge.
SJ160	Suspected air conditioning condensation and/or washwater discharge to interior drains in the Cancer Center. We recommend DEC contact the Cancer Center to notify them of these findings and request information concerning any activities that might discharge washwater to the stormdrain.
SJ190	No chronic illicit discharge.
SJ280	No chronic illicit discharge.
SJ290	No chronic illicit discharge.
SJ300	The Town of St. Johnsbury corrected a blockage in a sewer line that was causing the dry weather overflow observed on December 9, 2014.
SJ320	No chronic illicit discharge.
SJ400	No chronic illicit discharge.
SJ410	No chronic illicit discharge.
SJ430	A pipe blowout above the CSO outfall was apparently repaired.
SJ440	During wet weather, sanitary wastewater can discharge to the separate stormwater system on Concord Avenue. Two possible routes of entry are 1) discharge to the street under surcharged conditions followed by drainage to a catchbasin, and 2) sewage backing up and flowing to a connected basement floor drain. There are reports of sewer backups in certain houses on Concord Avenue due to surcharging of the municipal sewer. These observations should inform future investigations by the Town of St. Johnsbury.
SJ450	No chronic illicit discharge.
SJ470	No chronic illicit discharge.
SJ480	No chronic illicit discharge.
SJ500	No chronic illicit discharge.
SJ510, CB4 Pipe B branch	Suspected washwater dumping to catchbasin CB4A by Kingdom Cleaners. The Town of St. Johnsbury sent Kingdom Cleaners a letter on August 14, 2015 notifying them that dumping washwater to the catchbasin is illegal and they must stop.

Structure ID	Status
SJ510 CB9	The source of optical brightener at catchbasin CB9 may be a plugged and leaking sewer lateral at 17 Parker Avenue. This lateral was cleaned out on June 29, 2015. This maintenance may eliminate the suspected wastewater discharge. However, it is also possible that the sewer lateral is in poor condition and will continue to leak into the stormdrain unless replaced.
SJ620	No chronic illicit discharge.
SJ640	No chronic illicit discharge.
SJ670	Leaks in the water distribution system were fixed and chlorine has not been detected in the system since.
SJ780	No chronic illicit discharge.
SJ820	No chronic illicit discharge.
SJ840	Despite poor water quality, there appears to be no current illicit discharge in this system.
SJ880	No chronic illicit discharge. Contaminants detected during the summer of 2014 appear to have resulted from construction.
SJ920	During dry weather, there is a slow drip from this CSO outfall. This appears insignificant from a water quality perspective.
SJ950	Partially renovated wastewater from the septic system at 240 High Street appears to infiltrate a small stream passing through a deep culvert under the property. Because effluent does not surface, the system is not considered to have failed. Therefore, it appears that neither the Town of St. Johnsbury nor DEC could compel the property owner to replace the system.
SJ960	The chlorinated dry weather flow detected in this system on June 26, 2015 suggests a municipal water leak is present on lower Mt. Vernon Street. This issue was referred to the Town of St. Johnsbury.
SJ1000, CB1 branch	No chronic illicit discharge. Contaminants detected during the summer of 2014 appear to have resulted from construction.
SJ1000, CB3 branch	No chronic illicit discharge. Contaminants detected during the summer of 2014 appear to have resulted from construction.
SJ1000, CB4 branch	No chronic illicit discharge. Contaminants detected during the summer of 2014 appear to have resulted from construction.
SJ1010	A trickle of dry weather flow is present at this CSO outfall but it is not contaminated. The structure probably still functions as a CSO in wet weather.
SJ1060	The source of the ammonia, iron staining, and unpleasant odors observed at the outfall is a wetland east of Memorial Drive. There is no chronic illicit discharge in this system.
SJ1140	No chronic illicit discharge.
SJ1160	No chronic illicit discharge.
SJ1240	No chronic illicit discharge.
SJ1260	Water blow off valve. No chronic illicit discharge.
SJ1280	No chronic illicit discharge.
SJ1310	No chronic illicit discharge.

3.1 SJ010

The SJ010 system drains portions of the Green Mountain Mall lot and a commercial property south of the mall (Map SJ-1). It discharges to the Passumpsic River west of 1950 Memorial Drive. The Green Mountain Mall is covered by stormwater discharge permit #3284-9010.R. This permit specifically prohibits the discharge of non-stormwater into the drainage system.

Table 5. Water analysis data for outfall SJ010

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
SJ010	5/13/14	Flowing	0.4	0.05	0.2	306	Negative	Clear, no odor
	8/21/14	Flowing	0.1	0.03	0.2	226	--	No drains enter CB-C, CB-D, or CB-E. CB-B not found (paved over).
SJ010 CB-D	5/13/14	Flowing	--	--	--	--	--	Suds
SJ010 CB-F	5/13/14	--	0.5	--	0.75	--	--	Pipe A trickling
	8/21/14	--	0.4	0.03	0.5	489	--	Pipe A wet (not flowing)
	6/24/15	Flowing	--	--	--	--	--	No flow from mall drains
SJ010 CB-H Pipe A	8/21/14	Dripping	1.0	0.02	0.2	--	--	--
	6/24/15	Wet (no Flow)	--	--	--	--	--	--

Figure 2. Suds in catchbasin CB-D on May 13, 2015

Findings:

- Ammonia was detected at the outfall on May 13, 2014. On the same date, a low concentration of ammonia (0.5 mg/L) and a moderate concentration of detergents (0.75 mg/L) were measured in catchbasin CB-F behind the mall building. Suds were present in catchbasin CB-D (Figure 2), which is down-pipe of CB-F.
- Drain pipes enter catchbasins CB-F, CB-G, and CB-H from the direction of the mall building. No drains enter catchbasins CB-C, CB-D, or CB-E. Catchbasin CB-B was not found.
- On August 21, 2014, samples collected in the sump of catchbasin CB-F had low concentrations of ammonia and detergents and the drain pipe entering catchbasin CB-H had a moderate ammonia concentration.
- The source(s) of ammonia and detergents in this system appear to be the drain pipes entering catchbasins CB-F, CB-G, and/or CB-H; we suspect these pipes are connected to roof leaders and possibly to interior drains in the Green Mountain Mall.
- On June 24, 2015, we attempted to determine the origin of the drain pipes entering the catchbasins behind the mall, but were unable to access utility areas in the mall.
- The manager of the Green Mountain Mall, Steve Whittemore, was made aware of these findings in early July, 2015. Mr. Whittemore does not believe there are floor drains in the mall connected to the stormwater drainage system. However, he mentioned a slop sink that might be connected. Every morning he empties a floor scrubber machine into this sink.
- Mr. Whittemore agreed to investigate whether the slop sink (and any other drains in the mall) are connected to the stormdrain. Stone sent fluorescent dye to Mr. Whittemore with instructions for conducting dye testing. Unfortunately, as of August 14, 2015, this dye testing had not been performed.

Conclusion: We suspect that the slop sink or another interior drain in the Green Mountain Mall is connected to the stormdrain on the backside of the property and that washwater is routinely discharged to this sink or drain. Another possibility is that cleaning of roof vents or air conditioning units introduces detergent and ammonia to the stormdrain. Regardless of the source, it is clear that contaminated water has been discharged to the stormdrain on the mall property in violation of the mall's stormwater permit.

Resolution: At this time, Stone recommends that this issue be referred to enforcement by the DEC project manager.

3.2 SJ040

The SJ040 system discharges to a stormwater pond behind the Irving gas station at 1786 Memorial Drive. There is only one catchbasin in this system. Three underdrains discharge to this catchbasin. The outfall pipe is submerged in the stormwater pond. The pond drains to a large wetland area, which discharges at outfall SJ1060. Systems SJ1060 and SJ040 are shown on Map SJ-22.

Table 6. Water analysis data for outfall SJ040

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Observations
SJ040 CB-A	5/13/14	Trickling	Outfall submerged. Oil sheen present on pond and in catchbasin CB-A.
	8/21/14	--	Outfall submerged. No oil sheen on pond or in CB-A.
	11/13/14	No flow	No oil sheen on pond or in CB-A.
	6/24/15	Trickling	Outfall submerged. No oil sheen on pond or in CB-A. No indication of recent discharge from Vianor.

Findings:

- On May 13, 2014, petroleum sheen was observed on the stormwater pond near the SJ040 outfall and in the catchbasin. A flow path was evident from garage bays at Vianor, over the parking lot and a grassy area, and into the catchbasin.
- No petroleum sheen was observed in the pond near the outfall and in the catchbasin on several subsequent visits, including August 21, 2014, November 13, 2014, and June 24, 2015. No discharge was seen from Vianor.

Conclusion: Based on repeated visits to the site, it does not appear there is a recurrent discharge to this system.

Resolution: NA

3.3 SJ160

The SJ160 system drains the south side of the Cancer Center property. It discharges to the Passumpsic River south of the Price Chopper parking lot on Memorial Drive (Map SJ-2).

Table 7. Water analysis data for outfall SJ160

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
SJ160	5/15/14	Wet/no flow	--	--	--	--	Negative	--
	8/21/14	Wet/no flow	--	--	--	--	--	--
	8/26/14	Trickling	0.1	0.07	0.75	57.1	--	Clear, no odor
	10/30/14	Trickling	0.0	0.04	0.2	32.2	--	Clear, no odor
SJ160 CB2 (sump)	5/15/14	--	0.0	0.00	0.2	--	--	Pipe entering CB2 dripping. Foam present at drip.
	9/24/14	Dripping	0.1	0.03	0.1	27.5	--	Clear, no odor.
SJ160 CB3	8/21/14	--	--	--	--	--	--	Covered by new construction
	6/24/15		0.25	0.10	0.2	2280		Uncovered CB3

Findings:

- The exceptionally low specific conductance measured and detection of detergents on August 26, 2014 suggests that air conditioning condensation and possibly washwater are entering the stormwater drainage system.
- The catchbasin labelled CB3 on Map SJ-2 was covered over by construction on June 24, 2015. It was accessed on June 24, 2015. There are two pipes entering this catchbasin, a larger diameter pipe aligned with the corner of the Cancer Center building and a small diameter PVC pipe from the opposite direction.
- Low concentrations of ammonia and chlorine in catchbasin CB3 on June 24, 2015 suggest that these constituents enter the system through a connection to the Cancer Center building.

Conclusion: A pipe entering catchbasin CB3 from the Cancer Center on Hospital Drive is the likely source of contaminants believed to be entering this system. The discharge may include air conditioning condensate, washwater, or both.

Resolution: Air conditioning condensation is generally considered an allowable discharge. However, these data suggest that washwater is also present in the flow. We recommend DEC contact the Cancer Center to notify them of these findings and to request information concerning any activities that might discharge washwater to this stormdrain.

3.4 SJ190

The SJ190 system drains a small portion of the Northeastern Vermont Regional Hospital campus. It is located just north of St. Johnsbury Pediatrics and discharges to a swale on the east side of Sherman Street.

Table 8. Water analysis data for outfall SJ190

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
SJ190	5/15/14	Dripping	0.0	0.01	0.2	309	Indeterminate	Clear, no odor. Recent construction in area.
	7/17/14	--	--	--	--	--	Negative	--
	8/21/14	Dry	--	--	--	--	--	CB1 also dry. Construction completed.
	8/26/14	Dry	--	--	--	--	--	--
	8/27/14	Dry	--	--	--	--	--	--
	9/24/14	Dry	--	--	--	--	--	--

Findings:

- On May 15, 2014, a very low concentration of MBAS was measured at the outfall and the optical brightener test was indeterminate. Construction activities may have resulted in runoff to the system.
- No optical brightener was detected in follow up monitoring in July, 2014.
- The system was dry when inspected on multiple occasions in August and September, 2014 after construction activities ended.

Conclusion: The MBAS detergent detection on May 15, 2014 and the indeterminate optical brightener test may have resulted from construction activities. The system was dry on four visits after construction activities ended. Therefore, we conclude that there is no chronic illicit discharge in this system.

Resolution: NA

3.5 SJ280

The SJ280 system drains Centerview Terrace and portions of St. John Street and Memorial Drive. It discharges to the Passumpsic River west of Memorial Drive (Map SJ-3).

Table 9. Water analysis data for outfall SJ280

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
SJ280	5/15/14	Flowing	0.0	0.09	0.3	555	Negative	Discharge slightly gray, no odor.
	6/24/15	Trickling	--	0.04	--	--		
SJ280 CB2	8/21/14	Flowing	0.1	0.04	0.5	1165	--	--
	9/24/14	Dry	--	--	--	--	--	--
	6/24/15	Trickling	0.0	0.01	0.1	--		Clear, no odor
SJ280 CB2 Pipe A	10/30/14	Flowing	0.0	0.02	0.2	1240	--	Clear, no odor
SJ280 CB3	5/15/14	Not flowing						
SJ280 CB4	8/21/14	Trickling	--	0.04	0.5	1186	--	--
	9/24/14	Dry	--	--	--	--	--	--
SJ280 CB5 Pipe B	8/21/14	Trickling	--	0.03	0.2	1190	--	CB5 Pipe A is dry
SJ280 MH1	8/21/14	--	0.1	0.04	0.3	1143	--	--
SJ280 MH4	8/21/14	--	--	0.03	0.3	914	--	--
	10/30/14	--	--	--	0.1	1056	--	--

Findings:

- Chlorine (0.09 mg/L) was detected at the outfall on May 15, 2014.
- Low MBAS detergents concentrations (0.5 mg/L) were measured at catchbasins CB2 and CB4 on August 21, 2014. Sampling throughout the system on this date did not reveal chlorine or ammonia above limits of detection.
- On three subsequent dates, levels of the monitored contaminants have been very low or not detected.

Conclusion: There does not appear to be a chronic illicit discharge in this system. The chlorine detected at the outfall on May 15, 2015 and the low MBAS detergents detected in catchbasins CB2 and CB4 on August 21, 2014 may have resulted from vehicle washing and similar activities.

Resolution: NA

3.6 SJ290

The SJ290 system drains the lower portion of Tremont Street. It discharges to the Passumpsic River via an 18-inch diameter concrete pipe (Map SJ-4).

Table 10. Water analysis data for outfall SJ290

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
SJ290	5/15/14	Wet/no flow	--	--	--	--	Positive	--
	8/15/14	--	--	--	--	--	Negative	--
	5/14/15	Dry	--	--	--	--	--	--
	6/24/15	Trickling	0.0	0.00	0.2	859	--	Clear, no odor
	6/25/15	Dry	--	--	--	--	--	--

Findings:

- Optical brightener was detected at this outfall on May 15, 2014.
- No dry weather flow was observed at this outfall on repeated visits, with the exception of June 24, 2015 when a trickle of flow was present. On June 24, 2015, the only contaminant detected was MBAS detergent and this was at very low concentration.

Conclusion: We believe the initial detection of optical brightener at this outfall was due to wastewater discharged at CSO #21, labelled SJ300 on Map SJ-4. Systems SJ290 and SJ300 discharge to a short channel that runs down the bank to the Passumpsic River. When the river is high, backwater in this channel likely surcharges the SJ290 outfall, which would result in detection of optical brightener at SJ290 during an overflow event. Since there are no other indications of contamination in this system, we do not believe an illicit discharge is present.

Resolution: NA

3.7 SJ300

SJ300 is a combined sewer system with an overflow structure (CSO #21) located at the corner of Memorial Drive and Tremont Street. The structure is located at a siphon under the Passumpsic River. CSO #21 is active; it discharges untreated wastewater during certain storm events (Dufresne Group Consulting Engineers, 2014). It discharges to the Passumpsic River close to the SJ290 outfall (Map SJ-4).

Table 11. Water analysis data for outfall SJ300

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	OB Result	Observations
SJ300	5/15/14	Wet/no flow	Positive	--
	8/21/14	Dry	--	--
	12/9/14	Flowing	--	Strong wastewater odor
	5/14/15	Dry	--	Rubber Tide Flex valve installed over outlet
	6/24/15	Dry	--	--
	6/25/15	Dry	--	--

Figure 3. Sanitary wastewater overflow at CSO #21, December 9, 2014.

Findings:

- There was no flow at the outfall on the initial assessment date, May 15, 2014. Optical brightener was monitored at the outfall because it was not clear at the outset which structure was the CSO outfall. The result was positive.

- In the fall of 2014, significant overflows were observed on two visits following light rains. These observations were communicated to the Town in a November 19, 2014 meeting.
- On December 9, 2014, with temperatures below freezing, snow on the ground, and no recent rain, a significant sewer overflow (estimated at 26 gpm) was observed at the outfall (Figure 3). An email describing these observations was sent to the town manager and the public works director on December 10, 2014. The Town quickly corrected the problem after determining that the overflow was caused by a blockage in the line.

Conclusion: The Town of St. Johnsbury corrected a blockage in a sewer line contributing to the dry weather overflow observed on December 9, 2014 (and presumably also the frequent overflow events during the fall of 2014).

Resolution: The dry weather overflow problem we observed was corrected by the Town of St. Johnsbury. CSO #21 is an active CSO. Additional sewer separation is planned within the contributing area (Dufresne Group Consulting Engineers, 2014).

3.8 SJ320

The SJ320 system drains the Lawrence Circle area and discharges to a swale southwest of the intersection of Farmer Drive and Lawrence Circle (Map SJ-5).

Table 12. Water analysis data for outfall SJ320

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
SJ320	5/19/14	Flowing	0.0	0.00	0.2	536	Negative	Clear, slight odor. Iron staining.
SJ320 CB2 Pipe A	10/30/14	Trickling	0.00	0.03	0.0	634	--	Clear, no odor
SJ320 CB2 Pipe C	10/30/14	Flowing	0.0	0.00	0.0	440	--	Clear, no odor
SJ320 CB2 Pipe E	10/30/14	Trickling	0.0	0.00	0.0	1165	--	Clear, no odor

Findings:

- The only indication of an illicit discharge in this system was one very low detection of MBAS
- Careful inspection of the contributing drainage system on October 30, 2014 revealed no contamination.

Conclusion: No contamination was confirmed in this system in repeated testing. Therefore, we conclude that there is no chronic illicit discharge present.

Resolution: NA

3.9 SJ400

The SJ400 system drains the Coolidge Circle area as well as a small portion of Farmer Drive (from the culvert outlet near 387 Farmer Drive). It discharges to a swale just southwest of the intersection of Coolidge Circle and Farmer Drive.

Table 13. Water analysis data for outfall SJ400

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
SJ400	5/19/14	Flowing	0.0	0.00	0.2	572	Negative	Clear, no odor. Iron staining.
	8/21/14	Dry	--	--	--	--	--	--
	8/26/14	Dry	--	--	--	--	--	--
	8/27/14	Dry	--	--	--	--	--	--

Findings:

- The only indication of an illicit discharge in this system was a very low detection of detergent on May 19, 2014.
- The system was dry on three subsequent visits in August, 2014.

Conclusion: No contamination was confirmed in this system. Therefore, we conclude there is no chronic illicit discharge present.

Resolution: NA

3.10 SJ410

The SJ410 system drains the Shetland Circle area and discharges to a swale near 450 Farmer Drive (Map SJ-6).

Table 14. Water analysis data for outfall SJ410

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
SJ410	5/19/14	Flowing	0.0	0.00	0.3	598	Negative	Clear, no odor. Iron staining.
	8/21/14	--	0.1	0.03	0.2	507	--	--
	9/24/14	Flowing	--	--	0.0	470	--	Clear, no odor
SJ410 CB1 Pipe A	8/21/14	--	--	0.01	0.2	545	--	--
	8/26/14	Flowing	--	0.04	0.5	554	--	--
	10/30/14	Flowing	0.0	0.01	0.1	528	--	Clear, no 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
	6/25/15	Flowing	--	0.02	--	--	--	Clear, no odor
SJ410 CB1 Pipe B	8/21/14	--	--	0.04	0.3	420	--	--
SJ410 CB3 Pipe A	8/26/14	Flowing	--	0.03	0.4	473	--	--
SJ410 CB4 Pipe A	8/26/14	Flowing	0.1	0.02	0.2	355	--	--
	10/30/14	Flowing	0.0	0.00	0.0	385	--	Clear, no odor
	6/25/15	Flowing	--	0.04	--	--	--	Clear, no odor
SJ410 CB4 Pipe B	8/26/14	Dripping	0.1	0.15	0.1	--	--	--
	10/30/14	Trickling	0.0	0.00	0.0	446	--	--
	6/25/15	Flowing	--	0.00	--	--	--	Clear, no odor
SJ410 CB5 Pipe A	6/25/15	Flowing	--	0.00	--	--	--	Clear, no odor
SJ410 CB7	8/21/14	--	--	0.01	0.1	308	--	--

Findings:

- This system was sampled repeatedly due to a low concentration (0.3 mg/L) of MBAS detergent measured at the outfall on May 19, 2014.
- On August 26, 2014, slightly higher concentrations (0.4 – 0.5 mg/L) of detergent were measured at CB1 Pipe A and CB3 Pipe A.
- Chlorine (0.15 mg/L) was detected in water dripping from Pipe B (unmapped) in catchbasin CB4 on August 26, 2014. Due to this moderately high chlorine concentration, this pipe became a focus of investigation. Pipe B is believed to be the outlet of a French drain in the backyard of 12 Shetland Circle. A hot tub located next to the French drain was considered a possible source of chlorinated water.
- On October 30, 2014 and June 25, 2015, sampling at several points in the drainage system revealed no chlorine or detergents.
- The homeowner at 12 Shetland Circle, Ernie Thurston, was interviewed on June 25, 2015. Mr. Thurston stated that his hot tub had not been used in over 10 years. He was not aware of any water leaks, past or present, on Shetland Circle. He occasionally waters small perennial gardens in the back yard.

Conclusion: Based on results of repeated sampling, we conclude that there is no chronic illicit discharge present. The chlorine detected on August 26, 2014 likely resulted from a transient source, such as vehicle washing or landscape watering. The low levels of detergent measured may also have resulted from a transient source.

Resolution: NA

3.11 SJ430

SJ430 is a combined sewer system with an overflow structure (CSO #16) located on Concord Avenue south of the Gilman Avenue intersection (Map SJ-7). CSO #16 is an active CSO that discharges untreated wastewater to the Passumpsic River during certain storm events (Dufresne Group Consulting Engineers, 2014).

Table 15. Water analysis data for outfall SJ430

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Observations
SJ430	5/19/14	Dry	Outfall buried under river sediment. A blowout over the pipe above the outfall had evidence of recent sewage discharge (deposits).
	10/30/14	Dry	The pipe blowout appeared to have been repaired.

Findings:

- Observations made on May 19, 2014 at the CSO outfall indicated that combined sewage had bypassed the buried outfall via a blowout on the pipe above the outfall. By October 30, 2014 when the site was revisited, the problem had been corrected.

Conclusion: A detailed assessment of this combined sewer system is outside the scope of this project. The CSO outfall was flagged for follow-up inspection due to an unsanitary condition above the outfall, but this problem was apparently remedied.

Resolution: NA

3.12 SJ440

The SJ440 system drains Concord Avenue from approximately 550 Concord Avenue to the intersection of Concord Avenue and Elm Street (Map SJ-8). It discharges to the Moose River west of the intersection of Concord Avenue and Elm Street.

Table 16. Water analysis data for outfall SJ440

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
SJ440	5/19/14	Dripping	2.0	0.04	0.75	859	Positive	Clear, strong sewage odor in outfall.
	8/21/14	Wet, no flow	--	--	--	--	Positive	--
	8/26/14	Wet, no flow	--	--	--	--	--	--
	8/27/14	Wet, no flow	--	--	--	--	--	--
	9/23/14	Wet, no flow	--	--	--	--	--	--
	10/30/14	Dry	--	--	--	--	--	--

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
	11/12/14*	--	0.5	--	--	--	--	--
	5/14/15	Dry	--	--	--	--	--	--
	6/25/15	Dry	--	--	--	--	--	--
SJ440 CB1	8/21/14	--	--	--	--	--	Positive	--
	11/12/14*	--	0.25	--	--	--	--	--
	6/25/15	Dry	--	--	--	--	--	--
SJ440 CB2	8/21/14	--	--	--	--	--	Indeterminate	--
SJ440 CB3	8/21/14						Negative	--
	11/12/14*	--	0.25	--	--	--	--	*Sampled during rainstorm
SJ440 CB3A	8/21/14						Negative	
SJ440 CB4	8/21/14	--	--	--	--	--	Indeterminate	--
SJ440 CB5	8/21/14						Negative	
SJ440 CB5A	8/21/14	--	--	--	--	--	Indeterminate	--
SJ440 CB6	8/21/14						Negative	
SJ440 CB6A	8/21/14						Negative	
SJ440 CB7	8/21/14						Negative	
SJ440 CB8	8/21/14	--	--	--	--	--	Indeterminate	--

Findings:

- Optical brightener and a strong sewage odor were detected at the outfall on May 19, 2014. The ammonia concentration was high (2.0 mg/L) and MBAS was moderate (0.5 mg/L). These data provide clear evidence of a wastewater or combined sewage discharge.
- The outfall was inspected on eight subsequent dates and was never again observed flowing during dry weather.
- Optical brightener monitoring pads were deployed throughout the system on August 21, 2014 and collected on August 27. The results were largely inconclusive for use in bracket sampling, as an unusual number of pads were indeterminate. Optical brightener was detected at the outfall and catchbasins CB1.
- There are no documented combined sewer overflow structures in this location. The section of Concord Avenue from the bridge over the Moose River east to the railroad crossing was reportedly separated in 1991 (Dufresne Group Consulting Engineers, 2014).
- Options for advanced investigation were limited because, with the exception of the May 19, 2014, dry weather flow was not observed in this system. Sanitary wastewater discharges to the

system clearly do not occur during dry weather; therefore dye testing home plumbing fixtures would be pointless.

- There are (at least) two possible explanations for the sanitary wastewater discharge observed on May 19, 2014: 1) sanitary wastewater overflows the sewer main, discharges to the street, and is intercepted by the stormdrain, and/or 2) a sewage backup into a basement enters the stormwater system via a connected floor drain.
- Homes on Concord Avenue between Harrison Avenue and the Moose River bridge were visited on June 24-25, 2015 to assess whether sewage backups into basement could be the source of the wastewater discharged at the SJ440 outfall. The following summarizes information recorded from the homeowners:

Address	Notes
220 Elm St.	Homeowner reported no backup problems or odors but stated that backups were a longstanding problem in some houses on the north side of Concord Avenue, including #391 and #411.
375 Concord Ave.	Not home. Recently sold.
391 Concord Ave.	Not home.
411 Concord Ave.	Unoccupied. Homeowner recently deceased.
427 Concord Ave.	Owner reported a backup in 2014 that caused a small amount of wastewater to leak from the threads on a backflow preventer installed on the house sewer line. He since sealed the valve housing. There is no basement floor drain.
433 Concord Ave.	On septic system
447 Concord Ave.	Homeowner reports no sewage backup problems or odors.

- Information is lacking for the houses at 375, 391, and 411 Concord Avenue, which are perhaps the likeliest homes to experience backups and to contribute wastewater to system SJ440 based on their low elevation and proximity to the outfall. However, the information from homeowners at 220 Elm Street and 427 Concord Avenue demonstrates that the sanitary sewer does become surcharged in this area, suggesting that either of the above explanations is plausible.

Conclusion: Based on clear evidence of a wastewater discharge during monitoring at the outfall on May 14, 2014 and homeowner statements indicating that the sanitary sewer on Concord Avenue becomes surcharged close to the Moose River bridge, we conclude sanitary wastewater can discharge to the separate stormwater system during wet weather. Two possible routes of entry are by discharge to the street followed by drainage to a catchbasin and/or by sewage backing up in a house and flowing to a connected floor drain.

Resolution: These observations should inform future investigations in St. Johnsbury's long program to reduce combined sewer overflows. Specifically, in St. Johnsbury's Combined Sewer Overflow Abatement Inventory Report & 3-Year Plan, Dufresne Group (2014) recommended that smoke testing be performed for this section of Concord Avenue. This recommendation and additional door to door surveys should be prioritized given our findings at the SJ440 outfall.

3.13 SJ450

The SJ450 system drains a portion of Concord Avenue above Parker Avenue. It discharges to a small stream flowing through a culvert under Concord Avenue.

Table 17. Water analysis data for outfall SJ450

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
SJ450 (cross culvert)	5/19/14	Flowing	0.0	0.02	0.6	220	Negative	Clear, no odor. Iron staining.
	8/21/14	--	0.0	0.00	0.1	535	--	--
SJ450 (outfall within cross culvert)	10/30/14	--	0.0	0.00	0.0	295	--	Clear, no odor.

Findings:

- A moderate MBAS detergent concentration was measured at the downstream end of the cross culvert on May 19, 2014.
- No contaminants were detected in sampling at the cross culvert outlet on August 21, 2014 or within the culvert at the stormdrain outlet on October 30, 2014.

Conclusion: Based on results of repeated sampling, we conclude there is no chronic illicit discharge present.

Resolution: NA

3.14 SJ470

The SJ470 system drains from a swale north of Snell Road to the west side of George's Automotive at 909 Portland Street. It discharges into the Moose River just north of Portland Avenue.

Table 18. Water analysis data for outfall SJ470

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
5/19/14	Flowing	0.0	0.00	0.2	938	Negative	Clear, musty odor. Iron staining.
8/21/14	--	0.1	0.02	0.1	869	--	--
10/30/14	Flowing	0.0	0.01	0.1	825	--	Clear, no odor.

Findings:

- A very low MBAS detergent concentration was measured at the outfall on May 19, 2014.
- No contaminants were detected in repeated sampling.

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

Resolution: NA

3.15 SJ480

The SJ480 system drains swales north and alongside of Portland Street. It discharges to the Moose River south of Portland Street.

Table 19. Water analysis data for outfall SJ480

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
5/19/14	Flowing	0.0	0.01	0.2	395	Negative	Clear, no odor. Iron staining.
8/21/14	Dry	--	--	--	--	--	--
8/26/14	Dry	--	--	--	--	--	--
9/24/14	Dry	--	--	--	--	--	--

Findings:

- The only indication of a possible illicit discharge in this system was a very low concentration of detergent on May 19, 2014.
- The outfall was dry on three subsequent visits.

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

Resolution: NA

3.16 SJ500

The SJ500 system drains a swale on the north side of Portland Street. It discharges to the Moose River just south of Portland Street.

Table 20. Water analysis data for outfall SJ500

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
5/19/14	Flowing	0.0	0.00	0.2	451	Negative	Clear, no odor
8/21/14	Dry	--	--	--	--	--	--
8/26/14	Dry	--	--	--	--	--	--
9/24/14	Dry	--	--	--	--	--	--

Findings:

- The only indication of a possible illicit discharge in this system was a very low concentration of detergent on May 19, 2014.
- The outfall was dry on three subsequent visits.

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

Resolution: NA

3.17 SJ510

The SJ510 system drains a large area, from Overlook Drive to approximately 535 Concord Avenue (Maps SJ-9 and SJ-10). It discharges to a channel on the northeast side of Concord Avenue.

Table 21. Water analysis data for outfall SJ510

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
SJ510	5/20/14	Flowing	0.1	0.01	0.1	506	Negative	Clear, no odor
	7/17/14	--	--	--	--	--	Negative	--
SJ510 CB4 Pipe B	5/29/14	Flowing	0.25	0.03	0.1	503	Negative	Clear, no odor
	8/26/14	Dripping	0.1	0.07	0.5	--	--	--
SJ510 CB4A Sump	8/26/14		1.0	0.00	>3.0	1237	--	Cloudy/white, strong sewage odor, foamy when shaken. Deposits present on catchbasin grate.
	10/30/14	--	--	--	--	--	--	Suds in sump. Lint/fibers on grate.
	6/25/15							No signs of recent dumping to CB
SJ510 CB5	5/29/14	Flowing	0.1	0.03	0.1	495	Negative	Clear, no odor. Pulse of water every 2 seconds.
SJ510 CB8 Pipe A	6/3/14	Flowing	0.0	0.04	0.0	643	Negative	--
SJ510 CB8 Pipe C	6/3/14	Flowing	0.0	0.02	0.0	602	Negative	
SJ510 CB8 Pipe E	8/21/14						Negative	
SJ510 CB9 Pipe A	6/3/14	--	--	--	--	--	Indeterminate	Clear, no odor
	7/7/14	Flowing	0.25	0.02	0.1	640	Indeterminate	Clear, no 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
	8/26/14	Flowing	0.1	0.03	0.1	383		
	11/12/14	--	--	--	--	--	Negative	--
SJ510 CB9 Pipe B	6/3/14	--	--	--	--	--	Positive	--
	7/7/14	Flowing	0.25	0.03	0.2	693	Positive	--
	8/26/14	Flowing	0.1	0.03	0.1	590		
	11/12/14	--	--	--	--	--	Indeterminate	
SJ510 CB10	8/21/14	--	--	--	--	--	Negative	--
	11/12/14	--	--	--	--	--	Negative	--
SJ510 CB11 thru CB14	8/21/14	--	--	--	--	--	Negative	--

Three illicit discharges were suspected in this system. A discharge was suspected to catchbasin CB4A on Lafayette Street and to both pipes (A and B) discharging to CB9 at the intersection of Concord Avenue and Parker Avenue. The discharges to CB4A and CB9 are described separately below.

Catchbasin CB4A on Lafayette Street

Figure 4. Catchbasin CB4A on Lafayette Street showing debris caught on catchbasin grate

Findings: On August 26, 2014 an exceedingly high MBAS concentration was measured in catchbasin CB4A on Lafayette Street (Map SJ-9). The ammonia concentration was moderately high. The sample appeared cloudy, had a strong sewage odor, and foamed when shaken. Waste deposits were present on the catchbasin grate. The apparent source of the washwater was dumping from Kingdom Cleaners to catchbasin CB4A. A Kingdom Cleaners vehicle is often parked near the catchbasin (Figure 4). This conclusion was reinforced on October 30, 2014 when suds were observed in the catchbasin and lint and fibers were again found on the grate. However, on a recent visit (May 25, 2015), there were no signs of washwater dumping.

Conclusion: We conclude that Kingdom Cleaners is or was using catchbasin CB4A to dispose of washwater.

Resolution: The Town of St. Johnsbury sent Kingdom Cleaners a letter on August 14, 2015 describing these findings and notifying them that dumping washwater to the catchbasin is illegal and must stop.

Catchbasin CB9 at Concord and Parker Avenue

Two pipes discharge to catchbasin CB9 at the intersection of Concord and Parker Avenues (Map SJ-10). A very low concentration of ammonia was detected in flow from Pipe A, the main line down Concord Avenue, on September 7, 2014 and the optical brightener test was indeterminate. A second optical brightener test was also indeterminate. The ammonia concentration was similar in flow from Pipe B, which drains Parker Avenue, but optical brightener was detected. Isolating the source of optical brightener on Parker Avenue was not possible because the catchbasins are off-line and there are no stormwater manholes. On Overlook Drive, optical brightener was not detected in any catchbasins, including the basin at the intersection of Overlook Drive and Parker Avenue.

Dye testing was conducted on Parker Avenue on June 25, 2015. Dye was added to toilets in three homes (#79, #63, and #41) on the east side of Parker Avenue between Concord Avenue and Overlook Drive. No dye was observed in the stormdrain within approximately one hour. At #17 Parker Avenue, the homeowner stated that it would be pointless to dye test because their sewer line was clogged and wastewater was backing up into the house. In particular, the drain pipe for the laundry machine regularly overflowed. The homeowner stated that the St. Johnsbury Public Works Department planned to check the sewer line the next day. In a follow-up call on June 29, 2015, the homeowner stated that the Town had determined there was an obstruction in the sewer lateral close to the house and no problem in the sewer main. A sewer service company cleared the line within days of our visit.

#17 Parker Avenue is located at the corner of Concord and Parker Avenues, directly uphill from catchbasin CB9. Wastewater leaking from the clogged sewer lateral likely infiltrates the ground and flows downgradient toward the stormdrain on Concord and/or Parker Avenue.

Conclusion: Based on its location relative to catchbasin CB9, the clogged sewer lateral at #17 Parker Avenue is believed to be the source of optical brightener detected at catchbasin CB9.

Resolution: The clogged sewer lateral at 17 Parker Avenue was cleared on or about June 30, 2015. This maintenance may have eliminated the suspected discharge of wastewater from the sewer lateral. However, it is also possible that the sewer lateral is in poor condition and will continue to leak into the stormdrain unless replaced. Follow up optical brightener monitoring is planned to confirm whether the problem was resolved.

3.18 SJ620

The SJ620 system drains portions of Sunset Drive and Carroll Boulevard. It discharges to the Passumpsic River.

Table 22. Water analysis data for outfall SJ620

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
SJ620	5/20/14	Flowing	0.0	0.02	0.3	1049	Negative	Foam/suds, iron staining
	8/26/14	Wet/no flow	--	--	--	--	--	--
	8/27/14	Wet/no flow	--	--	--	--	--	--
	9/24/14	Dripping	0.1	0.02	0.1	1231	--	Clear, no odor

Findings:

- The only indications of a possible illicit discharge in this system were a very low concentration of detergent and the presence of suds on May 20, 2014.
- No contaminants were detected in three subsequent visits.

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

Resolution: NA

3.19 SJ640

The SJ640 system drains a small portion of River Road (approximately 204-368 River Road). It discharges to the Passumpsic River west of River Road.

Table 23. Water analysis data for outfall SJ640

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
SJ640	5/20/14	Flowing	0.25	0.02	0.1	966	Negative	Mat of filamentous algae in pipe
	8/26/14	Flowing	0.1	0.01	0.1	1058	--	--
	10/30/14	Flowing	0.0	0.00	0.1	1050	--	Clear, no odor.

Findings:

- The only indication of a possible illicit discharge in this system was a very low concentration of ammonia on May 20, 2014.
- No contaminants were detected in two subsequent visits.

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

Resolution: NA

3.20 SJ670

The SJ670 system drains the area around the intersection of River Road and Marion Avenue (Map SJ-11). It discharges to the Passumpsic River west of River Road.

Table 24. Water analysis data for outfall SJ670

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
SJ670	5/20/14	Flowing	0.4	0.01	0.1	668	Negative	Burst pipe upstream contributing flow.
	5/29/14	--	--	--	--	--	--	Pipe fixed
	8/26/14	Trickling	0.1	0.24	0.2	--	--	No odor
	10/30/14	Trickling	0.0	0.00	0.1	665	--	Clear, no odor
	6/25/15	--	--	0.03	--	--	--	Clear, no odor
SJ670 CB1 Pipe A	8/26/14	Trickling	0.1	0.04	0.1	626	--	Clear, no odor
SJ670 CB3 Pipe A	8/26/14	Trickling	0.1	0.02	0.1	622	--	Clear, no odor
	10/30/14	Trickling	--	0.00	--	--	--	Clear, no odor

Findings:

- A low ammonia concentration (0.4 mg/L) was measured at the outfall on May 20, 2014. Water from a burst pipe was flowing to the system.
- The burst pipe was apparently fixed by May 29, 2014.
- According to the Public Works Director, one or more water leaks occurred in the area of River Road, Marion Avenue, and Caledonia Street above during the summer of 2014. These water leaks--or the work to repair them--likely contributed to the high chlorine concentration (0.24 mg/L) measured at the outfall on August 26, 2014.
- On two later dates, October 30, 2014 and June 25, 2015, no chlorine was detected in this system.

Conclusion: Tap water from leaks in the water distribution system apparently drained to system SJ670, causing a high chlorine concentration at the outfall on August 26, 2014. The leaks were fixed and chlorine has not been detected in the system since.

Resolution: NA

3.21 SJ780

The SJ780 system drains and discharges from the western side of the St. Johnsbury wastewater treatment plant.

Table 25. Water analysis data for outfall SJ780

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
SJ780	5/20/14	Flowing	0.25	0.31	--	255	Negative	Muddy sample due to earth moving and stockpiling on adjacent lot.
	8/26/14	Wet/no flow	0.4	0.07	0.5	213	--	Muddy sample
	10/30/14	Dry	--	--	--	--	--	--
	6/25/14	Wet/no flow	--	--	--	--	--	--

Findings:

- System SJ780 was flowing when first assessed on May 20, 2015. There has been no flow at the outfall on three subsequent visits.
- Samples collected on May 20 and August 26, 2014 were exceptionally muddy, likely invalidating the analytical results.

Conclusion: Based on the absence of dry weather flow during repeated inspections, we conclude there is no illicit discharge present in this system.

Resolution: NA

3.22 SJ820

The SJ820 system drains a small area near 25 Pine Street. It discharges to the Sleepers River southwest of Pine Street.

Table 26. Water analysis data for outfall SJ820

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	OB Result	Observations
SJ820	5/20/14	Wet/no flow	Indeterminate	
	7/17/14	--	Negative	
	6/25/15	Dry	--	

Findings:

- The only indication of a possible illicit discharge in this system was an indeterminate optical brightener result on May 20, 2014.
- The outfall was not flowing on any of our three visits.

Conclusion: Based on lack of dry weather flow, we conclude there is no illicit discharge in this system.

Resolution: NA

3.23 SJ840

The SJ840 system drains a network of catchbasins on the St. Johnsbury Academy campus (Map SJ-12). It discharges into the Sleepers River south of Pine Street.

Table 27. Water analysis data for outfall SJ840

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
SJ840	5/20/14	Flowing	0.1	0.02	0.3	235	Indeterminate	Clear, no odor. Iron staining.
	5/29/14	Flowing	0.25	0.07	0.3	1306	--	Strong pool/laundry odor (pool located at house near outfall)
	7/17/14	--	--	--	--	--	Negative	--
	8/22/14	Dry	0.1	0.01	0.2	2250	--	Sampled trickle up-system of outfall
	10/30/14	Trickling	0.0	0.01	0.1	1343	--	Clear, no odor
	6/25/15	Flowing	0.0	0.10	0.2	2840	--	--
	6/26/15	--	0.0	0.03	--	2930	--	--
SJ840 CB1 Pipe A	5/29/14	--	--	--	--	--	Negative	--
	8/27/14	Trickling	0.75	0.16	0.2	2740	--	Sump sample. Dirty with particulates
SJ840 CB1 Pipe B	5/29/14	--	--	--	--	--	Negative	--
	12/9/14	Trickling	0.75	0.07	--	3730	--	--
	5/20/15	Trickling	0.75	0.02	0.8	9140		
SJ840 CB2	8/27/14	Trickling	0.25	0.09	0.2	2410	--	Sump sample
SJ840 CB2A	8/27/14	Trickling	0.1	0.08	0.00	936	--	Sump sample. Clear, no odor.
SJ840 CB3	5/20/15	Flowing	0.75	--	--	--	--	Sump sample
SJ840 CB4	8/27/14	Dry	--	--	--	--	--	--
	5/20/15	Wet, no flow	--	--	--	--	--	--
SJ840 CB5	5/20/15	No outflow	--	--	--	--	--	--
SJ840 CB8	5/20/15	No outflow	--	--	--	--	--	--
SJ840 CB9	5/20/15	No outflow	--	-	--	--	--	--

Findings:

- Investigation of this system has been challenging. It has been difficult to discern a pattern in the water chemistry data. The main reason for this is likely the exceedingly high specific conductance measured on certain dates. High dissolved solids interfere with the MBAS detergent test. The MBAS data are of questionable quality when specific conductance exceeds

approximately 2,000 µS/cm. Chlorine concentration readings seemed unstable in certain samples, possibly due to excessive turbidity or interference by dissolved metals

- Dry weather flow appears to originate in the section of pipe between CB4 and CB3, indicating groundwater infiltration. No outflow has been observed in catchbasins CB4 through CB9. Figure 5 shows catchbasin CB3 with contaminated flow entering from the pipe on the left. The surface of the catchbasin appears to have petroleum sheen.
- On June 25, 2015, we met with the St. Johnsbury Academy Facilities Director, Dennis Smith, to discuss our findings and request any relevant information he had. Regarding petroleum contaminated groundwater, St. Johnsbury Academy has replaced multiple underground storage tanks in the last three decades. One tank in particular served a dorm approximately 200 ft uphill from the CB4 and CB3 catchbasins. This 2,000 gallon fuel tank was replaced in 2006. Mr. Smith did not know if the tank was leaking and the Vermont Natural Resources Atlas does not include this as a hazardous waste site. Mr. Smith believed the high conductivity was simply due to the Academy's aggressive deicing program. He indicated the Academy uses a large amount of salt, recently switching to a product named "Magic Salt" produced by IBG. Finally, Mr. Smith speculated that chlorine may enter the system via a connection to the swimming pool (located adjacent to CB7 on Map SJ-12). We dye tested a floor drain in the pool's pump room and did not observe any dye in the stormdrain. Mr. Smith indicated he would research construction plans for the pool to determine where the water is discharged when the pool is drained. As of August 14, 2015, Mr. Smith had been unable to locate these plans.

Figure 5. Petroleum sheen in catchbasin CB3 in system SJ840. Contaminated groundwater appears to infiltrate Pipe A, which connects to CB3 to CB4

Conclusion: Petroleum contaminated groundwater and the reported use of large quantities of deicing salt by St. Johnsbury Academy would appear to explain most of the water quality data collected in this system. The possibility that pool water is discharged via the stormdrain appears unlikely based on the dye testing already performed; however, the Facilities Director agreed to investigate this possibility.

Resolution: Despite poor water quality, there appears to be no current illicit discharge in this system.

3.24 SJ880

The SJ880 system drains an extensive area, bounded by Main Street and Railroad Street to the west and east and Maple Street and Eastern Avenue to the north and south. The system discharges to the Passumpsic River southeast of Allen Lumber (Maps SJ-13 and SJ-14). System SJ880 was difficult to assess because there is a sewer overflow structure in the vicinity of Thaddeus Lane that discharges to the system, complicating interpretation of water quality data below this point. Also, all the catchbasins on Eastern Avenue are off-line and the mainline manholes were paved over.

Table 28. Water analysis data for outfall SJ880

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
SJ880	5/21/14	Flowing	0.25	0.07	0.5	2820	Negative	Sewage odor. Public works crew working nearby, could be source of dirty water
	8/26/14	Trickling	0.1	0.08	0.5	1000	--	Sewage odor. Sample cloudy and foamy.
	11/13/14	Flowing	0.0	0.0	0.1	513	--	--
	5/20/15	--	--	--	--	--	--	No access to stormline near Thadeus Avenue intersection. Manholes paved over and all catchbasins off-line.
	6/25/15	Flowing	0.0	0.04	0.2	2740	--	Clear, no odor
SJ880 MH4 Pipe A	8/26/14	Trickling	0.25	0.06	0.5	1450	--	Slightly cloudy and foamy.
SJ880 CB8X	5/21/14	Dry	--	--	--	--	--	--
	8/27/14	Dry	--	--	--	--	--	--
SJ880 CB9A	8/27/14	Dry	--	--	--	--	--	--
SJ880 CB11	5/21/14	Flowing	0.25	0.00	0.3	2410	Negative	Pipe A sampled. Gray water, suds/sheen
	8/27/14	Dry	--	--	--	--	--	--
SJ880 CB13	5/21/14	Dry	--	--	--	--	--	--

Figure 6. Suds in catchbasin CB11 in system SJ880 on May 21, 2014.

Findings:

- Ammonia, chlorine, and detergents were detected in this system at various points while construction was ongoing in the drainage area in 2014. Figure 6 demonstrates the poor water quality observed during certain construction activities.
- Since most construction activities in this system were completed, no contaminants were present above limits of detection.

Conclusion: Contaminants detected during the summer of 2014 appear to have resulted from construction. We conclude there is no chronic illicit discharge in this system.

Resolution: NA

3.25 SJ920

SJ920 is a combined sewer system with an overflow structure (CSO #24) located south of the ball fields on the St. Johnsbury School campus (Map SJ-15). CSO #24 is an active CSO which discharges untreated wastewater to the Sleepers River during certain storm events (Dufresne Group Consulting Engineers, 2014).

Table 29. Water analysis data for outfall SJ920

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Observations
SJ920	5/21/14	Dripping	Strong sewage odor
	8/27/14	Dripping	--
	11/12/14	Dry	--
	5/20/15	Dripping	--
	6/26/15	Dripping	Strong sewage odor

Findings: No significant dry weather flow was observed from this CSO outfall. On several visits this outfall was dripping at a rate too slow to consider sampling. The outfall has a pronounced sewage odor.

Conclusion: We suspect there is a crack or other imperfection in the overflow structure. However, the flow rate (a slow drip) is assumed to be insignificant from a water quality perspective.

Resolution: NA

3.26 SJ950

The SJ950 system consists of a long culvert which conveys runoff under the bike path and High Street and discharges over a low bank to the Sleepers River. The outfall is at the bottom of a concrete wall in the location indicated in Map SJ-16. Note that the stream segment shown on May SJ-16 now flows through the culvert under the bike path.

Table 30. Water analysis data for outfall SJ950

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
SJ950 outfall	5/21/14	Flowing	0.1	0.01	0.2	609	Indeterminate	Suds where flow enters river.
	7/17/14	Flowing	--	--	--	--	Positive	--
	8/27/14	Flowing	0.25	0.10	0.1	706	--	--
	11/18/14	Flowing	--	--	--	--	Positive	Suds where flow enters river.
SJ950 culvert inlet	11/18/14	Flowing	--	--	--	--	Negative	--

Findings:

- Detection of optical brightener at the outfall and a concentration of suds observed at the edge of the Sleepers River where this system discharges indicate the presence of a wastewater or washwater source.

- On November 19, 2014, monitoring pads were placed at the culvert inlet and at the outfall. Optical brightener was detected at the outfall but not at the inlet, indicating a source between the inlet and outfall. The only structure between these points is a house at 240 High Street.
- On June 24, 2015, samples were collected at the outfall for *E. coli* and total nitrogen analysis. The levels of both constituents were very low (see Section 4).
- 240 High Street has a septic system which appears to be located in a raised lawn between the house and the garage, proximate to the culvert running beneath the property.

Conclusion: The only possible source of optical brightener to this system is the house at 240 High Street. Based on repeated detection of optical brightener, suds repeatedly seen below the outfall, and the position of the culvert beneath the property, we suspect partially renovated effluent is infiltrating the culvert from the septic system at 240 High Street.

By design, septic systems reintroduce treated wastewater to the environment. The septic system serving the house at 240 High Street appears to function adequately to discharge wastewater without surfacing and to reduce odor and bacteria. However, more mobile and persistent constituents, including detergents and optical brightener, pass into the underlying stormdrain. Apparently, by DEC's operating definition, this septic system has not failed.

Resolution: Because the system has not failed per DEC's definition, it appears that neither the Town of St. Johnsbury nor DEC could compel the property owner to replace the system.

3.27 SJ960

The SJ960 system drains a portion of Mt. Vernon Street. It discharges to the Sleepers River downstream of the Mt. Vernon Street bridge.

Table 31. Water analysis data for outfall SJ960

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
SJ960	5/21/14	Flowing	--	--	--	--	--	Iron staining
	8/27/14	Dry	--	--	--	--	--	--
	9/24/14	Dry	--	--	--	--	--	--
	6/26/15	Flowing	0.0	0.15	0.1	774	--	Clear, no odor
SJ960 CB1	5/21/14	Flowing	0.0	0.01	0.2	727	Negative	--
	6/26/15	Flowing	--	0.09	--	--	--	--
CB2	6/26/15	Flowing	--	0.08	--	--	--	--
CB3	6/26/15	Flowing	--	0.06	--	--	--	--
CB4	6/26/15	Flowing	--	0.07	--	--	--	--

Findings:

- A very low concentration (0.2 mg/L) of MBAS detergent was measured in catchbasin CB1 on May 21, 2014.
- No dry weather flow was observed in the system on two subsequent dates.
- On June 26, 2015, a moderate concentration of chlorine (0.15 mg/L) was measured at the outfall. Chlorine was detected throughout the system although flows were low, generally increasing from CB4 to CB1.
- The system appears to have been reconfigured since the stormwater infrastructure was mapped. The catchbasins on lower Mt. Vernon Street are connected to the separated stormwater system discharging below the Mt. Vernon Street bridge rather than to a combined sewer system.

Conclusion: The chlorinated dry weather flow detected in this system on June 26, 2015 suggests a municipal water leak is present on lower Mt. Vernon Street.

Resolution: Referred to the Town of St. Johnsbury by this report.

3.28 SJ1000

The SJ1000 system discharges to the Sleepers River upstream of the Mt. Vernon Street bridge (Maps SJ-17 and SJ-18). The CB1 branch of the SJ1000 system drains Autumn Street (Map SJ-19). The CB3 branch drains portions of Church and Summer Street (Map SJ-20). The CB4 branch drains portions of Summer Street and Spring Street (Map SJ-21). Map SJ-17 indicates the primarily structures we assessed in system SJ1000.

Table 32. Water analysis data for outfall SJ1000

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Sp. Cond. (µs/cm)	OB Result	Observations
SJ1000	7/7/14	Flowing	0.1	0.02	0.3	969	--	Iron staining.
	8/27/14	Trickling	1.0	0.04	0.75	1230	--	No odor, sample slightly foamy when shaken.
	9/24/14	Flowing	0.25	0.04	0.2	1121	--	Slightly cloudy, no odor
	11/13/14	Flowing	0.0	0.00	0.2	1431	--	Clear, no odor
	6/26/15	Flowing	0.0	0.02	0.2	1684	--	Clear, no odor
SJ1000 CB1	7/7/14	Flowing	0.0	0.00	0.2	1460	Negative	Clear, no odor. Sample collected from Pipe A.
	8/27/14	Trickling	0.1	0.12	0.1	1085	--	Sample collected from Pipe A. Chlorine likely due to street sweeping. Sample clear with small particulates.
	6/18/15	--	--	--	--	--	Negative	Clear, no odor

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Sp. Cond. (µs/cm)	OB Result	Observations
SJ1000 CB-1A Pipe A	8/27/14	Trickling	0.1	0.05	0.1	642	--	Clear, no odor
SJ1000 CB-1B	8/27/14	Trickling	0.1	0.03	0.1	230	--	Particulates, no odor
SJ1000 CB-1C	8/27/14	Trickling	0.25	0.06	0.0	245	--	--
SJ1000 CB2	9/24/14	Trickling	0.25	0.06	0.1	1163	--	Sewage odor, small particulates.
	6/18/15	--	--	--	--	--	Negative	Clear, no odor
SJ1000 CB3	7/7/14	Flowing	0.1	0.03	0.75	645	Negative	OB pad deposited in CB3 sump. Sample from Pipe A.
	8/27/14	Trickling	0.1	0.15	0.1	483	--	Chlorine may be due to street sweeping. Musty odor.
	9/24/14	Dry	--	--	--	--	--	--
SJ1000 CB4	7/7/14	Flowing	0.25	0.04	0.1	730	Negative	Sample collected from Pipe A. Strong laundry odor.
	9/24/14	Flowing	0.25	0.06	0.2	1398	--	Sample cloudy, no odor.
SJ1000 CB-4A	7/7/14	--	--	--	--	--	Negative	--
SJ1000 CB-4B	7/7/14	--	--	--	--	--	Negative	--
SJ1000 CB-4C	7/7/14	--	--	--	--	--	Negative	--
	9/24/14	Flowing	0.25	0.05	0.2	1404	--	Sample from Pipe A, cloudy, no odor.
SJ1000 CB-4E Pipe B	9/24/14	Flowing	0.1	0.03	0.15	1265	--	--
SJ1000 MH1	5/20/15	Flowing	0.0	0.04	0.1	1631	--	Sampled Pipe C
SJ1000 MH2	5/20/15	Flowing	0.0	0.05	0.2	579	--	--
	6/18/15	--	--	--	--	--	Negative	Clear, no odor
CB-TG (old town garage)	6/18/15	--	--	--	--	--	Negative	No odor
Irving MH	6/18/15	--	--	--	--	--	Negative	--
CB@ Belvidere	11/13/14	--	0.0	0.02	0.2	1511	--	Sampled Pipe A. Clear, no odor
	6/18/15	--	--	--	--	--	Negative	--
CB@ Streeter	6/18/15	--	--	--	--	--	Negative	Accessed main stormline via off-line CB

Findings:

- Water quality data and observations made in the July–September 2014 period suggested that illicit discharges were present in multiple areas of this large system. A detailed review of the

data generated in these months is not warranted because we believe the contaminants, odors, and other issues recorded were the result of construction activities.

- No contaminants were present above limits of detection at the outfall and sampling points on major branches of the system (CB1, CB2, MH1, and MH2) on dates in May and June, 2015. Monitoring pads placed in all the major branches of the system indicated no optical brightener.

Conclusion: Despite a range of contaminants detected in this system in 2014, we conclude that there are no illicit discharges in the system at present. The contaminants and odors detected in 2014 appear to have resulted from construction activities.

Resolution: NA

3.29 SJ1010

SJ1010 is a combined sewer overflow structure (CSO #27) located to the right of the SJ1000 outfall (Map SJ-18). It discharges to the Sleepers River upstream of the Mt. Vernon Street bridge. CSO #27 is believed to be an active CSO that discharges untreated wastewater during certain storm events (Dufresne Group Consulting Engineers, 2014). Combined sewers throughout most of the contributing area were separated over the last few years (completion of the Eastern Avenue, Western Avenue, and Main Street CSO Project and Westside North Project); therefore the frequency of overflows is expected to have been greatly reduced.

Table 33. Water analysis data for outfall SJ1010

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)	Observations
SJ1010	5/29/14	Trickling	--	--	--	--	Sewage odor in pipe. Iron staining.
	11/13/14	--	0.0	0.00	0.1	1441	
	6/26/15	Trickling	0.0	0.00	0.1	1491	Sewage odor in pipe, but sample clear, with no odor

Findings:

- A trickle of dry weather flow is present at this outfall, but this is likely groundwater. A strong wastewater odor is present at the outfall and the sound of running water in the pipe system appears close to the outlet.

Conclusion: These results and observations indicate that dry weather flows are not contaminated and that the structure probably still functions as a CSO in wet weather. Based on its elevation, it may also be a source of infiltration to the sanitary system at higher river stages. Chad Whitehead, the new Town Manager, indicated that the Town intends to monitor the structure to determine its overflow frequency.

Resolution: NA

3.30 SJ1060

The SJ1060 system drains a stormwater pond and wetland behind Sanger Circle. It discharges to the Passumpsic River west of Memorial Drive (Map SJ-22).

Table 34. Water analysis data for outfall SJ1060

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
SJ1060	6/11/14	Flowing	0.4	0.02	0.25	481	Negative	Sewage odor in pipe. Some foam. Iron staining.
	8/27/14	Flowing	0.4	0.02	0.00	515	--	Iron staining. Sewage or "swampy" odor present.
	11/12/14	Flowing	0.4	--	--	--	--	--
SJ1060 CB1	11/13/14	--	0.75	--	--	--	--	Clear, no odor
SJ1060 inlet from wetland	6/25/15	Flowing	0.25	-	--	--	--	Sampled culvert draining wetland.

Findings:

- Low concentrations of ammonia and MBAS detergent were measured at the outfall on June 11, 2014. A sewage odor and iron staining were also observed.
- Low concentrations of ammonia at the outfall were measured again on August 27 and November 12, 2014.
- On June 25, 2015, the culvert draining the wetland shown in Map SJ-22 was sampled. Two flows converge at the culvert. One is clear and the other has iron staining and floc. Detection of ammonia at the wetland outlet suggests the wetland is the source of the ammonia in the system. Higher concentrations would likely be seen at lower flows (June was a wet month).
- The wetland is also the source of the iron staining and the "sewage" or "swamp" odor observed at the outfall.

Conclusion: A wetland east of Memorial Drive is the apparent source of the ammonia, iron staining, and unpleasant odors observed at the outfall. We conclude there is no chronic illicit discharge in this system.

Resolution: NA

3.31 SJ1140

The SJ1140 system crosses under Memorial Drive west of Maple Center Motors (Map SJ-23). It discharges to the Passumpsic River.

Table 35. Water analysis data for outfall SJ1140

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
SJ1140	6/11/14	Flowing	0.1	0.00	0.2	849	Negative	Clear, no odor. Iron staining.
	8/27/14	Flowing	0.25	0.18	0.1	730	--	--
	11/13/14	Trickling	0.25	0.02	0.1	724	--	--
	12/9/14	Flowing	0.1	0.02	0.1	819	--	--

Findings:

- Very low concentrations (0.25 mg/L) of ammonia were measured at the outfall on two dates, August 27 and November 13, 2014. A moderate concentration of chlorine (0.18 mg/L) was also measured on August 27, 2014.
- The source of the chlorine detected on August 27, 2014 is believed to have been municipal tapwater released when a fire hydrant was replaced on Memorial Drive. Public Works Director Hugh Wescott indicated this replacement occurred on or about August 27.
- Detections of ammonia suggested a possible washwater connection. The only building we determined could have a washwater connection to this system was Maple Center Motors. On June 25, 2015, the owner of Maple Center Motors stated that all the drains in the garage are connected to the sanitary sewer. Dye was added to a large floordrain in the back bay of the garage and it did not pass to the outfall, indicating that it is likely properly connected to the sanitary sewer.
- Samples were collected for *E. coli* and total nitrogen analysis on May 14, 2015. Levels of both *E. coli* (70 MPN/100 mL) and total nitrogen (0.1 mg/L) were low.
- Iron staining at the outfall suggests anoxic conditions in groundwater, which can lead to conversion of organic nitrogen to ammonia.

Conclusion: Based on repeated sampling of the outfall and dye testing at Maple Center Motors, we do not believe there is a chronic illicit discharge present in this system. The concentrations of ammonia at the outfall were very low and likely naturally occurring and the chlorine detection appears to have resulted from replacement of a fire hydrant.

Resolution: NA

3.32 SJ1160

The SJ1160 system drains the Kinney Drugs lot and Taco Bell at the intersection of Hospital Drive and Memorial Drive. It discharges to the Passumpsic River on the north side of Hospital Drive.

Table 36. Water analysis data for outfall SJ1160

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
SJ1160	6/11/14	Flowing	--	--	--	--	--	Sewage odor. Unable to sample outfall due to submersion.
	8/27/14	Flowing	0.25	0.02	0.0	590	--	Clear, no odor
SJ1160 MH1 Pipe B	6/11/14	Flowing	--	0.02	0.2	723	--	--
	8/27/14	Flowing	0.25	0.02	0.0	620	--	Clear, no odor
	11/13/14	Flowing	0.25	0.05	0.1	658	--	Clear, no odor
SJ1160 MH1 Sump	6/11/14						Negative	--
	7/17/14	Flowing	0.25	0.03	0.1	654		
	11/13/14	--	0.1	0.04	0.1	654	--	Clear, no odor

Findings:

- Very low concentrations of ammonia (0.25 mg/L) were measured in the first up-pipe manhole on July 17, 2014 and again at the outfall on August 27, 2014.
- Concentrations of free chlorine and MBAS detergent in this system were at or below applicable detection limits.

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

Resolution: NA

3.33 SJ1240

The SJ1240 system drains a swale west of Centerview Terrace and the lot at 162 Memorial Drive. It discharges to the Passumpsic River west of Memorial Drive.

Table 37. Water analysis data for outfall SJ1240

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
SJ1240	6/11/14	Flowing	0.0	0.04	0.2	503	Negative	Clear, no odor
	9/23/14	Flowing	0.0	0.03	0.1	626	--	--

Findings:

- The only indication of a possible illicit discharge in this system was a very low MBAS detergent concentration (0.2 mg/L) measured on June 11, 2014.
- No contaminants were detected in sampling on September 23, 2014.

Conclusion: Based on the results of repeated sampling, we conclude there is no illicit discharge present in this system.

Resolution: NA

3.34 SJ1260

This discharge point appears to be a blow off valve on the municipal water distribution system. It discharges to the Passumpsic River west of 46 Memorial Drive (Map SJ-24).

Table 38. Water analysis data for outfall SJ1260

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
SJ1260	6/11/14	Flowing	0.25	0.03	0.02	175	--	Clear, no odor. Pipe under pressure and spraying into the river.
	11/12/14	Flowing	0.0	0.12	0.0	227	--	Spraying into river

Findings:

- In a November 19, 2014 meeting, the Public Works Director confirmed that this pipe is a blow off valve on the municipal water distribution system.

Conclusion: Municipal tapwater from a water blow off valve is not typically considered an illicit discharge.

Resolution: NA

3.35 SJ1280

The SJ1280 system drains Memorial Drive west of the Ford dealership at 8 Memorial Drive. It discharges to the Passumpsic River south of Memorial Drive.

Table 39. Water analysis data for outfall SJ1280

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
SJ1280	6/11/14	Flowing	0.0	0.01	0.5	463	Negative	Clear, no odor.
	9/23/14	Flowing	0.0	0.03	0.0	430	--	Clear, no odor.
	11/13/14	Flowing	0.1	0.02	0.0	453	--	Clear, no odor.

Findings:

- The only indication of a possible illicit discharge in this system was a low MBAS detergent concentration (0.5 mg/L) measured on June 11, 2014.
- No contaminants were detected in sampling on two subsequent dates.

Conclusion: Based on the results of repeated sampling, we conclude there is no illicit discharge present in this system.

Resolution: NA

3.36 SJ1310

The SJ1310 system drains Hastings Hill from Mt Pleasant Street north to the Ford dealership at 8 Memorial Drive. It discharges to the Passumpsic River north of the Aldrich Fabrication parking lot (Map SJ-25). This system was difficult to assess properly because most of the catchbasins are off-line and the manholes are in the middle of a busy road.

Table 40. Water analysis data for outfall SJ1310

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
SJ1310	6/11/14	Flowing	0.25	0.02	0.2	1138	Negative	Clear, no odor
	9/23/14	Flowing	0.1	0.03	0.1	1067	--	Clear, no odor
	11/13/14	Flowing	0.0	0.01	0.2	1067	--	Clear, no odor
	6/25/15	Flowing	0.0	0.05	0.1	1246	--	Clear, no odor
SJ310 MH11	9/23/14	Flowing	0.1	0.07	0.1	1054	--	Sewer odor inside basin. Small floating organics.
	11/13/14	Flowing	0.0	0.02	0.2	1089	--	Clear, slight odor in basin.
	5/20/15	Flowing	0.0	0.02	0.2	1198	--	Minor suds

Findings:

- Very low ammonia and MBAS detergent concentrations were measured at the outfall on June 11, 2014. No chlorine or optical brightener was detected. In subsequent sampling at the outfall, no contaminants were measured above their limits of detection.
- Manhole MH11 has been sampled repeatedly because a slight sewage odor was observed in the manhole on September 23, 2014. Suds were observed on May 20, 2015. However, the water chemistry data at this structure have not indicated presence of an illicit discharge.
- MH11 is on the lot of a dilapidated motel. A small stream flows from a wetland to the stormdrain behind the motel. On September 23, 2014, we walked along the stream up to the wetland looking for any improper connections. None were seen. The wetland is strewn with trash, drums, and other waste.

- On May 14, 2015, samples were collected from MH11 for *E. coli* and total nitrogen analysis. The *E. coli* level (640 MPN/100 mL) and nitrogen concentration (5 mg/L) were elevated.

Conclusion: Despite certain indications of an illicit discharge in the manhole MH11 branch of system SJ1310, we do not believe an illicit discharge is present. We suspect the *E. coli* and total nitrogen are naturally occurring in the wetland and stream.

Resolution: NA

4. NITROGEN LOADING AND *E. COLI* CONCENTRATIONS

Samples were collected on May 14 and 20, 2015 for *E. coli* and total nitrogen analyses by the Vermont DEC laboratory. If feasible, a discharge measurement was made immediately following sampling. Daily loading of total nitrogen was calculated from the concentration and discharge data. These data are presented below (Table 41).

Table 41. E. coli and total nitrogen data for selected drainage systems

System	Date	*E. coli* (MPN/100 mL)	TN (mg/L)	Discharge (L/min)	TN loading (g/day)
SJ510 CB9 Pipe B	5/14/15	<1	1.5	15.4	33
SJ950	5/20/15	<1	0.3	433	187
SJ1000 MH2	5/20/15	<1	1.2	--	--
SJ1140	5/14/15	70	0.1	5.0	0.7
SJ1310 MH11	5/20/15	640	5.0	--	--

5. EROSION CONCERNS

Relative to most of the towns in which we have performed illicit discharge detection and elimination projects, we found significant erosion problems at more outfalls in St. Johnsbury. Erosion was particularly prevalent at outfalls to the Passumpsic River west of Memorial Drive. The most significant erosion concerns are highlighted below (Table 42). Where gully dimensions are given, these are approximations.

Table 42. Outfalls with erosion problems

System	Date	Observation
SJ030	5/13/14	Section of bank above outfall eroded from road should to Passumpsic River. Gully approximately 8 ft wide and 3 ft deep.
SJ080	5/13/14	Bank undercut, slumping
SJ160	5/15/14	Gully 6 ft wide and 4 ft deep. Major bank slumping downslope.
SJ260	5/15/14	Significant bank failure
SJ270	5/15/14	Gully 7 ft wide and 3-4 ft deep
SJ280	5/15/14	Gully 3-4 ft wide and 4 ft deep
SJ320	5/15/14	Gully 4 ft wide and 2 ft deep
SJ330/340	5/19/14	Gully 4 ft wide and 2 ft deep
SJ550	5/20/14	Gully 2-4 ft wide and 3-4 ft deep
SJ700	5/20/14	Gully 2-3 ft wide and 1-2 ft deep
SJ710	5/20/14	Gully 5 ft wide and 1 ft deep
SJ810	5/20/14	Gully 5 ft wide and 3 ft deep
SJ840	5/20/14	Gully 8 ft wide and 6 ft deep
SJ990	5/29/14	Gully 40 ft wide and 40 ft deep. Pipe completely exposed.
SJ1140	6/11/14	Gully 4 ft wide and 5 ft deep
SJ1150	6/11/14	Gully 4 ft wide and 4 ft deep
SJ1240	6/11/14	Gully 4 ft wide and 4 ft deep

6. REFERENCES

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

Dufresne Group Consulting Engineers. 2014. Combined Sewer Overflow Abatement Inventory Report & 3-Year Plan, St. Johnsbury, Vermont. September 30, 2014.

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.

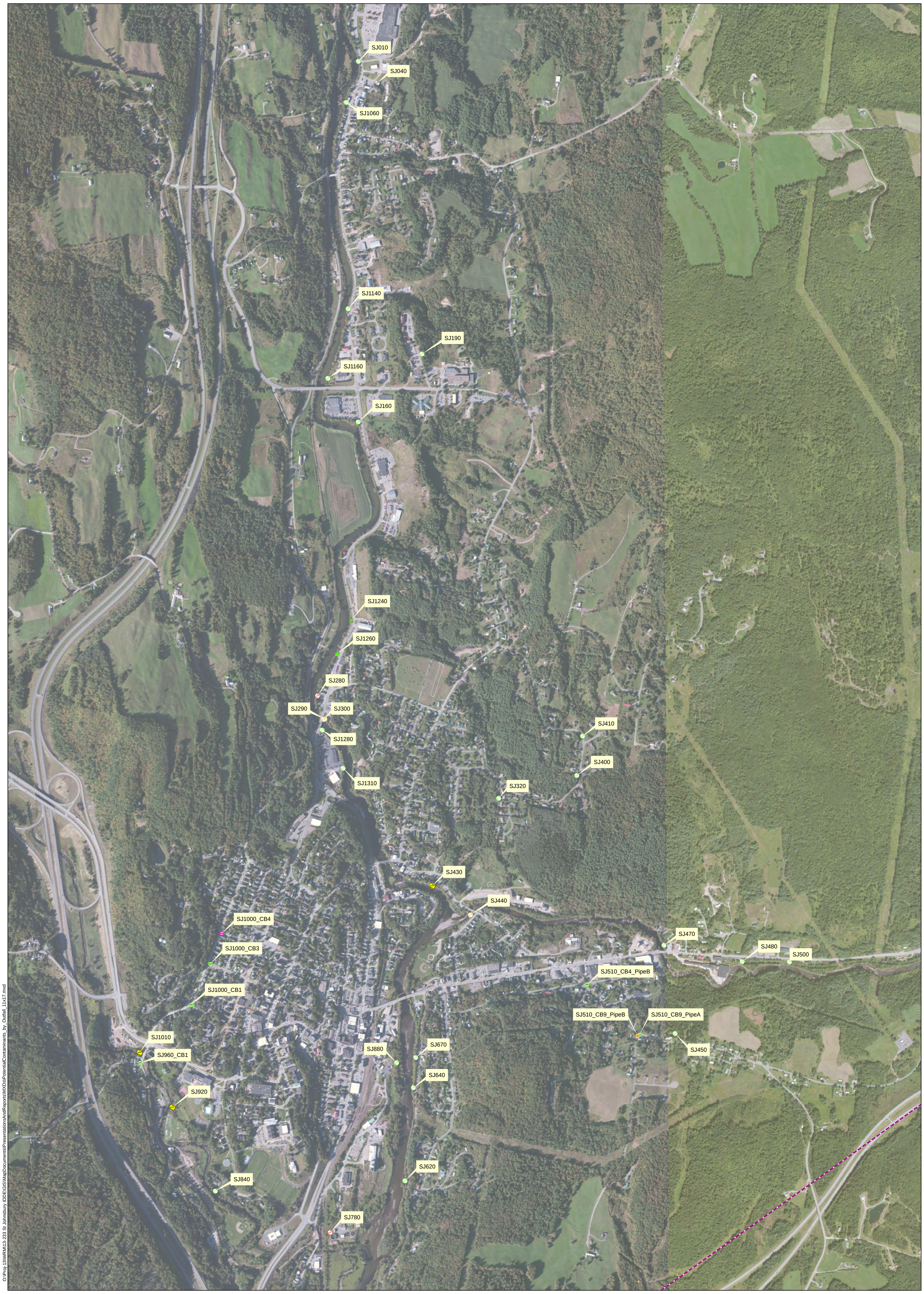
Stone Environmental, Inc. SEI SOP 6.38.0: Optical Brightener Testing. September 11, 2008.

APPENDIX A: ASSESSMENT DATA (INTERIM RESULTS)

System ID	Structure ID	Date assessed	Structure	Pipe diam. (in.)	Pipe material	Dry, Wet (no flow), Dripping, or	Flow depth (in.)	Pipe position	Erosion	Erosion description	Floatables	Deposits/ Stains	Damage	Obstructions	OB pad set?	Date pad retrieved	OB Result	NH3 (mg/L)	Cl2 (mg/L)	MBAS (mg/L)	Sp. cond. (µs/cm)	Discharge characteristics	Comments
SJ010	CB-F	5/13/14	catchbasin	na	na	trickling	na	na	na	na	na	na	na	na	N	na	NA	0.5	na	0.75	na	na	Sampled trickle from pipe A from mall
SJ010	SJ010	5/13/14	outfall	48	corrugated metal	flowing	0.5	free flow	none	na	none	none	none	none	Y	05/21/14	Negative	0.4	0.05	0.2	306	clear, no odor	
SJ020	SJ020	5/13/14	outfall	24	concrete	dry	na	free flow	none	na	none	none	none	partially obstructed	N	na	NA	na	na	na	na	na	
SJ030	SJ030	5/13/14	outfall	36	corrugated metal	dry	na	free flow	yes	bank above outfall eroded, 3 ft deep and 8 ft wide	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ040	SJ040	5/13/14	outfall	10	smooth plastic	trickling	na	submerged	none	na	oil sheen in pond	none	none	none	N	na	NA	na	na	na	na	na	CB-A has petroleum sheen as does the pond. Flow path evident from garage through parking lot through grass to CB-A.
SJ050	SJ050	5/13/14	outfall	30	corrugated metal	flowing	4.0	free flow	yes	1-2 ft sediment deposit, cut through by flow	none	none	none	none	Y	05/29/14	Negative	0.0	0.00	0.1	303	clear, no odor	Sediment deposition likely caused by river surcharging cross culvert
SJ060	SJ060	5/13/14	outfall	8	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ070	SJ070	5/13/14	outfall	12	corrugated black plastic	wet (no flow)	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ080	SJ080	5/13/14	outfall	unknown	steel	dry	na	free flow	yes	ground undercut, slumping	none	none	none	buried	N	na	NA	na	na	na	na	na	
SJ090	SJ090	5/13/14	outfall	11	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ100	SJ100	5/13/14	outfall	12	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1000	CB1	7/7/14	catchbasin	na	na	flowing	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	0	0.00	0.2	1460	clear, no odor	Padded CB1 sump
SJ1000	CB3	7/7/14	catchbasin	na	na	flowing	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	0.1	0.03	0.75	645	clear, no odor	Padded CB3 sump
SJ1000	CB3D	7/7/14	catchbasin	na	na	flowing	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	na	na	na	na	na	
SJ1000	CB4	7/7/14	catchbasin	na	na	flowing	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	0.25	0.04	0.1	730	strong laundry odor in CB, foam	Padded CB4 sump. On Winter Street
SJ1000	CB4A	7/7/14	catchbasin	na	na	dripping	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	na	na	na	na	na	
SJ1000	CB4B	7/7/14	catchbasin	na	na	dripping	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	na	na	na	na	na	
SJ1000	CB4C	7/7/14	catchbasin	na	na	dripping	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	na	na	na	na	na	
SJ1000	SJ1000	5/29/14	mapped CSO	36	corrugated metal	flowing	0.5	free flow	none	na	none	iron staining	crushed	none	N	na	NA	0.1	0.02	0.3	969	clear, no odor	CSO outfall for West Side project.
SJ1010	SJ1010	5/29/14	mapped CSO	24	concrete	dripping	na	free flow	none	na	none	algae, iron staining	cracking, spalling	none	N	na	NA	na	na	na	na	sewage odor in pipe	To right (facing up pipe) of SJ1000.
SJ1020	SJ1020	5/29/14	outfall	12	vitrified clay	flowing	0.2	buried	none	na	none	iron staining	cracking, spalling, crushed	fully obstructed	Y	06/11/14	Negative	na	na	na	na	clear, no odor	Located exposed pipe in vicinity of mapped outfall but outfall could not be found. Up-pipe CBs were not flowing. Exposed pipe was cracked so pad was inserted through the crack.
SJ1030	SJ1030	6/11/2014	outfall	31	corrugated metal	wet (no flow)	na	free flow	none	na	none	iron staining	corrosion	none	N	na	NA	na	na	na	na	na	
SJ1040	SJ1040	6/11/2014	outfall	30	corrugated metal	wet (no flow)	na	free flow	none	na	none	iron staining	corrosion	none	N	na	NA	na	na	na	na	na	
SJ1050	SJ1050	6/11/2014	outfall	1.5	steel	flowing	0.2	free flow	none	na	none	none	none	none	Y	06/16/14	Negative	0.0	0.00	0.1	262	clear, no odor	Likely a well overflow drain
SJ1060	SJ1060	6/11/2014	outfall	16	corrugated metal	flowing	0.2	free flow	none	na	none	iron staining	corrosion, crushed	none	Y	06/16/14	Negative	0.4	0.02	0.25	481	some foam	Sewage odor in pipe
SJ1070	SJ1070	6/11/2014	outfall	16	steel	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1080	SJ1080	6/11/2014	outfall	12	smooth plastic	wet (no flow)	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1090	SJ1090	6/11/2014	outfall	12	concrete	dry	na	free flow	none	na	none	sediment	none	partially obstructed	N	na	NA	na	na	na	na	na	
SJ110	SJ110	5/13/14	outfall	18	corrugated black plastic	dripping	na	free flow	none	na	none	none	none	none	Y	05/29/14	Negative	na	na	na	na	na	
SJ1100	SJ1100	6/11/2014	outfall	24	corrugated metal	dry	na	free flow	none	na	none	sediment	none	none	N	na	NA	na	na	na	na	na	
SJ1110	SJ1110	6/11/2014	outfall	14	corrugated metal	wet (no flow)	na	free flow	none	na	none	iron staining	none	none	N	na	NA	na	na	na	na	na	
SJ1120	SJ1120	6/11/2014	outfall	12	corrugated metal	wet (no flow)	na	free flow	none	na	none	iron staining	none	none	N	na	NA	na	na	na	na	na	
SJ1130	SJ1130	6/11/2014	outfall	18	corrugated metal	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1140	SJ1140	6/11/2014	outfall	12	concrete	flowing	0.1	free flow	yes	4 ft wide, 5 ft deep	none	iron staining	none	none	Y	06/16/14	Negative	0.1	0.00	0.2	849	clear, no odor	No flow in first up-pipe CB
SJ1150	SJ1150	6/11/2014	outfall	20	corrugated black plastic	wet (no flow)	na	free flow	yes	4 ft wide, 4 ft deep	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1160	MH-1 Pipe B	6/11/2014	manhole	na	na	flowing	na	na	na	na	none	none	none	none	N	na	NA	na	0.02	0.2	723	unknown	Pipe A is unmapped and was partially submerged in sump.
SJ1160	MH-1 Sump	7/17/2014	manhole	na	na	flowing	na	na	na	na	unknown	unknown	unknown	unknown	Y	07/17/14	Negative	0.25	0.03	0.1	654	unknown	Sampled 7/17/14
SJ1160	SJ1160	6/11/2014	outfall	15	corrugated metal	flowing	0.2	partially submerged	none	na	none	none	none	none	N	na	NA	na	na	na	na	sewage odor	Unable to get a sample at the outfall due to submersion.
SJ1170	SJ1170	6/11/2014	outfall	24	concrete	dry	na	free flow	none	na	none	sediment	none	partially obstructed	N	na	NA	na	na	na	na	na	
SJ1180	SJ1180	6/11/2014	outfall	30	steel	dry	na	free flow	none	na	none	sediment	none	partially obstructed	N	na	NA	na	na	na	na	na	
SJ1190	SJ1190	6/11/2014	outfall	24	corrugated metal	dry	na	partially submerged	none	na	none	none	crushed	none	N	na	NA	na	na	na	na	na	
SJ120	SJ120	5/13/14	outfall	20	corrugated metal	wet (no flow)	na	free flow	none	na	none	none	none	partially obstructed	N	na	NA	na	na	na	na	na	
SJ1200	SJ1200	6/11/2014	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	N	na	NA	na	na	na	na	unknown	Outfall buried or no longer exists. Could not find up-pipe connection in retention basin. Two outfall pipes (18-in corrugated black plastic) terminating in retention basin were dry.
SJ1210	SJ1210	6/11/2014	outfall	18	corrugated metal	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1220	SJ1220	6/11/2014	outfall	30	corrugated metal	dry	na	free flow	none	na	none	iron staining	none	none	N	na	NA	na	na	na	na	na	
SJ1230	SJ1230	6/11/2014	outfall	unknown	unknown	unknown	unknown	buried	yes	outfall covered by sediment and riprap	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	Outfall covered over by eroded sediment and rip rap. First up-pipe CB was dry. In eroded gully, an 8-in CSO pipe (I think) was exposed for 6 ft horizontally. There was about 1 ft of clearance below CSO pipe.
SJ1240	SJ1240	6/11/2014	box culvert	36 x 48	concrete	flowing	0.3	free flow	yes	gully 4 ft wide, 4 ft deep	none	none	none	none	Y	06/16/14	Negative	0.0	0.04	0.2	503	clear, no odor	Described here is a box culvert. Flowing outfall in first up-pipe CB located directly across street.
SJ1250	SJ1250	6/11/2014	outfall	12	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1260	SJ1260	6/11/2014	pipe	0.5	steel	flowing	full	free flow	yes	some directly around pipe	none	none	none	none	N	na	NA	0.25	0.03	0.2	175	clear, no odor	Pipe under pressure and spraying into river
SJ1270	SJ1270	6/11/2014	outfall	18	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1280	SJ1280	6/11/2014	outfall	36	corrugated metal	flowing	1	free flow	none	na	none	none	none	none	Y	06/16/14	Negative	0.0	0.01	0.5	463	clear, no odor	
SJ1290	SJ1290	6/11/2014	outfall	18	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ130	SJ130	5/13/14	outfall	16	corrugated metal	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1300	SJ1300	6/11/2014	outfall	10	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ1310	SJ1310	6/11/2014	outfall	24	corrugated black plastic	flowing	0.5	free flow	none	na	none	none	none	none	Y	06/16/14	Negative	0.25	0.02	0.2	1138	clear, no odor	
SJ1320	SJ1320	6/11/2014	mapped CSO	unknown	unknown	unknown	unknown	partially submerged	yes	gully at outlet of pipe	unknown	unknown	unknown	partially obstructed	N	na	NA	na	na	na	na	unknown	Could not find outfall, but there is a public works sign indicating it exists. Found a hole in the streambank partially submerged in the river. There is a depressed gully at the outlet of the hole suggesting the CSO outfall is buried and discharges through the hole.
SJ1330	SJ1330	6/11/2014	outfall	12	corrugated black plastic	unknown	na	partially submerged	none	na	none	none	none	none	N	na	NA	na	na	na	na	unknown	
SJ1340	SJ1340	6/11/2014	outfall	12	smooth plastic	dry	na	free flow	none	na	none	none	cracking, spalling	none	N	na	NA	na	na	na	na	na	
SJ140	SJ140	5/13/14	outfall	14	corrugated white plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ160	CB2	5/15/14	catchbasin	na	na	na	na	na	na	na	foam	none	buried	buried	N	na	NA	0.0	0.00	0.2	na	na	Sampled CB2 sump. 10-in. diam. pipe entering CB2 was dripping with a little foam.
SJ160	SJ160	5/15/14	outfall	18	concrete	wet (no flow)	na	free flow	yes	gully 4 ft deep and 6 ft wide. Widens downslope	none	none	none	none	Y	05/21/14	Negative	na	na	na	na	na	
SJ170	SJ170	5/15/14	outfall	16	corrugated white plastic	dry	na	free flow	none	na	none	sediment	none	partially obstructed	Y	05/21/14	Negative	na	na	na	na	na	Wet further up pipe
SJ180	SJ180	5/15/14	outfall	18	corrugated black plastic	wet (no flow)	na	free flow	yes	slope failure around top	none	none	none	none	Y	05/21/14	Negative	na	na	na	na	na	
SJ190	SJ190	5/15/14	outfall	19	smooth plastic	dripping	na	free flow	none	na	none	none	none	none	Y	1) 5/21/2014 2) 7/17/14	Indeterminate Negative	0.0	0.01	0.2	309	clear, no odor	To the left (facing up-pipe) of SJ200. Ongoing construction around 3 unmapped CBs up-pipe of SJ190. CB3 drains rain garden under construction. CB2 pipe A (8 in.) aligned towards building, pipe B (19 in.) connects CB3 outlet to CB1. OB result for 7/17/14 from a re-pad. Water quality test data from 5/15/14.
SJ200	SJ200	5/15/14	outfall	18	corrugated metal	dripping	na	free flow	none	na	none	none	none	none	Y	05/21/14	Negative	na	na	na	na	clear, no odor	To the right (facing up-pipe) of SJ190. Drains single CB along road.
SJ210	SJ210	5/15/14	outfall	18	corrugated metal	dry	na	free flow	none	na	none	sediment	none	none	N	na	NA	na	na	na	na	na	Drains one CB in parking lot

System ID	Structure ID	Date assessed	Structure	Pipe diam. (in.)	Pipe material	Dry, Wet (no flow), Dripping, or	Flow depth (in.)	Pipe position	Erosion	Erosion description	Floatables	Deposits/ Stains	Damage	Obstructions	OB pad set?	Date pad retrieved	OB Result	NH3 (mg/L)	Cl2 (mg/L)	MBAS (mg/L)	Sp. cond. (µs/cm)	Discharge characteristics	Comments
SJ221	SJ221	5/15/14	outfall	4	smooth plastic	dry	na	free flow	none	na	none	none	none	none	Y	05/21/14	Negative	na	na	na	na	na	Coming from southeast building
SJ222	SJ222	5/15/14	outfall	15	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	Unsure which CB the outfall is connected to, if any.
SJ230	SJ230	5/15/14	outfall	16	corrugated black plastic	dry	na	free flow	none	na	none	sediment	none	none	N	na	NA	na	na	na	na	na	Open system (no CBs) that drains grassy swale
SJ240	SJ240	5/15/14	outfall	unknown	smooth plastic	dry	na	buried	none	na	none	none	buried	fully obstructed	N	na	NA	na	na	na	na	na	Filled over with soil and grass. Small hole opening to outfall which appears crushed. Drains two CBs that were dry (~18-in. outlets).
SJ250	SJ250	5/15/14	outfall	6	corrugated black plastic	wet (no flow)	na	free flow	none	na	none	none	none	none	Y	05/21/14	Negative	na	na	na	na	na	Drains a single CB in parking lot. Outfall next to road.
SJ260	SJ260	5/15/14	outfall	unknown	unknown	unknown	unknown	unknown	yes	bank failure all around	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	Found small diameter steel pipe that could be a bridge drain. Could not find outfall of mapped drainage system. Entire river bank slumping. Outfall likely buried.
SJ270	SJ270	5/15/14	outfall	8	smooth plastic	wet (no flow)	na	free flow	yes	3-4 ft deep, 7 ft wide around outfall	none	none	none	none	Y	05/29/14	Negative	na	na	na	na	na	To the left (facing up-pipe) of SJ280. Padded CB22 farther up-system even though it was dry (floor drain connected).
SJ280	SJ280	5/15/14	outfall	24	concrete	flowing	0.4	free flow	yes	3-4 ft deep, 7 ft wide around outfall	cigarettes	none	crushed, pipe end broken off	none	Y	05/29/14	Negative	0.0	0.09	0.3	555	slightly gray, no odor, lots of particles	To the right of SJ270. Drains CB2. CB2 pipe A not flowing and could not find its outfall; pipe B flowing to SJ280. CBs 10 through 17 dry.
SJ290	SJ290	5/15/14	outfall	18	concrete	wet (no flow)	na	free flow	yes	small gully 3 ft wide, 1 ft deep	none	none	none	none	Y	05/21/14	Positive	na	na	na	na	na	To the right (facing up-pipe) of SJ300; in vicinity of mapped CSO. May be mapped CSO although there is no end cover on pipe.
SJ300	SJ300	5/15/14	outfall	10	smooth plastic	wet (no flow)	na	free flow	yes	3 ft wide, 1 ft deep	none	sediment	none	none	Y	05/21/14	Positive	na	na	na	na	na	To left (facing up-pipe) of SJ290; in vicinity of mapped CSO
SJ310	SJ310	5/19/14	outfall	13	corrugated metal	wet (no flow)	na	free flow	none	na	none	none	none	partially obstructed	Y	05/29/14	Negative	na	na	na	na	na	
SJ320	SJ320	5/19/14	outfall	15	corrugated metal	flowing	0.4	free flow	yes	4 ft wide, 2 ft deep, cut back	none	iron staining	20 ft section removed	none	Y	05/29/14	Negative	0.0	0.00	0.2	536	clear, slight odor	Drains CB1 and CB2. CB2 contains pipes A, B, C, D, and E. Pipes A, D, and E were flowing. Pipes B and C were wet but not flowing. Did not pad or test in CB2.
SJ330	SJ330	5/19/14	outfall	4	smooth plastic	wet (no flow)	na	free flow	yes	4 ft wide, 2 ft deep	none	iron staining	none	none	Y	05/29/14	Negative	na	na	na	na	na	SJ330 is above SJ340. On pipe: "PVC Sewer Pipe".
SJ340	SJ340	5/19/14	outfall	4	smooth plastic	wet (no flow)	na	free flow	yes	4 ft wide, 2 ft deep	none	iron staining	none	none	Y	05/29/14	Negative	na	na	na	na	na	SJ330 is above SJ340. On pipe: "PVC Sewer Pipe".
SJ350	SJ350	5/19/14	outfall	unknown	smooth plastic	dry	na	free flow	none	na	none	none	none	fully obstructed	N	na	NA	na	na	na	na	na	Could not find outfall, likely buried.
SJ360	SJ360	5/19/14	outfall	10	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	Unmapped 4-inch diameter overflow connected to catchbasin on Farmer Drive. Across street from SJ350. CB is full of sediment.
SJ370	SJ370	5/19/14	outfall	12	smooth plastic	flowing	1.5	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	clear, no odor	Outfall conveys a stream under a road. Only CB in system was dry.
SJ380	SJ380	5/19/14	outfall	18	corrugated metal	dry	na	free flow	none	na	none	sediment	none	partially obstructed	N	na	NA	na	na	na	na	na	Half full of sediment. Drains one CB connected to roadside grass swale.
SJ390	SJ390	5/19/14	outfall	18	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ400	SJ400	5/19/14	outfall	19	corrugated metal	flowing	0.2	free flow	none	na	none	iron staining	none	none	Y	05/29/14	Negative	0.0	0.00	0.2	572	clear, no odor	Monitoring well in flow path a few feet down from outfall.
SJ410	SJ410	5/19/14	outfall	18	corrugated black plastic	flowing	4.0	partially submerged	none	na	none	iron staining	none	none	Y	05/29/14	Negative	0.0	0.00	0.3	598	clear, no odor	
SJ415	SJ415	5/29/14	outfall	4	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	Could not find outfall in location mapped. The assessed outfall is 25 ft downstream of mapped outfall. Up-pipe CB was mapped correctly and was not flowing.
SJ420	SJ420	5/19/14	outfall	unknown	smooth plastic	dry	na	buried	none	na	none	none	crushed	fully obstructed	N	na	NA	na	na	na	na	na	Adjacent to stream outfall. Buried under several feet of sand/sediment.
SJ430	SJ430	5/19/14	CSO outfall	unknown	unknown	dry	na	buried	none	na	none	sewage	cracking, crushed	fully obstructed	N	na	NA	na	na	na	na	na	Buried under several feet of sand. Pipe burst uphill. Sewage deposits around burst hole and down flowpath from hole.
SJ440	SJ440	5/19/14	outfall	38	smooth plastic	trickling	na	free flow	none	na	none	none	crushed	none	Y	05/29/14	Positive	2.0	0.04	0.75	859	clear, sewage odor in pipe	Not mapped as CSO. Strong sewage odor in outfall. Placed OB pads at CB3, CB5, CB7, and CB9
SJ450	SJ450	5/19/14	outfall	36	corrugated metal	flowing	1.5	free flow	none	na	none	iron staining	none	none	Y	06/03/14	Negative	0.0	0.02	0.6	220	clear, no odor	Could not access up-pipe manhole that connects main stormline to stream. No access to stormline.
SJ460	SJ460	5/19/14	outfall	14	corrugated metal	dry	na	free flow	none	na	none	unknown	none	none	N	na	NA	na	na	na	na	na	Could not access. Hanging below a bridge. Drains one CB.
SJ470	SJ470	5/19/14	outfall	15	concrete	flowing	0.5	free flow	none	na	none	iron staining	none	none	Y	05/29/14	Negative	0.0	0.00	0.2	938	clear, musty	
SJ480	SJ480	5/19/14	outfall	18	corrugated metal	flowing	0.4	free flow	none	na	none	iron staining	cracking	none	Y	05/29/14	Negative	0.0	0.01	0.2	395	clear, no odor	Assessed outfall of system immediately below first up-pipe CB.
SJ490	SJ490	5/19/14	outfall	18	corrugated black plastic	flowing	0.2	free flow	none	na	none	iron staining	none	none	Y	05/29/14	Negative	0.0	0.00	0.1	387	clear, no odor	
SJ500	SJ500	5/19/14	outfall	18	corrugated black plastic	flowing	0.1	free flow	none	na	none	none	none	none	Y	05/29/14	Negative	0.0	0.00	0.2	451	clear, no odor	
SJ510	CB4 Pipe B	5/20/14	catchbasin	unknown	smooth plastic	flowing	na	free flow	na	na	none	none	none	none	Y	05/29/14	Negative	0.25	0.03	0.1	503	clear, no odor	Up-pipe of SJ510. At bottom of eastern end of Lafayette St.
SJ510	CB5	5/20/14	catchbasin	unknown	unknown	flowing	na	free flow	na	na	none	none	none	none	Y	05/29/14	Negative	0.1	0.03	0.1	495	clear, no odor	Up-pipe of SJ510. At bottom of Mountain Ave. Flow continuous, but pulses of water coming out of pipe every 2 seconds.
SJ510	CB8 Pipe A	5/29/14	catchbasin	unknown	unknown	flowing	na	free flow	na	na	none	none	none	none	Y	06/03/14	Negative	0.0	0.04	0.0	643	clear, no odor	Pad from CB8 pipe A retrieved from sump
SJ510	CB8 Pipe C	5/29/14	catchbasin	unknown	unknown	flowing	na	free flow	na	na	none	none	none	none	Y	06/03/14	Negative	0.0	0.02	0.0	602	clear, no odor	
SJ510	CB9 Pipe A	5/29/14	catchbasin	unknown	unknown	flowing	na	free flow	na	na	none	none	none	none	Y	06/03/14	Indeterminate	0.25	0.02	0.1	640	clear, no odor	Drains short footing drain. Water quality data from retest on 7/7/14. Original data form lost.
SJ510	CB9 Pipe B	5/29/14	catchbasin	unknown	unknown	flowing	na	free flow	na	na	none	none	none	none	Y	06/03/14	Positive	0.25	0.03	0.2	693	clear, no odor	Drains underdrain from Parker Ave. Water quality data from retest on 7/7/14. Original data form lost.
SJ510	SJ510	5/20/14	outfall	28	concrete	flowing	1.0	free flow	none	na	none	none	none	none	Y	1) 6/3/2014 2) 7/17/14	Negative Negative	0.1	0.01	0.1	506	clear, no odor	No flow from western end of Lafayette St. OB result for 7/17/14 from a re-pad. Water quality test data from 5/20/14.
SJ520	SJ520	5/20/14	outfall	16	concrete	dry	na	free flow	yes	3 ft wide, 3 ft deep	none	none	cracking, spalling	none	N	na	NA	na	na	na	na	na	
SJ530	SJ530	5/20/14	outfall	18	steel	dry	na	free flow	none	na	none	none	cracking, corrosion	none	N	na	NA	na	na	na	na	na	
SJ540	SJ540	5/20/14	outfall	18	corrugated metal	dry	na	free flow	yes	bank cut, 10 ft tall	none	none	corrosion	none	N	na	NA	na	na	na	na	na	
SJ550	SJ550	5/20/14	outfall	6	smooth plastic	dry	na	free flow	yes	2-4 ft wide, 3-4 ft deep	none	none	none	none	N	na	NA	na	na	na	na	na	Drains one dry roadside CB
SJ560	SJ560	5/20/14	mapped CSO	22	concrete	dry	na	free flow	none	na	none	toilet paper	none	none	N	na	NA	na	na	na	na	na	Sewage odor in sand; steel door over end of pipe
SJ570	SJ570	5/20/14	outfall	15	corrugated black plastic	wet (no flow)	na	free flow	none	na	none	none	none	none	Y	05/29/14	Negative	na	na	na	na	na	
SJ580	SJ580	5/20/14	outfall	unknown	unknown	unknown	unknown	unknown	none	na	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	Could not find outfall. Covered by soil, dead trees, and brush. Only CB in system was dry.
SJ590	SJ590	5/20/14	outfall	18	corrugated metal	dry	na	free flow	yes	minor erosion at outfall, more downhill	none	iron staining	corrosion	none	N	na	NA	na	na	na	na	na	To the left (facing up-pipe) of SJ600
SJ600	SJ600	5/20/14	outfall	12	corrugated black plastic	dry	na	free flow	yes	minor erosion at outfall, more downhill	none	none	none	none	N	na	NA	na	na	na	na	na	To the right (facing up-pipe) of SJ590
SJ610	SJ610	5/20/14	outfall	unknown	unknown	unknown	unknown	unknown	none	na	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	Outfall buried by dead trees, soil, brush. Up-pipe CB is dry.
SJ620	SJ620	5/20/14	outfall	18	corrugated metal	flowing	3.0	partially submerged	yes	some bank failure	suds	iron staining	corrosion	none	Y	05/29/14	Negative	0.0	0.02	0.3	1049	a little foamy	
SJ630	SJ630	5/20/14	outfall	unknown	unknown	unknown	unknown	unknown	none	na	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	No outfall or CB found in mapped locations.
SJ640	SJ640	5/20/14	outfall	15	corrugated black plastic	flowing	0.5	free flow	none	na	none	none	none	none	Y	05/29/14	Negative	0.25	0.02	0.1	966	mat of filamentous algae in pipe	4-inch pipe in hillside flows into up-pipe CB
SJ650	SJ650	5/20/14	outfall	6	corrugated black plastic	flowing	0.2	free flow	none	na	none	iron staining	none	partially obstructed	Y	05/29/14	Negative	na	0.02	0.1	1203	clear, no odor	To the right (facing up-pipe) of SJ660
SJ660	SJ660	5/20/14	outfall	12	corrugated black plastic	dry	na	free flow	none	na	sediment	none	none	partially obstructed	N	na	NA	na	na	na	na	na	To the left (facing up-pipe) of SJ650
SJ670	SJ670	5/20/14	outfall	12	corrugated black plastic	flowing	0.2	free flow	none	na	none	sediment	none	partially obstructed	Y	05/29/14	Negative	0.4	0.01	0.1	668	clear, no odor	One third full of sediment. Flowing on 5/20/14 due to burst pipe under Marion Ave., which drains into up-pipe CB. The burst pipe had been fixed by 5/29/14.
SJ680	SJ680	5/20/14	outfall	12	corrugated metal	flowing	unknown	free flow	yes	slumping	none	none	crushed	partially obstructed	N	na	NA	na	na	na	na	clear, no odor	Did not pad or sample since flow is from a burst pipe on Marion Ave. The burst pipe had been fixed by 5/29/14 and the flow eliminated. Same water already tested at SJ670. Drains a single closed CB.
SJ690	SJ690	5/20/14	outfall	8	smooth plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ700	SJ700	5/20/14	outfall	12	smooth plastic	dry	na	free flow	yes	gully 2-3 ft wide, 1-2 ft deep	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ710	SJ710	5/20/14	outfall	15	corrugated black plastic	dry	na	free flow	yes	5 ft wide, 1 ft deep	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ720	SJ720	5/20/14	outfall	18	corrugated black plastic	dry	na	free flow	none	na	none	sediment	none	partially obstructed	N	na	NA	na	na	na	na	na	Half full of sediment
SJ730	SJ730	5/20/14	outfall	8	corrugated black plastic	dry	na	free flow	yes	0.5 ft wide, 1 ft deep, 4 ft long	none	sediment	none	none	N	na	NA	na	na	na	na	na	
SJ740	SJ740	5/20/14	outfall	36	steel	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	New unmapped outfall. Three outfalls mapped on other side of fence no longer exist (likely were routed to this new outfall).
SJ750	SJ750	5/20/14	outfall	unknown	unknown	unknown	unknown	unknown	none	na	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	No outfall or any structures found in mapped location. WWTP operator confirmed it no longer exists.

System ID	Structure ID	Date assessed	Structure	Pipe diam. (in.)	Pipe material	Dry, Wet (no flow), Dripping, or	Flow depth (in.)	Pipe position	Erosion	Erosion description	Floatables	Deposits/ Stains	Damage	Obstructions	OB pad set?	Date pad retrieved	OB Result	NH3 (mg/L)	Cl2 (mg/L)	MBAS (mg/L)	Sp. cond. (µs/cm)	Discharge characteristics	Comments
SJ760	SJ760	5/20/14	mapped CSO	unknown	unknown	unknown	unknown	unknown	none	na	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	No outfall or any structures found in mapped location. WWTP operator confirmed it no longer exists.
SJ770	SJ770	5/20/14	outfall	24	concrete	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	At wastewater plant
SJ780	SJ780	5/20/14	outfall	18	concrete	flowing	5.0	partially submerged	none	na	none	none	none	none	Y	05/29/14	Negative	0.25	0.31	na	255	very dirty	Could not find outfall at mapped location. Found outfall upstream on the same stormline. Very dirty water likely due to construction.
SJ790	SJ790	5/20/14	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	N	na	NA	na	na	na	na	unknown	Could not access due to ongoing construction
SJ810	SJ810	5/20/14	outfall	18	corrugated metal	dry	na	free flow	yes	5 ft wide, 3 ft deep	none	none	corrosion	none	N	na	NA	na	na	na	na	na	Assessed outfall is northwest of mapped outfall location.
SJ820	SJ820	5/20/14	outfall	8	smooth plastic	wet (no flow)	na	free flow	none	na	none	none	none	none	Y	1) 5/29/2014 2) 7/17/14	Indeterminate Negative	na	na	na	na	na	OB result for 7/17/14 from a re-pad.
SJ830	SJ830	5/20/14	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	fully obstructed	N	na	NA	na	na	na	na	unknown	Could not find outfall at mapped location. Area covered in sediment. Assessed up-pipe CB (CB1) on 7/7/14, which was dry.
SJ840	CB1 pipe A	5/20/14	catchbasin	unknown	corrugated black plastic	flowing	na	unknown	na	na	none	iron staining	none	none	Y	05/29/14	Negative	na	na	na	na	unknown	
SJ840	CB1 pipe B	5/20/14	catchbasin	unknown	corrugated black plastic	flowing	na	unknown	na	na	none	iron staining	none	none	Y	05/29/14	Negative	na	na	na	na	unknown	
SJ840	SJ840	5/20/14	outfall	24	corrugated black plastic	flowing	0.2	free flow	yes	gully 8 ft wide, 6 ft deep	none	iron staining	none	none	Y	1) 5/29/2014 2) 7/17/14	Indeterminate Negative	1) 0.1 2) 0.25	1) 0.02 2) 0.07	1) 0.3 2) 0.3	1) 235 2) 1306	1) clear, no odor 2) strong pool/laundry odor	Second set of water quality data from resampling on 5/29/14. Temperature was 23.2°C on 5/29/14. Second OB result on 7/17/14 from a re-pad.
SJ850	SJ850	5/21/14	outfall	10	smooth plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ860	SJ860	5/21/14	mapped CSO	24	concrete	dry	na	free flow	yes	downcutting and sediment scour	none	sewage	none	none	N	na	NA	na	na	na	na	na	Steel door over outfall
SJ870	SJ870	5/21/14	mapped CSO	30	concrete	dry	na	free flow	yes	downcutting and sediment scour	none	sewage	none	none	N	na	NA	na	na	na	na	na	Steel door over outfall
SJ880	CB11 Pipe A	5/21/14	catchbasin	unknown	smooth plastic	flowing	na	free flow	na	na	suds, sheen	none	none	none	Y	06/03/14	Negative	0.25	0.00	0.3	2410	gray water	No flow from pipe B. Noted public works crew working on CB13, which was the likely the source of the dirty water. CB15 was dry.
SJ880	SJ880	5/21/14	outfall	36	concrete	flowing	0.2	free flow	none	na	none	none	none	none	Y	05/29/14	Negative	0.25	0.07	0.5	2820	sewage odor in pipe	Outfall of large stormwater system. CB11 was flowing. CB8-X was dry. CB21 and CB22 also dry.
SJ890	SJ890	5/21/14	mapped CSO	25	concrete	dry	na	free flow	none	na	none	sewage deposits	none	none	N	na	NA	na	na	na	na	na	Steel door over outfall
SJ900	SJ900	5/21/14	outfall	10	smooth plastic	wet (no flow)	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ910	SJ910	5/21/14	outfall	24	corrugated black plastic	dry	na	free flow	none	na	none	none	none	none	N	na	NA	na	na	na	na	na	
SJ920	SJ920	5/21/14	mapped CSO	unknown	concrete	dripping	na	free flow	none	na	none	sediment	cracking	none	N	na	NA	na	na	na	na	strong sewage odor in pipe	Not enough flow to sample.
SJ930	SJ930	5/21/14	mapped CSO	unknown	steel	unknown	unknown	submerged	none	na	unknown	unknown	corrosion	none	N	na	NA	na	na	na	na	unknown	In river
SJ940	SJ940	5/21/14	mapped CSO	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	N	na	NA	na	na	na	na	unknown	Could not find outfall
SJ950	CB-1	7/17/14	catchbasin	unknown	unknown	dry	na	free flow	none	na	none	none	none	none	Y	07/17/14	Negative	na	na	na	na	clear, no odor	
SJ950	SJ950	5/21/14	outfall	25 x 10	concrete	flowing	2.0	free flow	none	na	none	none	none	none	Y	1) 5/29/2014 2) 7/17/14	Indeterminate Positive	0.1	0.01	0.2	609	suds where flow enters river	Outfall within 1 ft of the river level. The only up-pipe CB was dry. Noted 2-in. diam. pipe spraying onto river 50 m upstream of outfall. Water quality test data from 5/21/14.
SJ960	CB1	5/21/14	catchbasin	na	na	flowing	na	na	na	na	na	na	none	none	Y	05/29/14	Negative	0.0	0.01	0.2	727	unknown	Could not access outfall so collected sample from CB1
SJ960	SJ960	5/21/14	outfall	18	corrugated metal	flowing	0.2	free flow	none	na	none	iron staining	none	none	N	na	NA	na	na	na	na	unknown	Could not access outfall so collected sample from CB1
SJ970	SJ970	5/21/14	outfall	12	corrugated metal	dry	na	free flow	none	na	none	iron staining	none	none	N	na	NA	na	na	na	na	na	
SJ980	SJ980	5/29/14	catchbasin	unknown	unknown	dry	na	na	na	na	none	unknown	unknown	unknown	N	na	NA	na	na	na	na	na	Could not find outfall. Up-pipe CB was dry.
SJ990	SJ990	5/29/14	outfall	unknown	corrugated metal	dry	na	free flow	yes	large gully 40 ft deep and 40 ft wide	none	none	corrosion, crushed, exposed	partially obstructed	N	na	NA	na	na	na	na	na	Homeowner not home. Up-pipe CB was not flowing, but could not see an outlet pipe.



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Potential Contaminants by Structure
St. Johnsbury, Vermont

Structure Type, Potential Contaminants

- Box Culvert, Ammonia and/or detergent
- Catchbasin, Ammonia and/or detergent
- Outfall, Ammonia and/or detergent
- Pipe, Ammonia and/or detergent
- Catchbasin, Optical brightener
- Outfall, Optical brightener
- Catchbasin, Wastewater odor
- Outfall, Chlorine
- Outfall, Petroleum
- Mapped CSO, CSO issue

APPENDIX B: ASSESSMENT DATA FORM

St. Johnsbury 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 TN analysis: YES NO NA			Date: _____ Time: _____			
Flow measurement (if *E. coli* and/or nutrients sample collected):						
Comments:						

APPENDIX C: 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

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.

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

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.

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 KCl 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

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.

EPA the U.S. Environmental Protection Agency.

FIFRA the Federal Insecticide, Fungicide, and Rodenticide Act as amended.

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.

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:

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.

Added instructions about cleaning and re-hydrating the probe to Section 3.1.

Added Section 9.0.

Reformatted.

Minor word editing.

Revision number 2:

Changed the title.

Removed sections 7.0 (Measurement) and 8.0 (Maintenance/Repairs).

Added section called (General and Annual Maintenance).

Minor editing.

Reformatted.

Revision number 3:

Minor wording edits in Section 1.0, Objective.

Updated style to match SEI Style Guide – font and text. Reformatted using MS Word

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.

Deleted section on logs being given to the QAU.

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

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.

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

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.

Care must always be taken when approaching a sampling location. Do not, under any circumstances, place yourself in danger to collect a sample.

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

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: _____

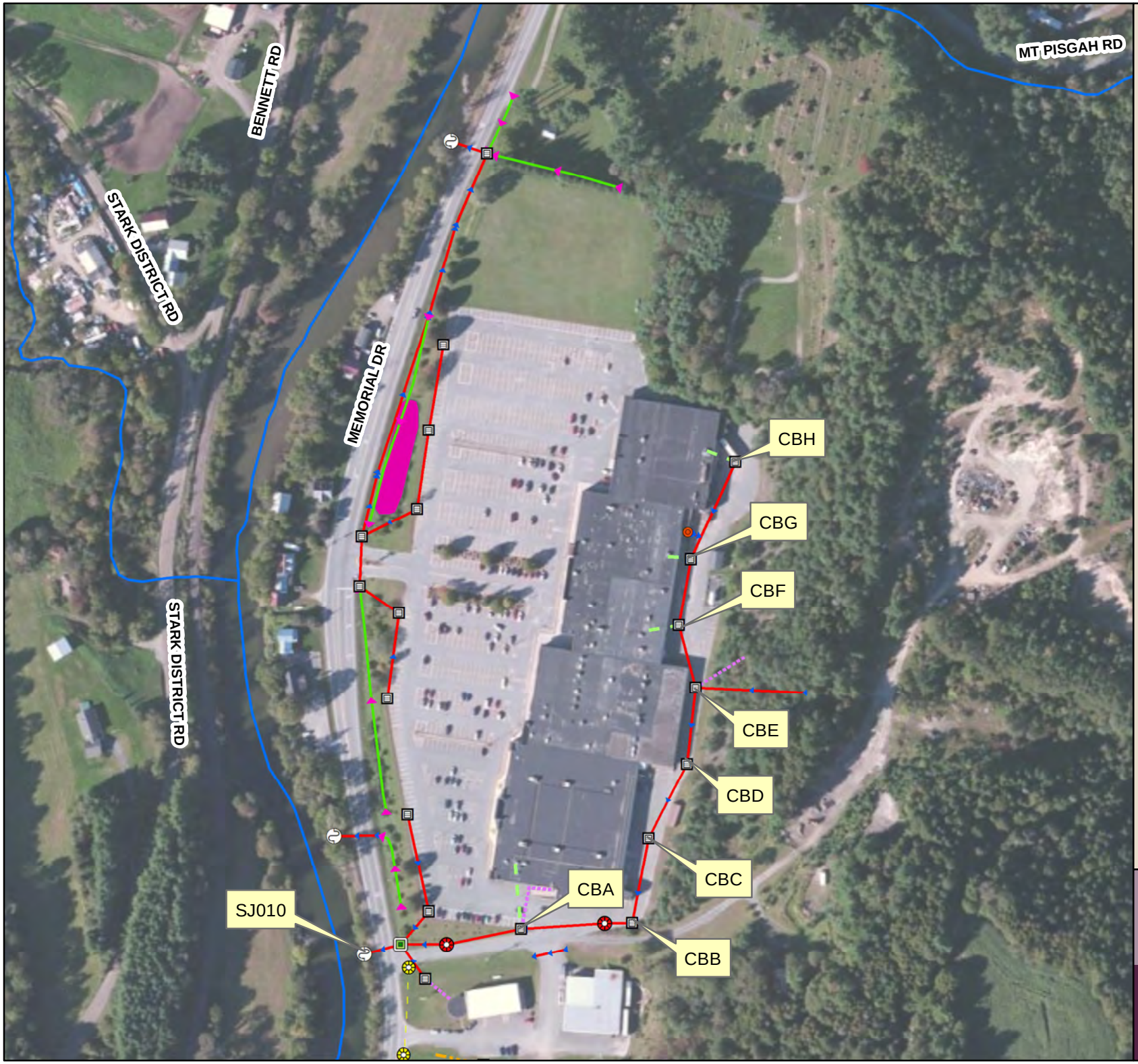
Christopher T. Stone, President

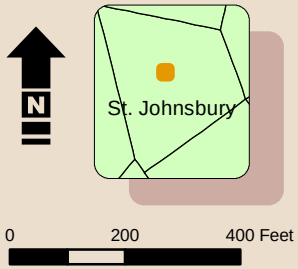
10.0 REVISION HISTORY

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 D: MAPS





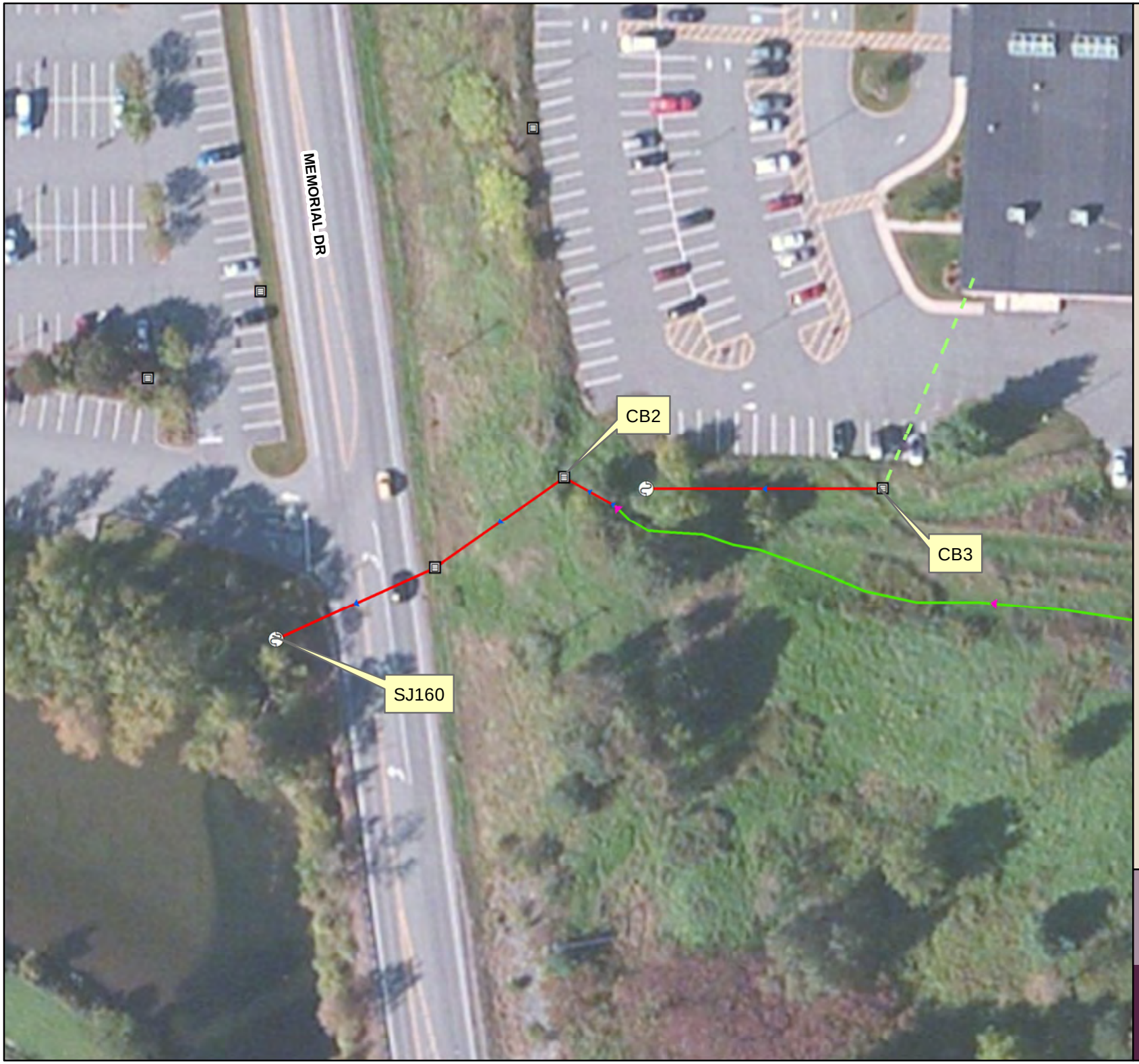
- Catchbasin
- Culvert inlet
- Junction Box
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Sanitary line
- Swale
- Footing drain
- Under drain
- Roof drain
- Stream
- Proposed

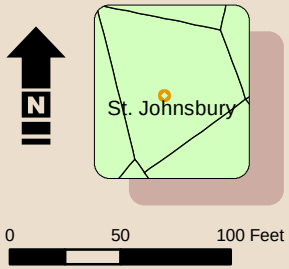
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-1
System SJ010
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Outfall

Storm line

Swale

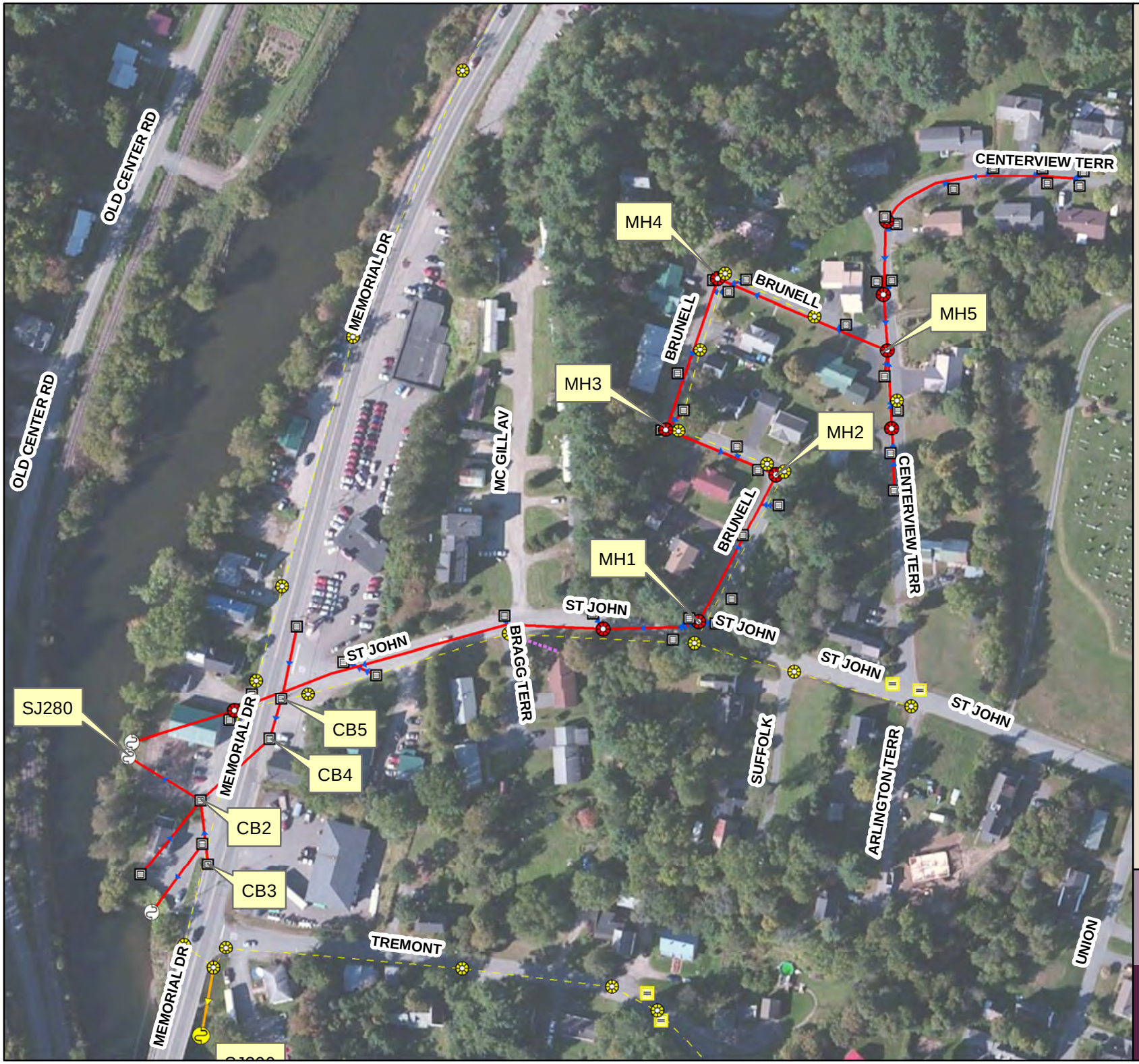
Roof drain

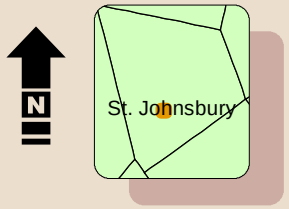
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-2
System SJ160
St. Johnsbury, VT

St. Johnsbury IDDE





0 140 280 Feet

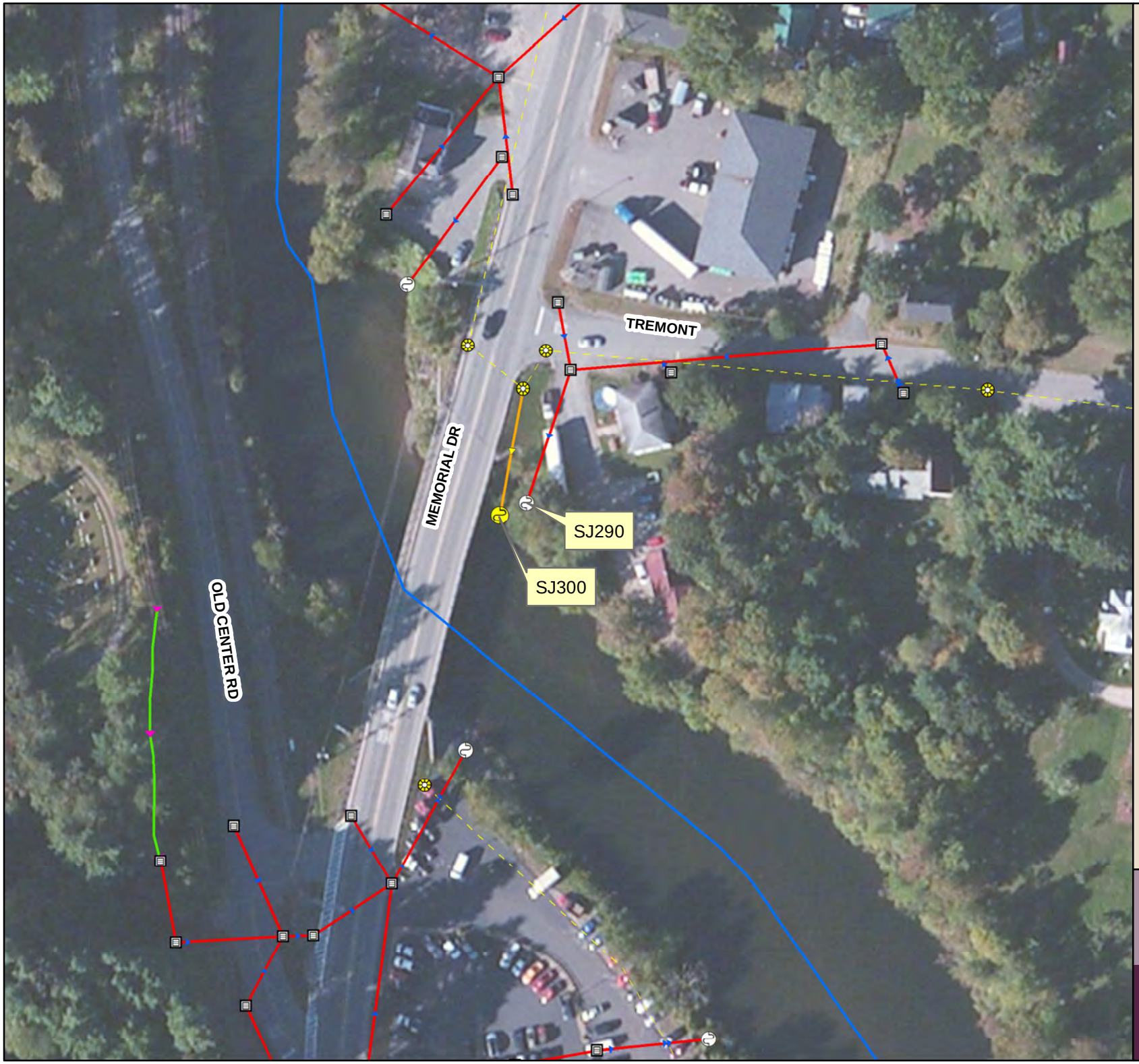
- Catchbasin
- CSO outfall
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Combined sewer
- Sanitary line
- Footing drain

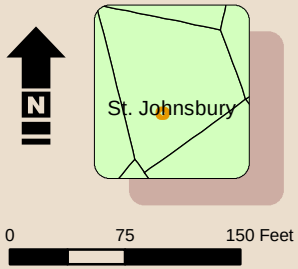
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-3
System SJ280
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

CSO outfall

Sanitary Manhole

Outfall

Storm line

Combined sewer

Sanitary line

Swale

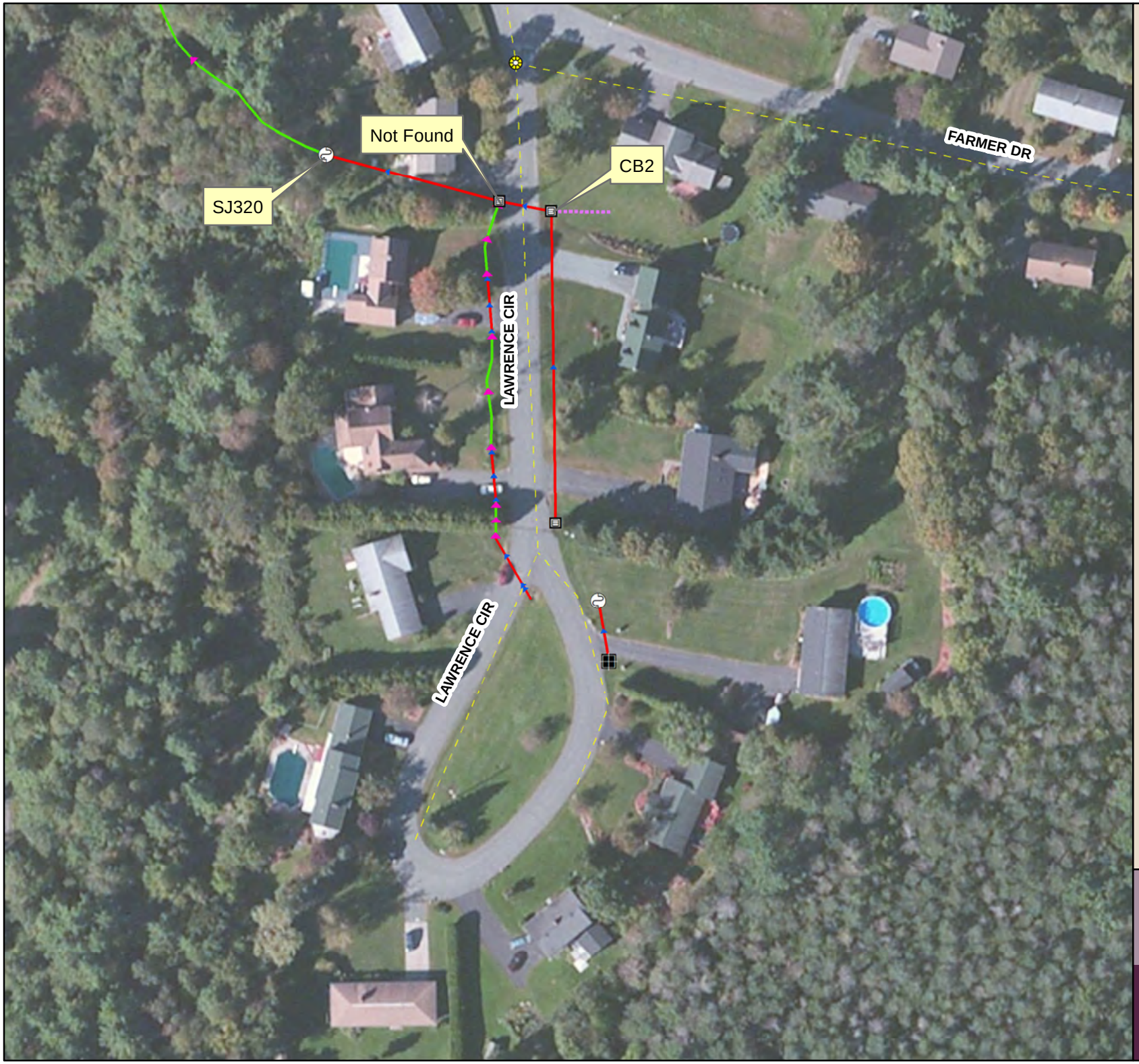
Stream

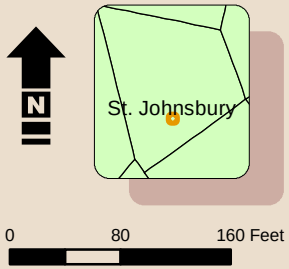
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-4
Systems SJ290 and SJ300
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Drop Inlet

Sanitary Manhole

Outfall

Storm line

Sanitary line

Swale

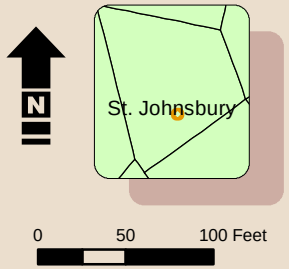
Footing drain

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

STONE ENVIRONMENTAL INC

Map SJ-5
System SJ320
St. Johnsbury, VT

St. Johnsbury IDDE



Catchbasin

Stormwater Manhole

Sanitary Manhole

Outfall

Storm line

Sanitary line

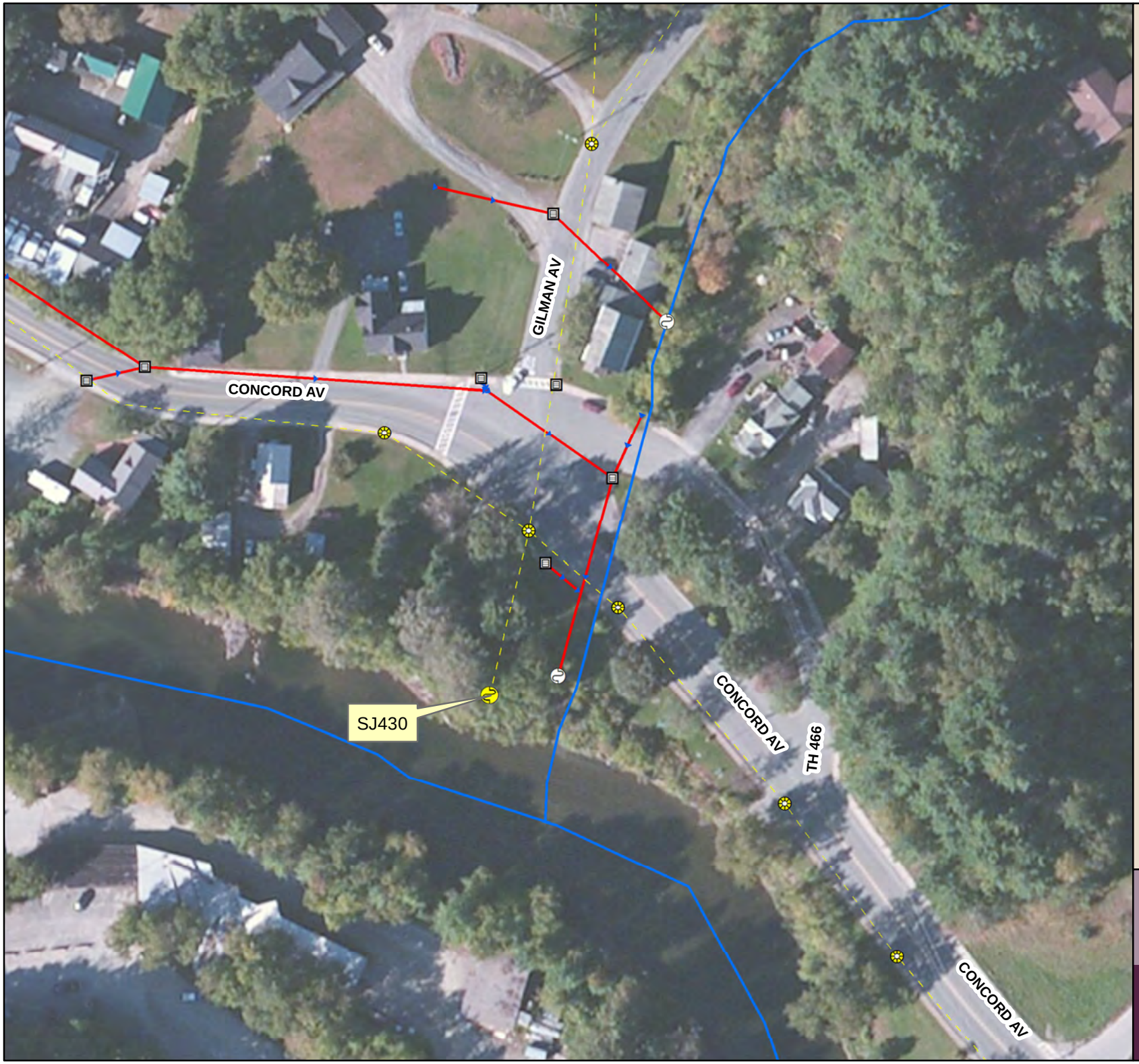
Swale

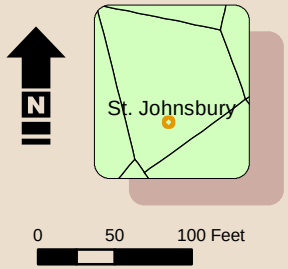
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-6
System SJ410
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

CSO outfall

Sanitary Manhole

Outfall

Storm line

Sanitary line

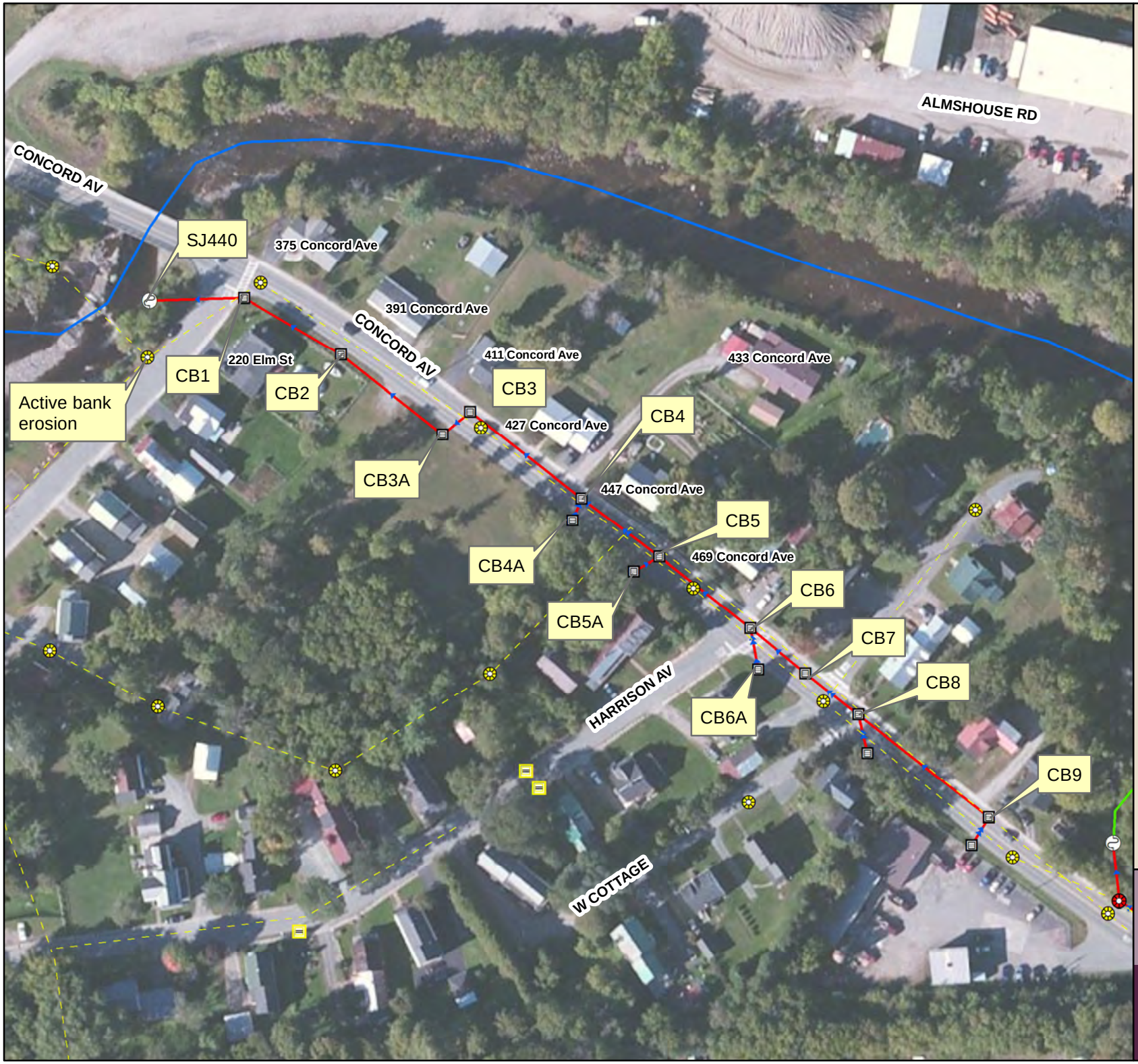
Stream

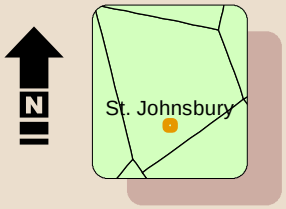
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-7
System SJ430
St. Johnsbury, VT

St. Johnsbury IDDE





0 75 150 Feet

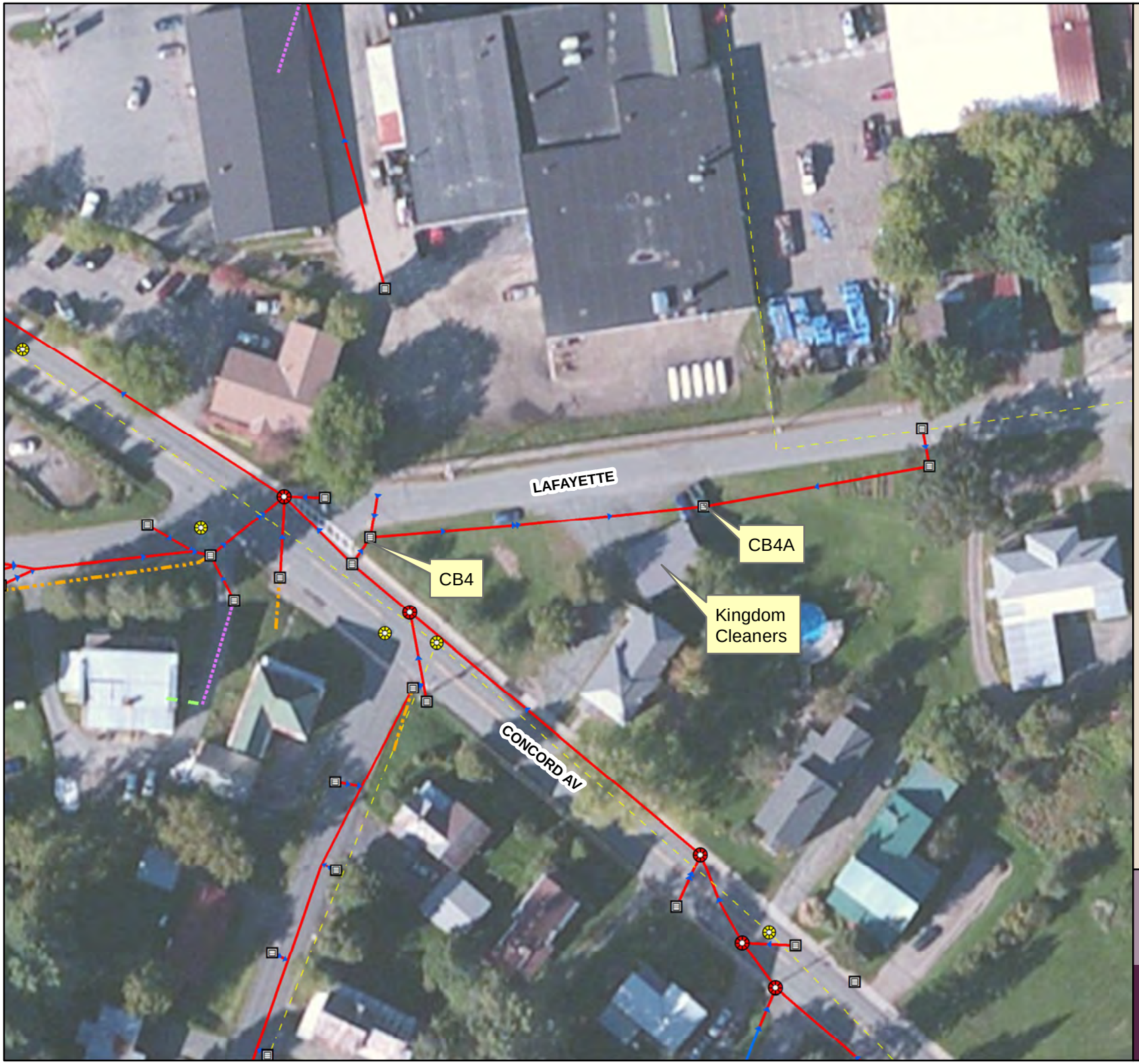
- Catchbasin
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Sanitary line
- Swale
- Stream

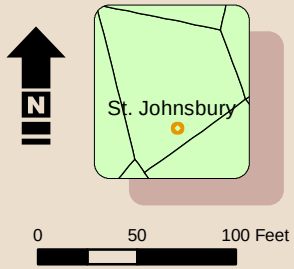
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-8
System SJ440
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Stormwater Manhole

Sanitary Manhole

Storm line

Sanitary line

Footing drain

Under drain

Roof drain

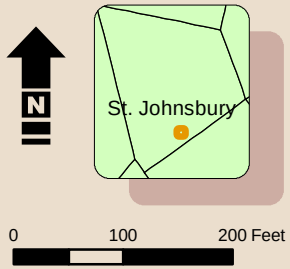
Stream

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

STONE ENVIRONMENTAL INC

Map SJ-9, System SJ510, CB4 Pipe B Branch St. Johnsbury, VT

St. Johnsbury IDDE



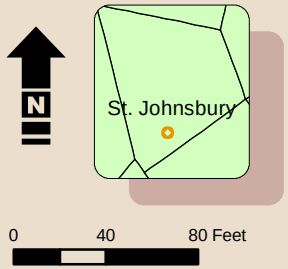
Catchbasin
Stormwater Manhole
Sanitary Manhole
Outfall
Storm line
Sanitary line
Footing drain
Under drain
Stream

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

STONE ENVIRONMENTAL INC

Map SJ-10, System SJ510, CB9 Pipe B Branch St. Johnsbury, VT

St. Johnsbury IDDE



Catchbasin

Sanitary Manhole

Outfall

Storm line

Sanitary line

Footing drain

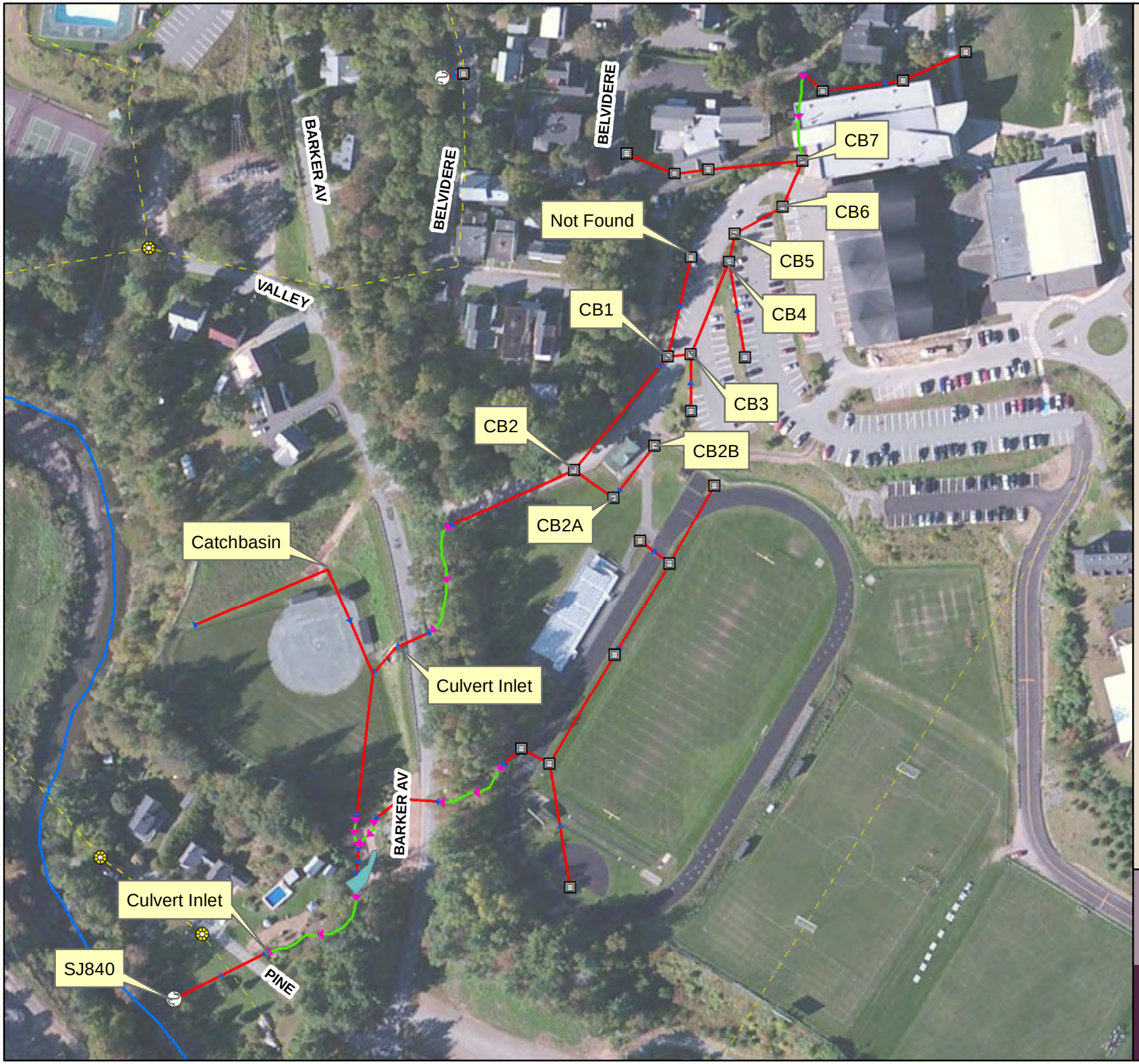
Stream

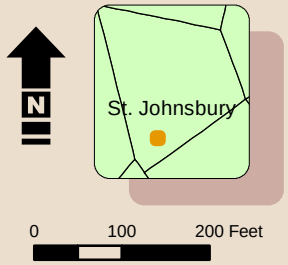
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-11
System SJ670
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Sanitary Manhole

Outfall

Storm line

Sanitary line

Swale

Stream

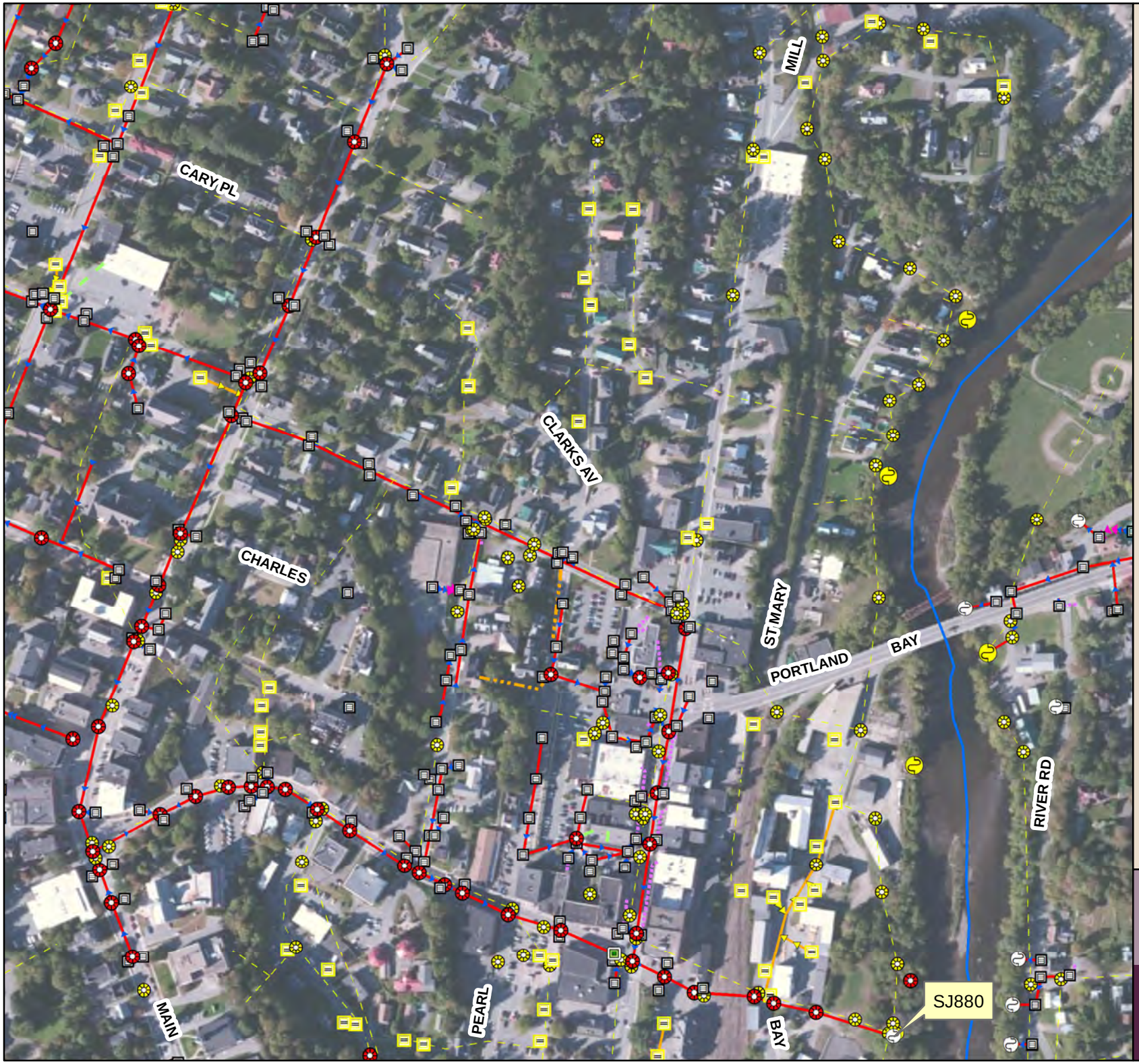
Retention Pond

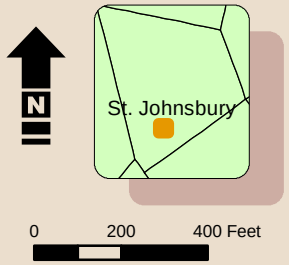
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-12
System SJ840
St. Johnsbury, VT

St. Johnsbury IDDE





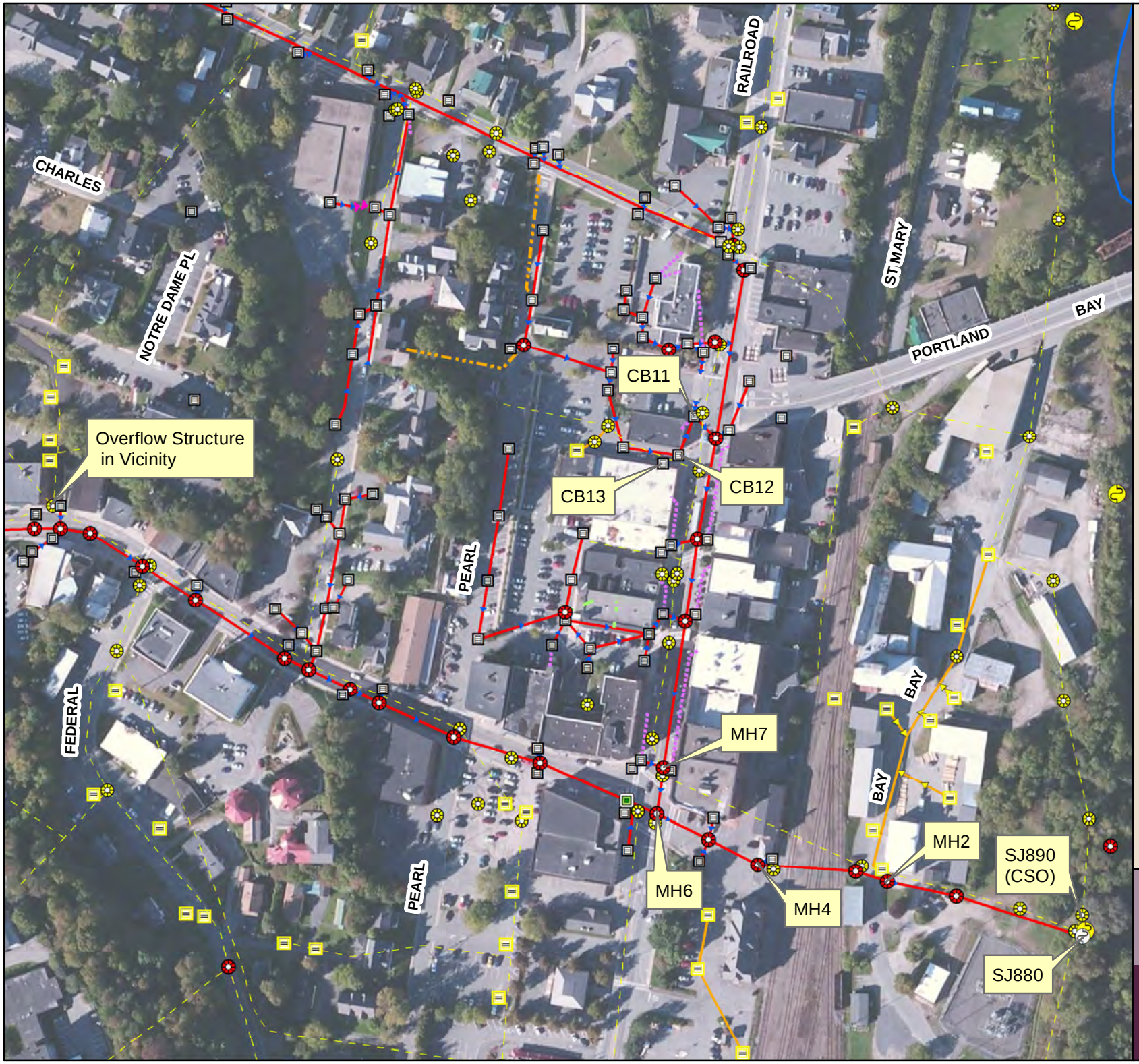
- Catchbasin
- CSO outfall
- Junction Box
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Combined sewer
- Sanitary line
- Swale
- Footing drain
- Under drain
- Roof drain
- Stream

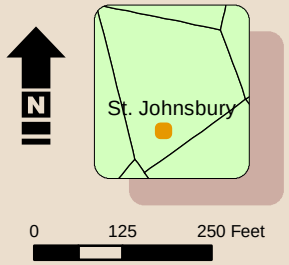
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-13 - Full Extent
System SJ880
St. Johnsbury, VT

St. Johnsbury IDDE





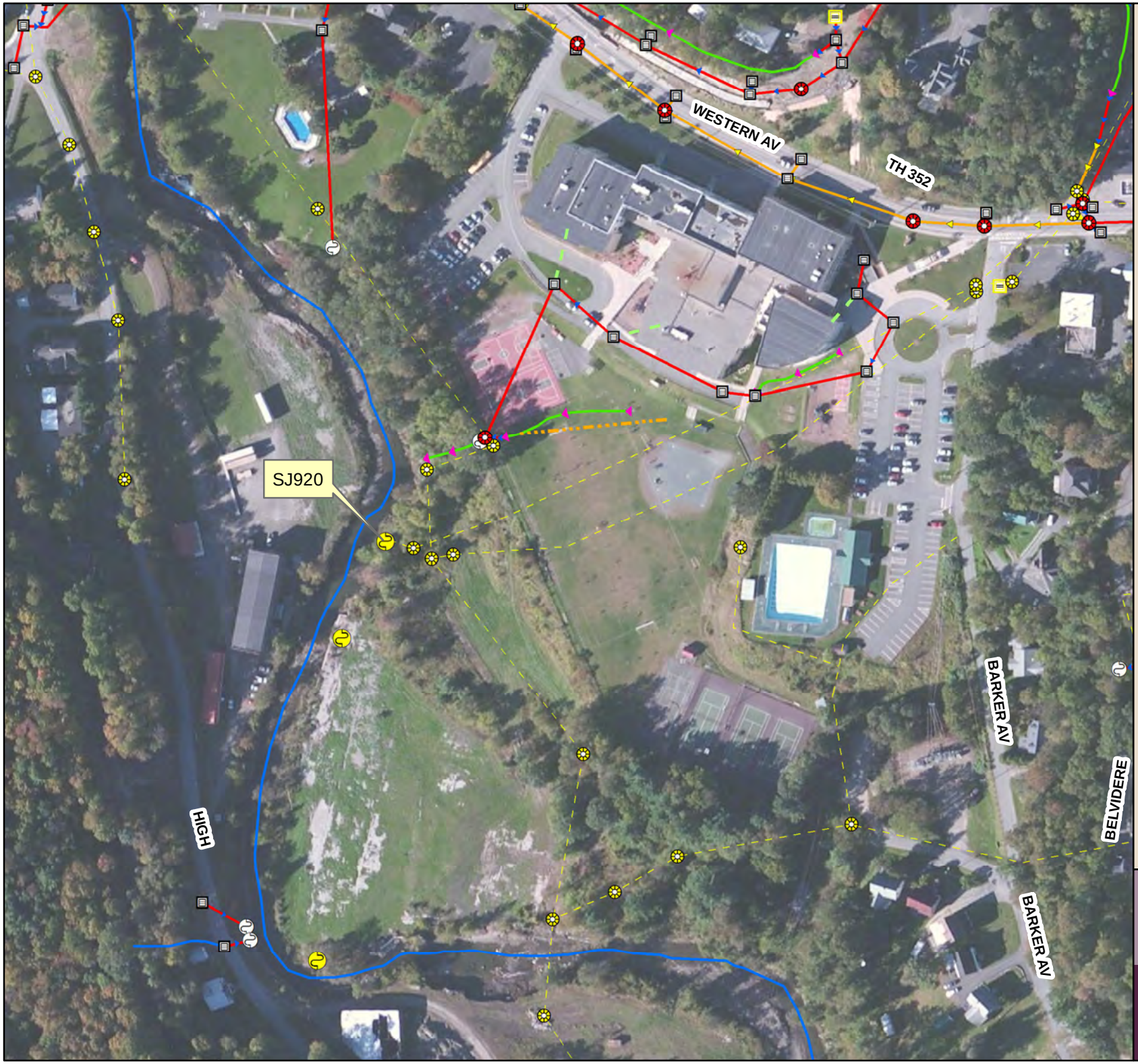
- Catchbasin
- CSO outfall
- Junction Box
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Combined sewer
- Sanitary line
- Swale
- Footing drain
- Under drain
- Roof drain
- Stream

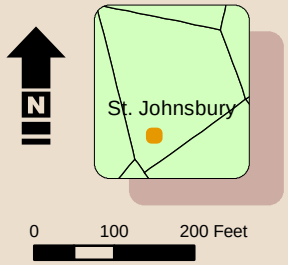
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-14 - Assessed Area
System SJ880
St. Johnsbury, VT

St. Johnsbury IDDE





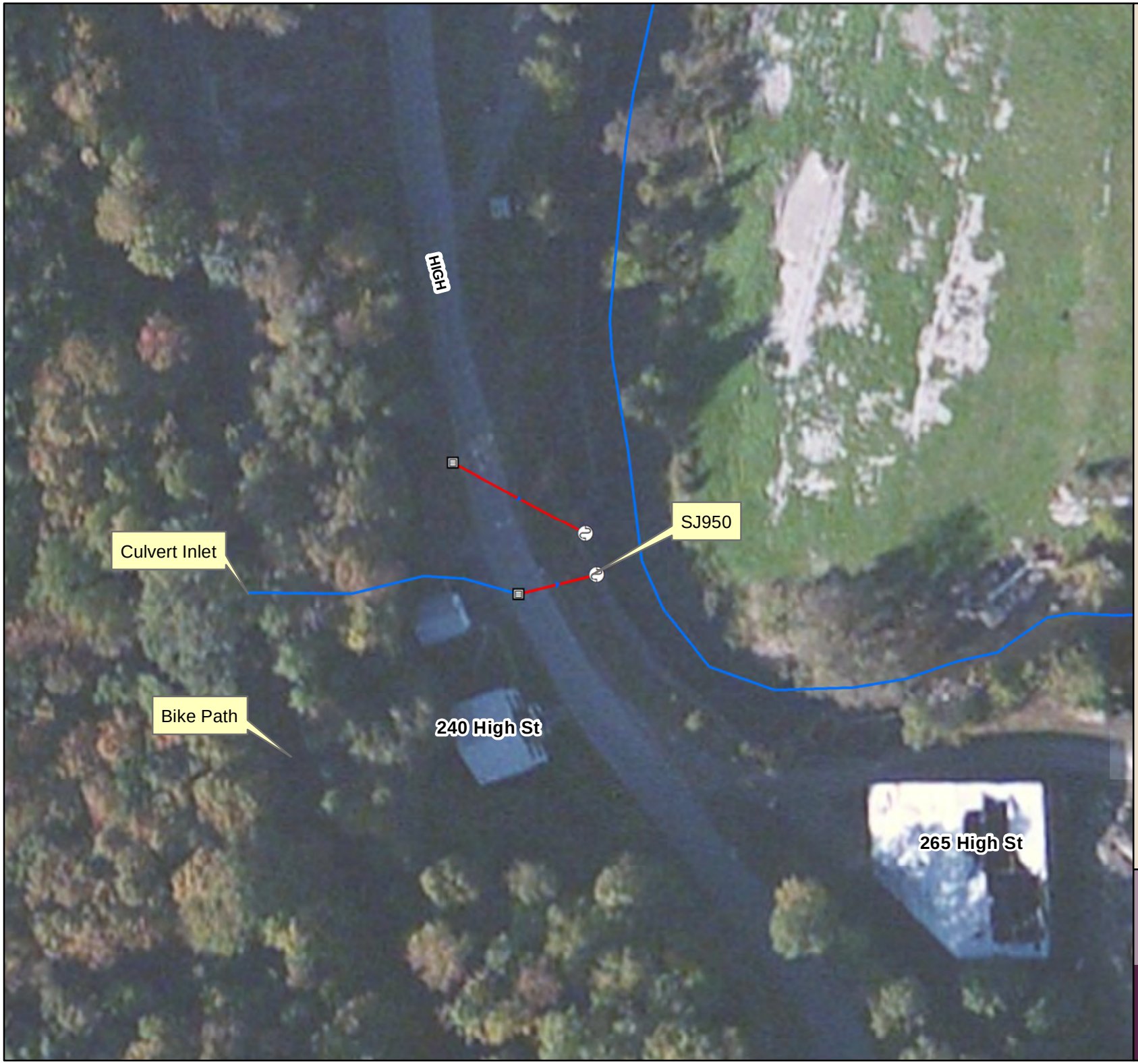
- Catchbasin
- CSO outfall
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Combined sewer
- Sanitary line
- Swale
- Under drain
- Roof drain
- Stream

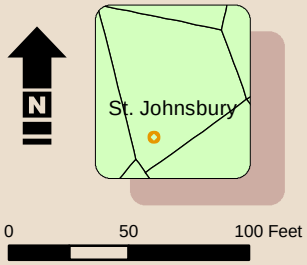
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-15
System SJ920
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Outfall

Storm line

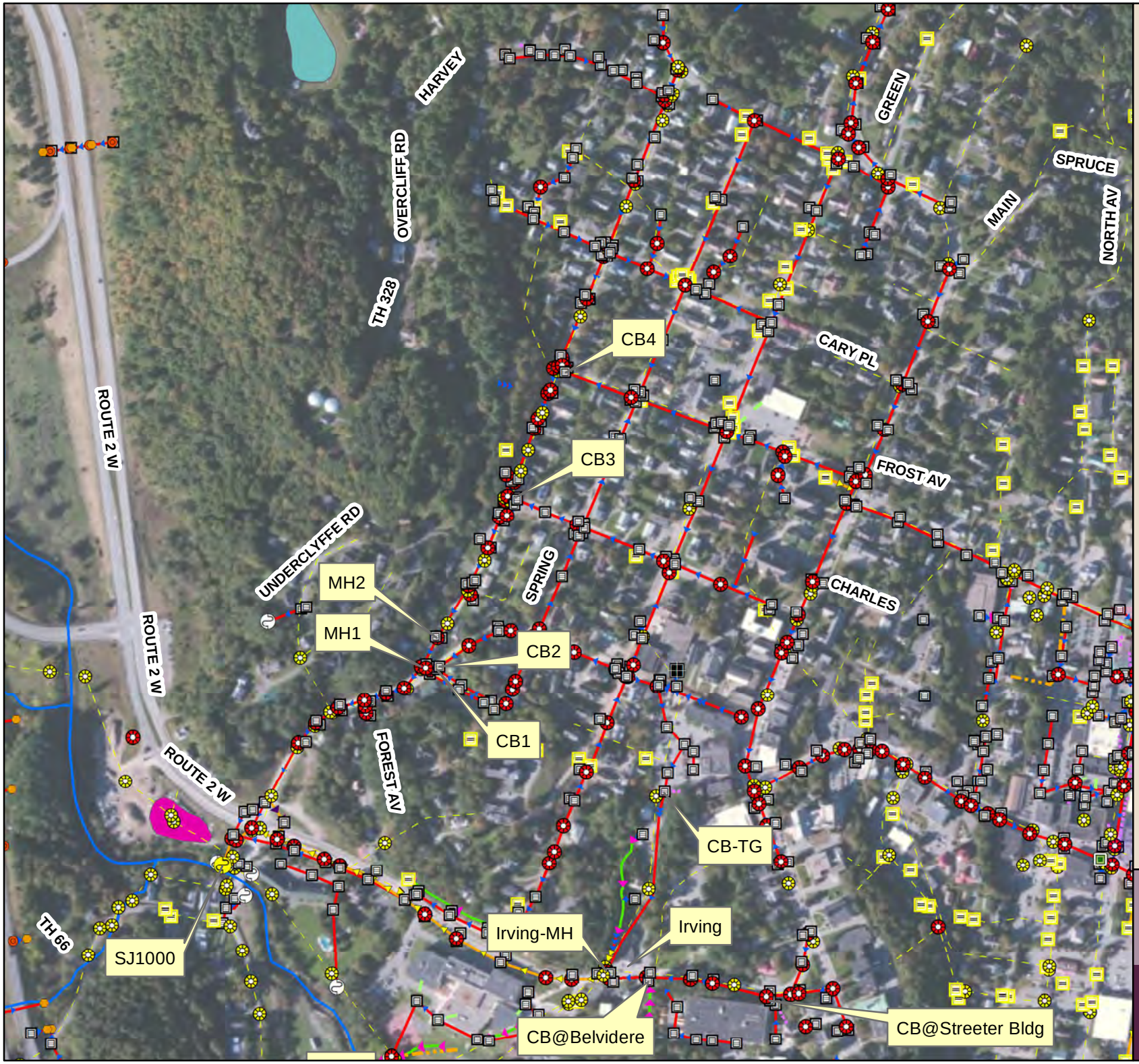
Stream

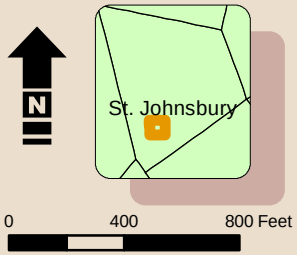
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-16
System SJ950
St. Johnsbury, VT

St. Johnsbury IDDE





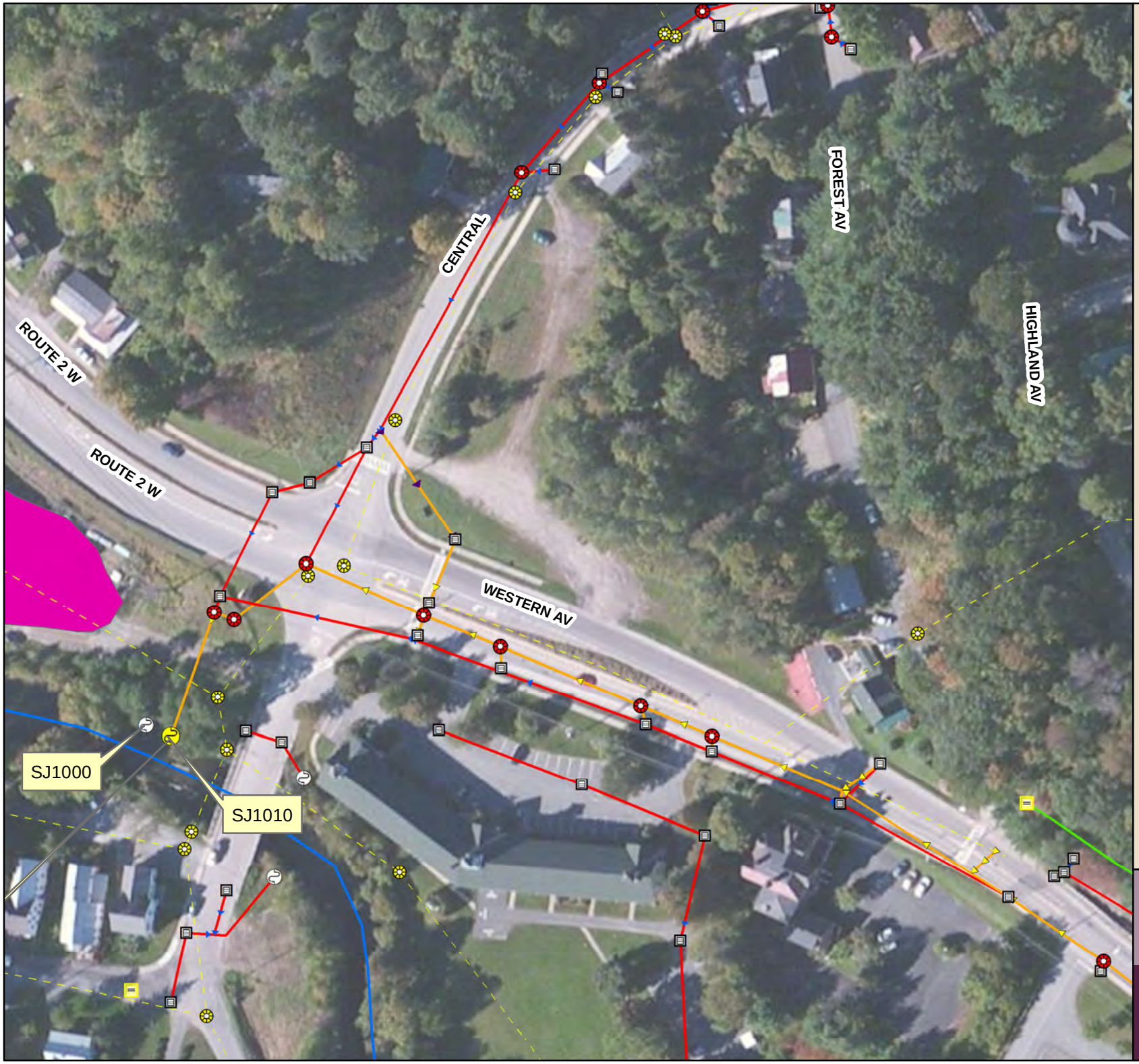
- Catchbasin
- CSO outfall
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Junction Box
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Combined sewer
- Sanitary line
- Swale
- Footing drain
- Under drain
- Roof drain
- Stream
- Retention Pond
- Proposed Treatment Area

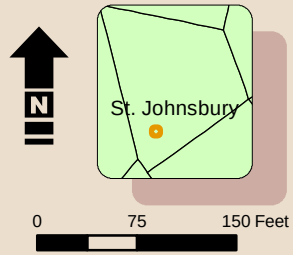
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-17 - Full Extent
System SJ1000
St. Johnsbury, VT

St. Johnsbury IDDE





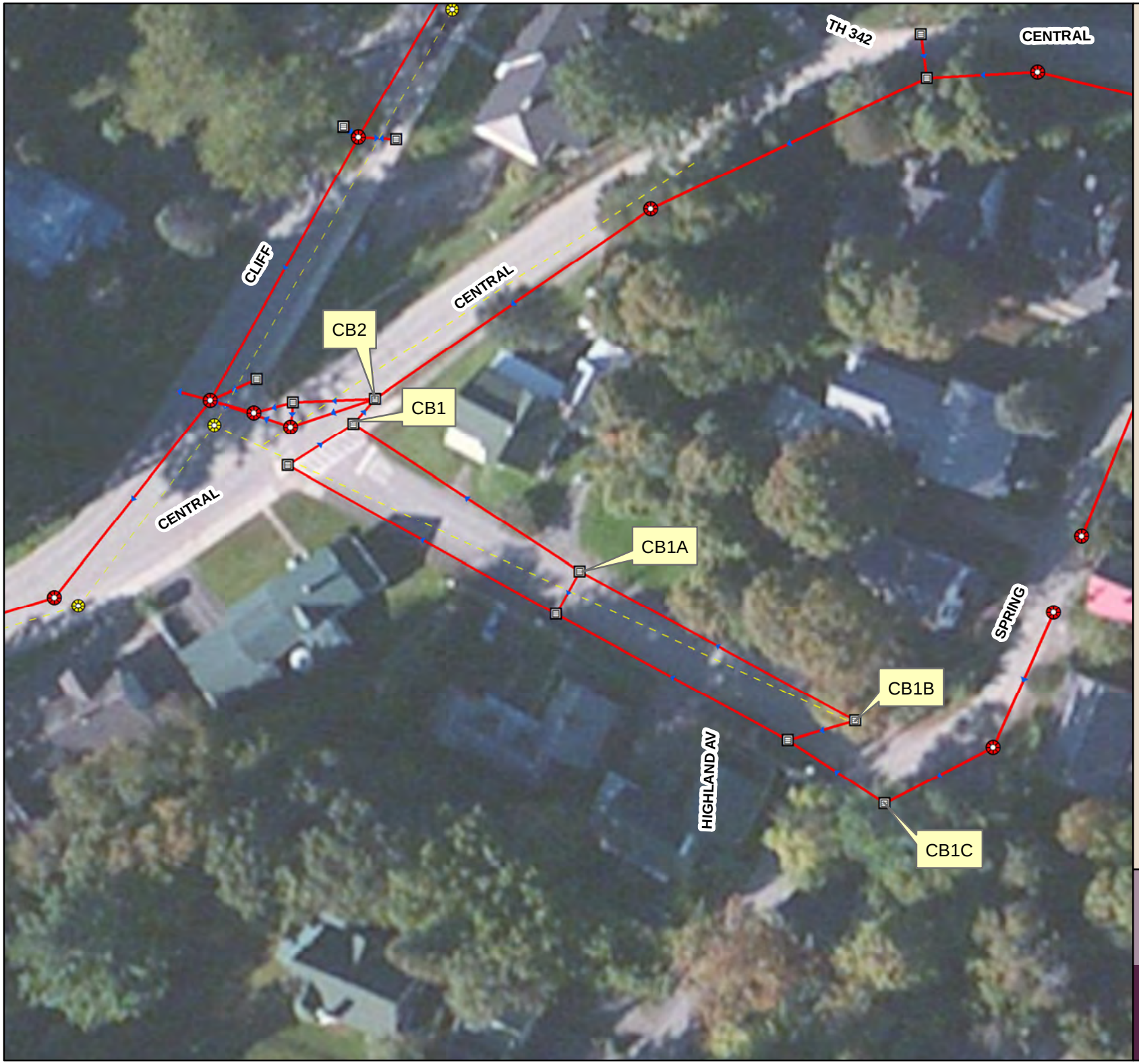
- Catchbasin
- CSO outfall
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Combined sewer
- Sanitary line
- Swale
- Stream
- Proposed Treatment Area

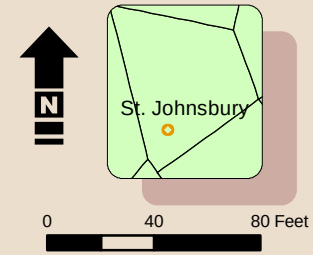
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-18 - Outfall Systems SJ1000 and SJ1010 St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Stormwater Manhole

Sanitary Manhole

Storm line

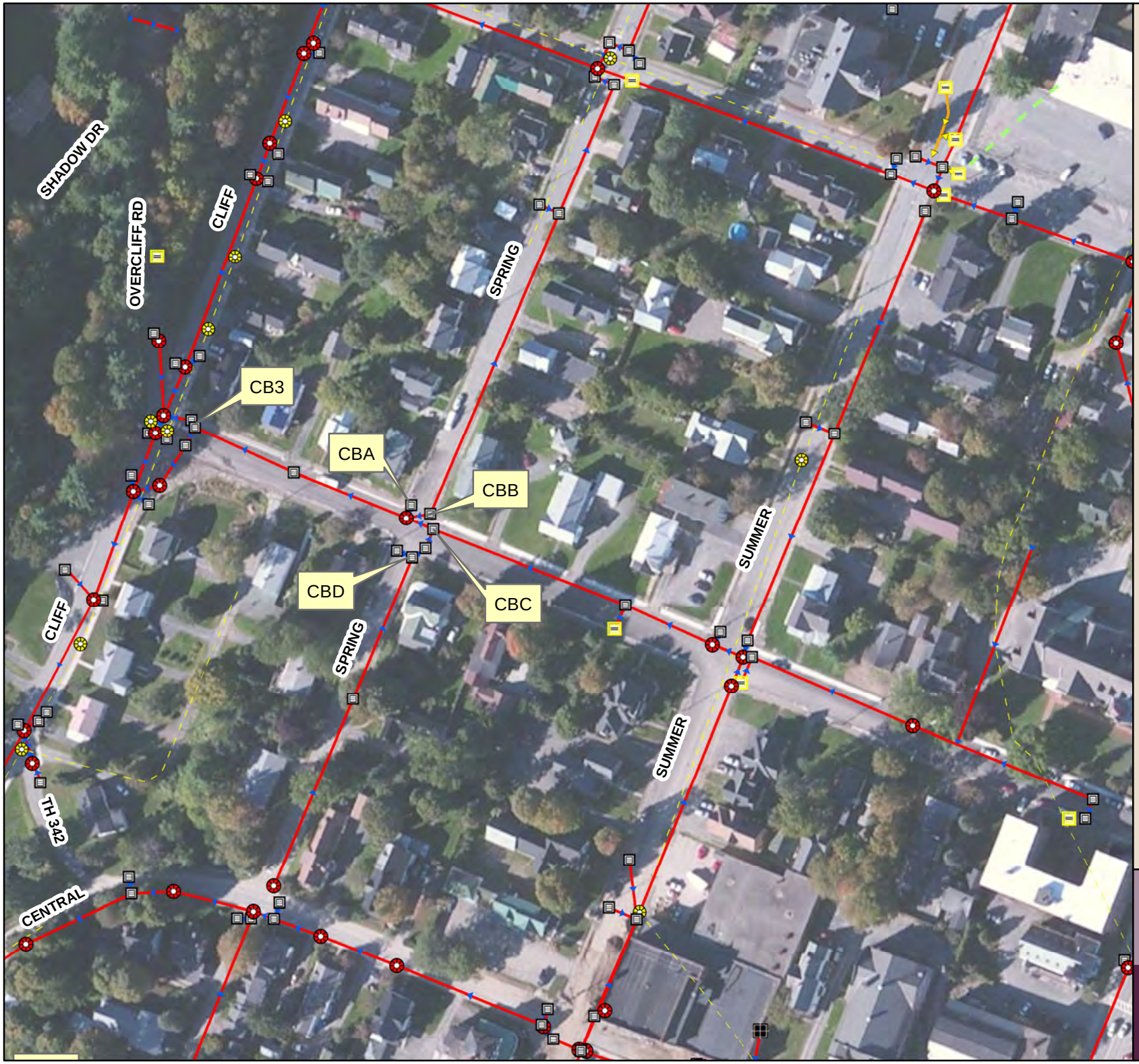
Sanitary line

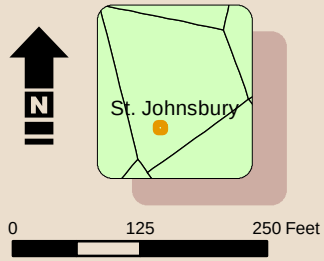
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-19 - Branch CB1
Systems SJ1000
St. Johnsbury, VT

St. Johnsbury IDDE





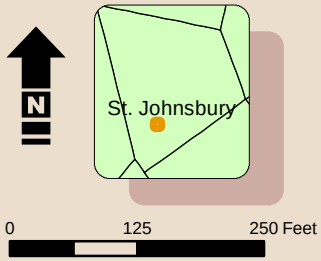
- Catchbasin
- Drop Inlet
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Storm line
- Combined sewer
- Sanitary line
- Roof drain

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

STONE ENVIRONMENTAL INC

Map SJ-20 - Branch CB3
Systems SJ1000
St. Johnsbury, VT

St. Johnsbury IDDE



Catchbasin

CB tied to sanitary sewer

Stormwater Manhole

Sanitary Manhole

Storm line

Combined sewer

Sanitary line

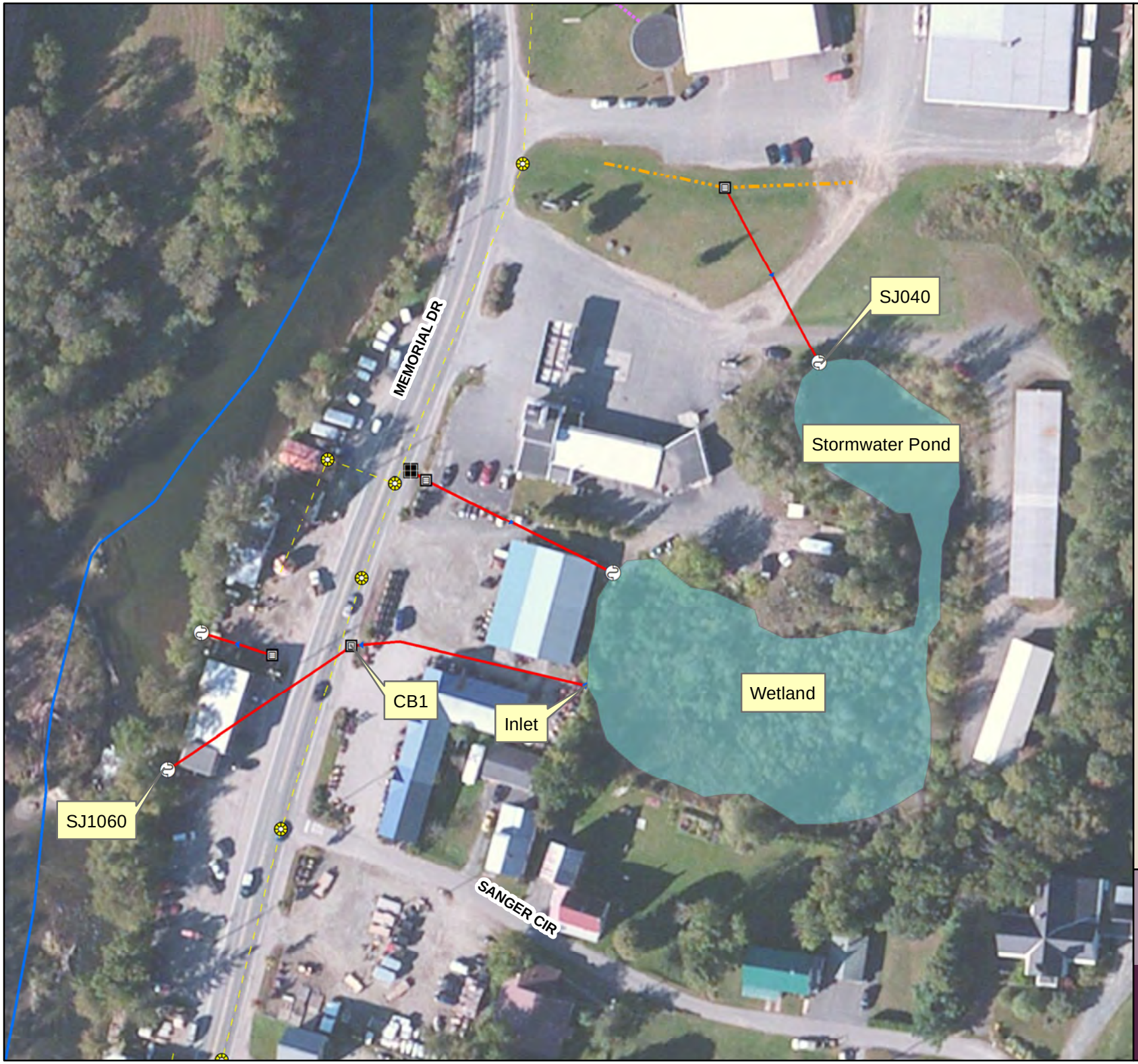
Roof drain

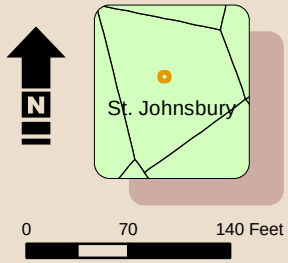
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-21 - Branch CB4
Systems SJ1000
St. Johnsbury, VT

St. Johnsbury IDDE





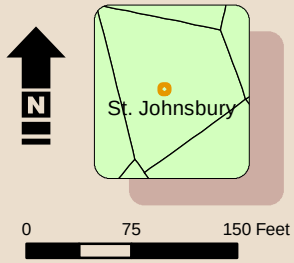
- Catchbasin
- Drop Inlet
- Sanitary Manhole
- Outfall
- Storm line
- Sanitary line
- Footing drain
- Under drain
- Stream
- Retention Pond

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

STONE ENVIRONMENTAL INC

Map SJ-22
System SJ1060
St. Johnsbury, VT

St. Johnsbury IDDE



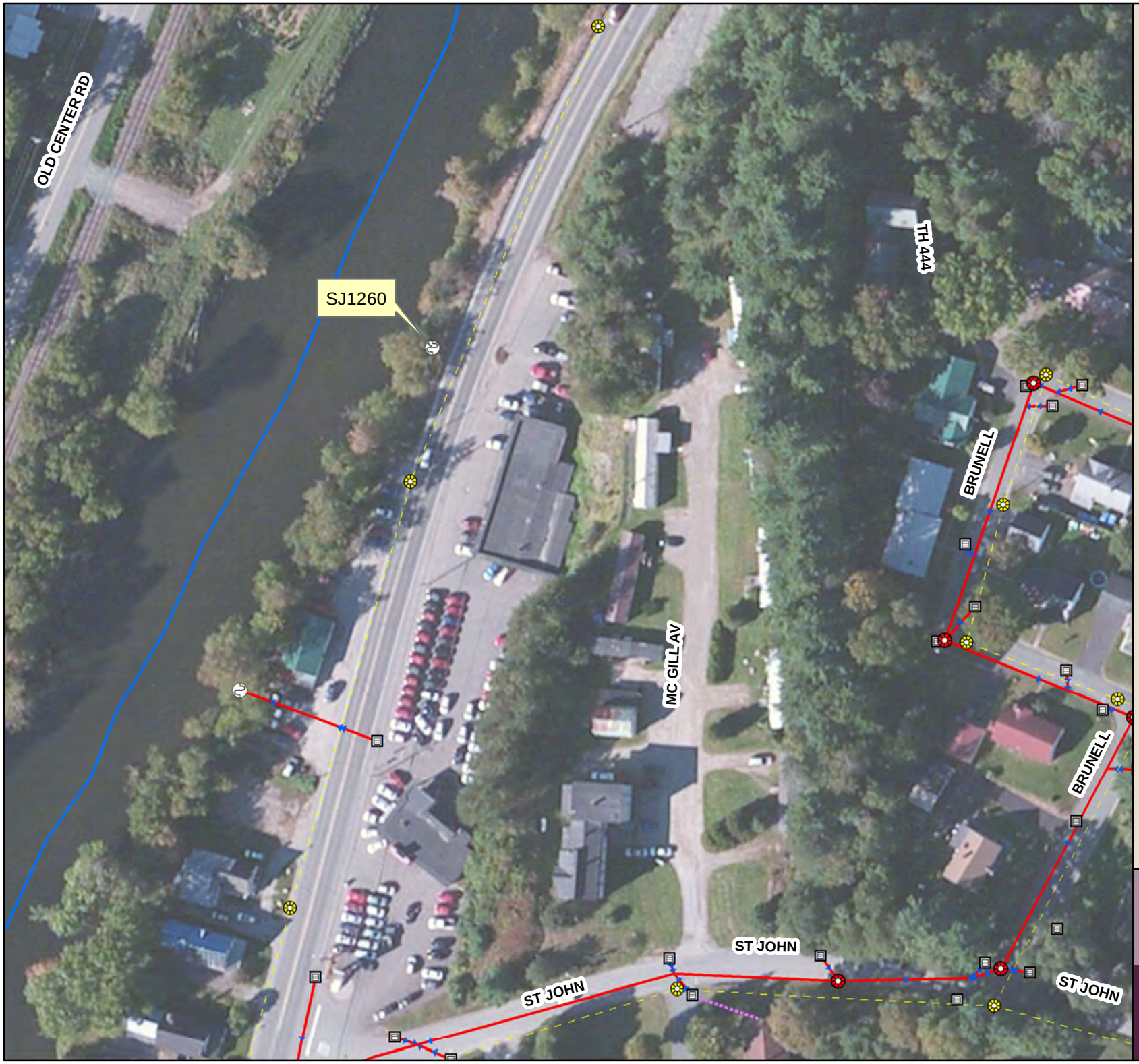
Catchbasin
Culvert inlet
Stormwater Manhole
Sanitary Manhole
Outfall
Storm line
Sanitary line
Swale
Stream

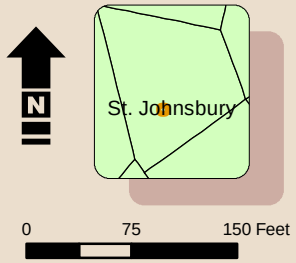
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-23
System SJ1140
St. Johnsbury, VT

St. Johnsbury IDDE





Catchbasin

Stormwater Manhole

Sanitary Manhole

Outfall

Storm line

Sanitary line

Footing drain

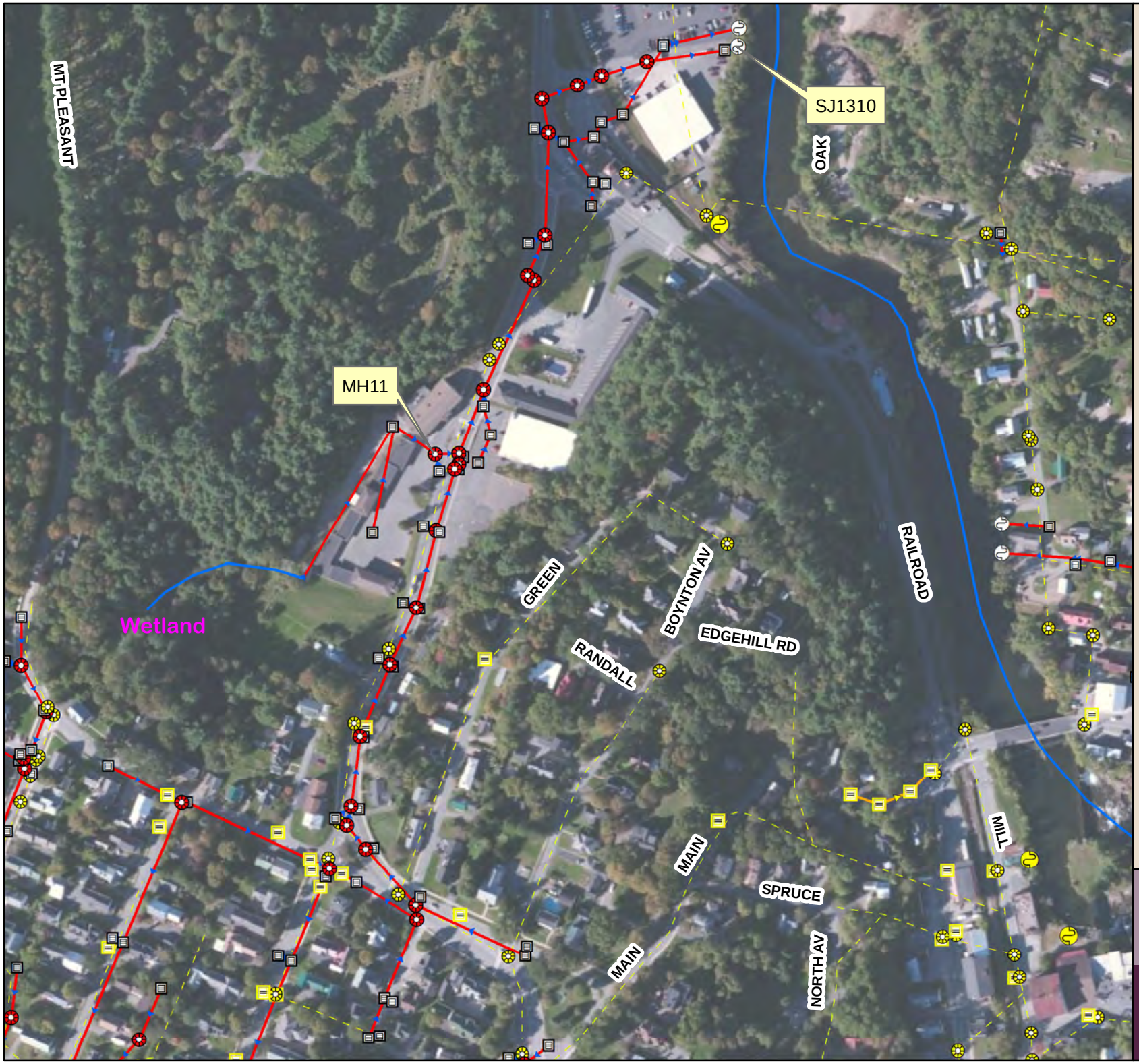
Stream

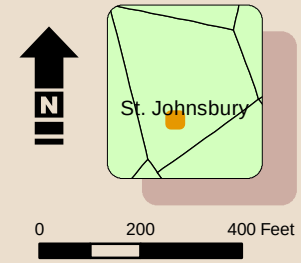
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map SJ-24
System SJ1260
St. Johnsbury, VT

St. Johnsbury IDDE





- Catchbasin
- CSO outfall
- CB tied to sanitary sewer
- Stormwater Manhole
- Sanitary Manhole
- Outfall
- Storm line
- Combined sewer
- Sanitary line
- Stream

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

STONE ENVIRONMENTAL INC

Map SJ-25
System SJ1310
St. Johnsbury, VT

St. Johnsbury IDDE

APPENDIX E: TOWN OF ST. JOHNSBURY LETTER TO KINGDOM CLEANERS

TOWN OF ST. JOHNSBURY
Town Manager Office
51 Depot Square, Suite 3
St. Johnsbury, VT 05819
802-748-3926

Kingdom Cleaners
767 Concord Avenue
St Johnsbury, VT 05819

August 14, 2015

To whom it may concern:

Over the past year, a private firm (Stone Environmental, Inc.), working in cooperation with the Town of St. Johnsbury under a grant from the Vermont Department of Environmental Conservation, has been performing water quality testing of stormwater drainage systems in St. Johnsbury. Their results indicate contamination of a stormwater catch basin located on Lafayette Street near your Concord Avenue facility (see map Page 2). We are concerned that washwater may have been drained from a Kingdom Cleaners fleet vehicle into this catch basin. The Town of St. Johnsbury is writing to you to inform you of these findings and to insist that Kingdom Cleaners not cause washwater or other materials to be discharged to this or any other catch basin in St. Johnsbury. Henceforth, any suspected washwater discharge from your activities to the stormwater drainage system will be referred to the Department of Environmental Conservation. Discharge of washwater or other materials to this catch basin is prohibited. The catch basin in question is part of a municipal stormwater drainage system. Any waste discharged to this catch basin will flow to the Moose River, not to the Town's wastewater treatment plant.

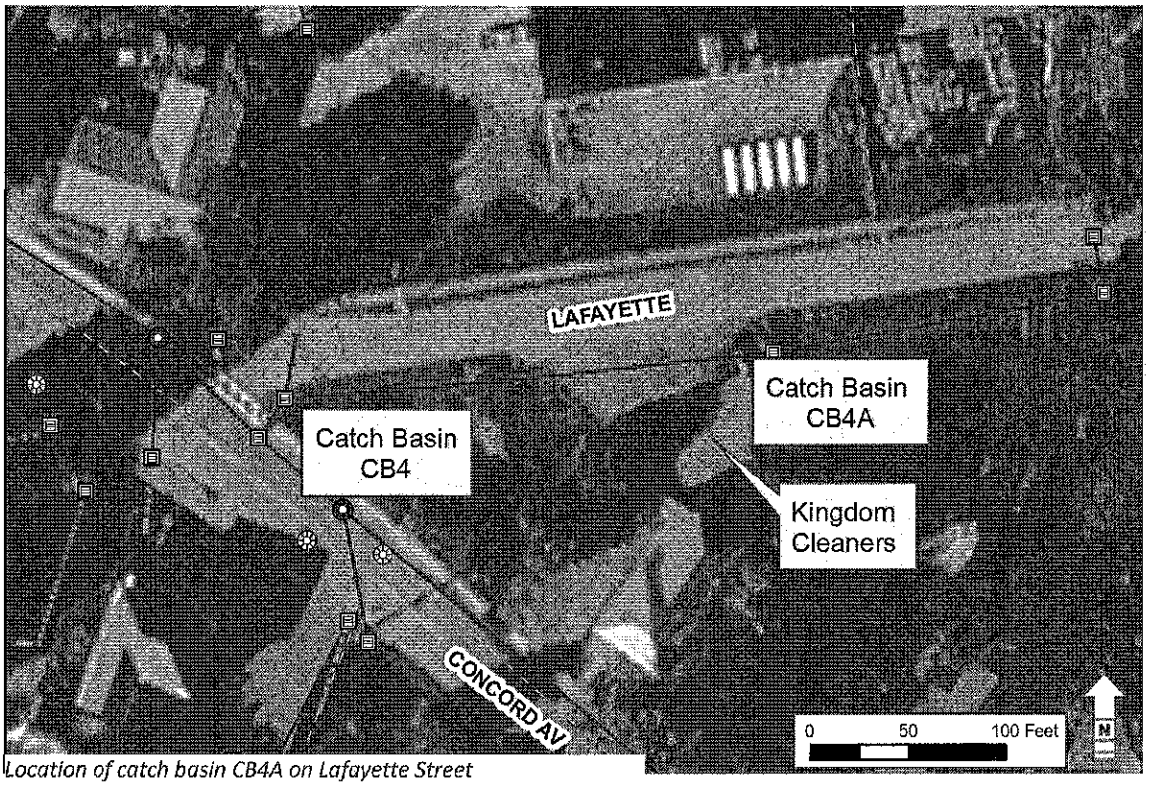
The consultant's relevant findings are summarized below.

- On August 26, 2014 an exceedingly high concentration of detergents (>3.0 mg/L) was measured in catchbasin CB4A on Lafayette Street. The ammonia concentration was moderately high (1.0 mg/L). The water sample appeared cloudy, had an offensive odor, and foamed when shaken. Foreign debris was present on the catch basin grate. The suspected source of these contaminants was washwater dumping from a Kingdom Cleaners vehicle to the catchbasin. A Kingdom Cleaners vehicle is often parked near the catchbasin.
- On October 30, 2014, detergent suds were observed in the catchbasin and lint and fibers were again found on the grate (see photograph Page 2). These observations are consistent with washwater dumping to the catchbasin.
- On a third visit, May 25, 2015, there were no signs of washwater dumping.

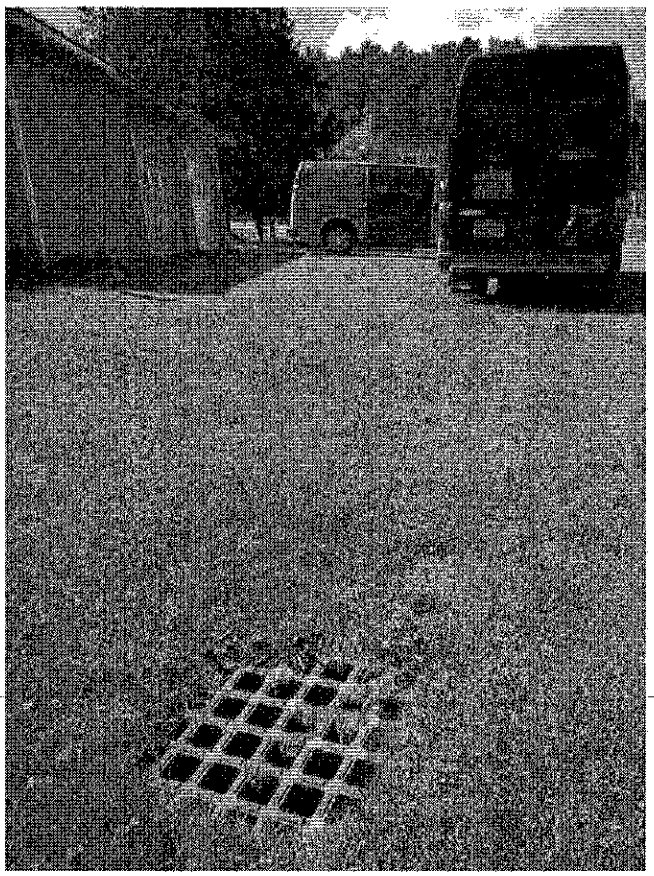
If you have any questions, please contact me at 748-3926

Sincerely,
Town of St Johnsbury

Chad L. Whitehead, PE
Town Manager



Location of catch basin CB4A on Lafayette Street



Catch basin CB4A on Lafayette Street showing debris caught on the grate