2019 REPORT – CITY OF ST. ALBANS – ILLICIT DISCHARGE DETECTION AND ELIMINATION STUDY

ST. ALBANS, VERMONT

Progress Report

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City and Town of St. Albans Illicit Discharge Detection and Elimination (IDDE) Study Final Report, *Watershed Consulting Associates, LLC (2012)*

Missisquoi River Basin Advanced Illicit Discharge Detection and Elimination (IDDE) Study FINAL REPORT, *Aldrich + Elliott, PC & Stone Environmental (2014)*

1 INTRODUCTION

In Fall, 2017, Watershed Consulting Associates, LLC (Watershed) was awarded a contract with the City of St. Albans to conduct Illicit Discharge Detection and Elimination (IDDE) work on a selection stormwater outfalls. This work involved initially reviewing the results of studies performed in: 2007 (Vermont Department of Environmental Conservation), 2012 (Watershed Consulting, with Center for Watershed Protection working on a grant awarded by VT DEC) and 2014 (Aldrich + Elliott, PC, with Stone Environmental working on a grant awarded by VT DEC).

Watershed completed the 2018 field season and submitted a progress report in December 2018. During the 2018 field season a number of outfalls were investigated, and many were resolved as to the possibility of illicit discharge. However, a number of outfalls were not investigated as the field season drew to a close and winter conditions did not allow for efficient or effective field work. During the early part of 2019, these outfalls were investigated to the extent that they could be given the limited scope of the original contract. This progress report describes the investigations performed at those outfalls and all results (preliminary or final) associated with each of them.

In 2019, Watershed performed the following work and reached the following conclusions:

- Outfall 14: A 2007 optical brightener study resulted in a suspected washwater source of illicit discharge to this outfall. It was decided that additional water quality bracketing needed to be conducted on this system. In 2018 sampling was conducted on the outfall only and was flagged for follow up due to high E. *coli* concentrations. Work resumed in 2019 and water quality sampling was conducted on 8-14-2019 in five locations. The highest *E. coli* concentration was measured at the outfall. This indicated that a possible illicit discharge is occurring below the first sampling location at the intersection of Bishop St and Lincoln Ave. Smoke testing was then conducted from multiple locations below the Bishop St and Lincoln Ave intersection and a smoke alarm was heard going off in a house between Fairfield St and Ferris St. A second round of smoke testing was conducted between Fairfield St and Ferris St in early 2020 and no crossover was observed. Homeowner outreach should be conducted in order to facilitate dye testing and a camera inspection within this area. This should be investigated further under an additional scope of work. Of note regarding this outfall – there is potentially an old stone block sewer on Lincoln Avenue that may be allowing sanitary sewage to enter the stormwater system. The City has conducted some work on this issue in the past but may not have resolved the issue fully.
- Outfall 15: The 2012 report concluded that results seen at this outfall could potentially be due to farm field runoff. As a result, no follow-up was conducted in 2014. Based on these results, Watershed Consulting and the City of St Albans made this system a lower priority for investigation using Environmental Canine Services (ECS) Ship and Sniff testing (see Methods for explanation of this investigation technique). This system was tested using typical water quality parameters and ECS testing. Additionally, Watershed tested Stevens Brook at five different locations using ECS Ship and Sniff testing. Results from the outfall, as well as one upstream manhole tested, came back positive for sewage, as did three of the five stream samples. It is not known at this time what the source of the sewage to the outfall could be, nor is the precise source of sewage to the stream known. This outfall should be investigated further under an additional scope of work.
- Outfall 16: This outfall was found to have a cross-tie with the sanitary sewer at the intersection of Hudson St and Main St. This cross tie was supposedly fixed after its discovery. Watershed did not complete any testing on this outfall in 2019 however, water quality sampling was conducted in early 2020. The outfall was retested and found to have a very high *E. coli* concentration. MBAS

levels were also found to be elevated at this time. During a follow up visit, the closest downstream infrastructure from the "fixed" dross-tie was tested and found to have a very high MBAS concentration (*E. coli* levels were below detection). It is suspected that there is still an illicit discharge to this system. Recommended follow up work includes: a camera inspection for the Hudson and Main St connection, water quality bracketing in the area of the suspected cross-tie, and smoke and dye testing to locate the exact source. This should be investigated further under an additional scope of work.

- Outfall 29 / 29.1: Smoke and dye testing was conducted in this system with no crossover observed. It is suspected that elevated detergent levels in the parking lot catchbasins are due to backflow from Stevens Brook. Watershed does not believe there to be an illicit discharge to these outfalls and considers these outfalls to be resolved.
- Outfall 37: Extensive smoke testing was conducted at this outfall in 2018 and one potential illicit discharge discovered there. The City installed a temporary disconnect on this outfall as a result. The outfall was to be retested but the outfall was backwatered from Stevens Brook in an early 2020 visit. Samples were taken from the nearest upstream catchbasin and results from the water quality sampling indicate that there is no longer an issue with this system. Watershed considers this outfall to be resolved.
- Outfall 38: Located on Aldis Street, south of the Public Works facility. Water quality results from 2018 outfall sampling were inconclusive, though ECS canines did alert on the sample sent. This outfall was smoked tested in early 2019 from two different points on the storm system. No smoke was observed crossing over into the sanitary sewer system. Smoke testing was not conducted from the sanitary sewer to the storm sewer, however the potential for crossover seems unlikely. It is possible that ECS canines alerted on the sample sent as it contained backwater from Stevens Brook. Watershed does not believe there to be an illicit discharge to this outfall and considers this outfall resolved.
- Outfall 40: The system associated with this outfall is relatively small and residential. As a result, it was decided that smoke testing would be the most efficient follow up method. This should be conducted under an additional scope of work.
- Outfall 46: It was decided that water quality sampling at this outfall would be the best way to proceed. However, obtaining a sample from the outfall was infeasible in 2018 given that that outfall pipe was partially buried in sediment and backwatered by Stevens Brook. Upstream sampling was not possible due to a lack of flow. As a result, smoke testing was conducted in early 2019. No smoke was observed crossing over between storm and sanitary sewers, indicating that there is little likelihood of an illicit discharge at this outfall. Watershed considers this outfall to be resolved.

Table 1: Summary of Assessments by Outfall

Outfall	Location	Summary
Outfall 14	Lincoln Avenue	Not Resolved - Needs dye testing and camera inspection.
Outfall 15	Upper Welden Street / Main Street	Not Resolved - Canine results indicate possible illicit discharge. Other WQ results not conclusive.
Outfall 16	Upper Welden Street / Main Street	Not Resolved - Needs camera inspection, water quality bracketing, and smoke and dye testing.

Outfall 29 / 29.1	Lower Welden Street	Resolved by Smoke and Dye Testing. No illicit discharge.
Outfall 37	Pearl Street	Resolved by Temporary Disconnect.
Outfall 38	Aldis Street	Resolved by Smoke Testing. No illicit discharge.
Outfall 40	Four Winds Apts	Not Resolved - Needs smoke testing.
Outfall 46	Lake Street	Resolved by Smoke Testing. No illicit discharge.

2 METHODS

Our general methodology for this study follows the protocols and recommendations established by the Center for Watershed Protection (CWP), as well as additional guidelines developed over the course of several other studies by the Vermont Department of Environmental Conservation (VT DEC).

2.1 Field Work Preparation

Initial preparation for the study involved obtaining the necessary field supplies for sample collection and analysis, creating a digital smartphone-based application for outfall reconnaissance inventory (ORI) and advanced investigation (AI) data collection in the field based on the CWP's ORI field and laboratory forms, and creating storm and sanitary sewer digital base layers to use within the smartphone app based on the most recent mapping performed by the VT DEC under the Stormwater Infrastructure Mapping Program.

A kick-off meeting was held with the City of St. Albans to discuss methodology, access, and data generation.

2.2 Outfall Reconnaissance Inventory – Dry Weather Survey

Note – the methods described for the ORI only apply to systems where additional water quality bracket sampling was performed.

Stormwater systems were assessed during dry weather to minimize dilution by large volumes of runoff. Dry weather was defined as <0.1" precipitation in the previous 24 hours to the maximum extent practicable. There were times during the study when outfalls were assessed when precipitation had marginally exceeded this amount – this was noted in the ORI reports. Surveys during these times were kept to a bare minimum and avoided whenever possible. Outfalls in the public right-of-way or along a water body were accessed via public land. Where portions of the stormwater system were on private land, permission was obtained prior to investigating the system. If access to property was denied, infrastructure within the public right of way was assessed. Where no publicly accessible infrastructure existed, and access denial was noted, the system was not analyzed.

Watershed developed a digital smartphone-based application to use for the collection, storage, analysis, and reporting of survey data. This application, developed using a third-party software platform, is based on the CWP field and laboratory forms merged into one overall interface and accessed in the field using a smartphone or tablet device. An integral part of the creation of this application was the import of all stormwater and sanitary sewer infrastructure points from VT DEC's stormwater infrastructure mapping program. Each of these features was imported into Watershed's app using a code assigned by previous studies. This enabled field staff to quickly find each outfall or other infrastructure point using the phone's built-in GPS. Using these previously-mapped points also ensured the accuracy of each point's geo-location as built-in phone GPS units are only accurate to 3-5 meters where most of the data is sub-meter accurate.

At every outfall point, the basic procedure was to search for the presence or absence of flow. If there was no flow during dry weather, it was generally assumed that there was no chronic illicit discharge present unless other non-flow-based indicators such as outfall damage, deposits or stains, abnormal vegetation, poor pool quality, or pipe benthic growth were noted. If these indicators were not present, basic date and time information was entered into the application, along with a 'No' for flow and non-flow-based indicators, and the outfall was assigned an overall characterization of 'Unlikely'.

If flow was present, immediate analysis for temperature, pH, specific conductance, and ammonia was conducted in the field. Other indicators, such as color, odor, turbidity, and floatables were noted as well. If any indicators were above established thresholds (see Table 2), a further sample was taken for analysis later that day for total chlorine (if applicable, and depending on methylene blue active substances (MBAS) - a detergent indicator).

In cases where other non-flow based indicators (listed above) were present, or a sample was not otherwise able to be obtained from a flow or pool, a cotton pad was placed in the line of assumed flow to capture intermittent discharges and analyze them for the presence of optical brighteners. Watershed used this technique sparingly, as most outfalls, or other infrastructure, had adequate flow or a pool to sample from and the water could be analyzed for MBAS.

Additionally, Watershed noted any non-IDDE issues at the outfall or structure such as erosion, structure damage, headwall collapses, etc.

2.3 Water Quality Analysis Methods

Temperature/pH/Specific Conductance:
The Hannah Instruments HI98129 Combo pH and EC meter was used for all three parameters. Fresh pH and conductivity buffers were ordered at the beginning of the study from Endyne Labs in Williston, VT to ensure accuracy using standard solutions at known specific conductivity ranges.

Ammonia:
Ammonia was measured immediately in the field using the LaMotte Colorimeter 1200 (Model 3680-01). This unit uses Nessler's reagent for the detection of ammonia using a color reaction that is measured by the colorimeter. The range is 0-5ppm/0.05ppm NH_3-N. Fresh reagents were maintained throughout the course of the study.

Methylene Blue Active Substances (MBAS):
The presence of detergents was determined using the Chemetrics R-9400 Detergents test which used a methylene blue active substances (MBAS) test, a method consistent with APHA Standard Methods, 21st ed., Method 5540 C (2005).

Total Chlorine:
Total chlorine was measured using the Hach Model CN66 Chlorine – Free and Total Color Disk Kit with a 0-3.5 mg/L range. This kit uses a powdered DPD reagent method and visual color wheel to quickly and accurately determine total chlorine concentration in samples.

Optical Brighteners:
Where indicated, Watershed used cotton pads placed either in the potential flow path of water at the outfall or in the sump of a catchbasin where flow was anticipated. These pads were allowed to sit for a period of 4-10 days and were encased in a plastic-coated wire mesh pouch. After this period, pads were retrieved, rinsed, and dried, then exposed to an ultraviolet (UV) light. If detergents are present, the pad will fluoresce to varying degrees under UV light. Watershed did not attempt to make measurements of the relative amount of fluorescence – this test was only for presence or absence. However, fouling with other debris and dirt often made reading results difficult. In most cases where there was generally reliable flow or pooled water in the catchbasin sump, the MBAS test was used. Some studies have indicated that it takes a relatively high concentration of optical brighteners to cause a pad to fluoresce under UV light (up to 50 mg/L), while the MBAS test is reliable ranging from 0 – 3 ppm. For this reason, we tended to use it more frequently.

2.4 Advanced Investigation Methods

Using water quality thresholds established by the CWP and used by the US Environmental Protection Agency in their IDDE guidance, as well as thresholds referenced in other studies performed throughout Vermont on IDDE (Table 2), outfalls were designated for follow-up investigation based on exceedance of these thresholds. In addition to these chemical benchmarks, other criteria such as outfall damage, deposits or stains, abnormal vegetation, poor pool quality, or pipe benthic growth, as well as water color, odor, turbidity, or the presence of floatables were used to supplement assessments.

Follow-up investigation consists primarily of following any observed flow up a stormline to pin-point its source, then testing that source using the aforementioned thresholds. If multiple sources were observed coming into a main line, those sources were tested as well to attempt to bracket possible pollution inputs. Where possible, a section of a stormline was isolated as possibly containing the origin point of pollution.

Table 2: Water quality threshold values for determining possibility and nature of illicit discharges.

Test	Threshold (US EPA)	Theshold (VT Specific Studies)	Notes
E. coli (MPN/100ml)	235	400	Wastewater (undiluted) will have levels far exceeding 400 MPN. However E. coli can occur due to animal waste entering the storm system though open catch basins. Additionally, there is some evidence which indicates that E. coli populations can survive in anaerobic sediment conditions found in streams, ponds, or other similar environments. E. coli is a difficult indicator to use in IDDE for these reasons.
Ammonia (mg/L)	0.1	0.25	Ammonia is an indicator of decompostion of organic matter. Decomposing landscaping vegetation within catch basins under anoxic conditions can cause elevated ammonia in water. This can cause misleading results. The threshold of 0.25 mg/L is only used when other indicators are present. Othewise a value of 0.5 mg/L is the trigger for additional investigation.
MBAS (mg/L)	0.25	0.2	Anionic detergents are fairly commonly found at outfalls in low-flow conditions found during dry weather as they correlate with various outdoor washing practices (of cars, house siding, windows, and also windshield washing fluid). Higher levels (typically 0.5-0.75 mg/L or greater) can sometimes indicate wastewater discharges.
Optical Brightener	N/A	Presence	Presence of optical brighteners can indicate washwater or wastewater contaminants as brighteners are contained in some hair conditions, bleached paper products, and laundry detergents. Petroleum products will also cause fluorescence. Some studies indicate that a relatively high concentration of OB must be present for detection. We only use this test when other indicators are strongly present.
Chlorine (mg/L)	N/A	0.06	This test is used only in municipalities where municipal water is provided and chlorinated. This test was used very sparingly during this study as few of the towns chlorinated their water. As it degrades in the presence of organic materials, it's not a good wastewater indicator.
Specific Conductance (uS/cm)	>2000	600	Specific conductance can be elevated by road deicing materials, or metals from corrosion. It can help in determining some industrial discharges but is primarily used in conjunction with other strong indicators.

2.4.1 Televising Sanitary and Stormlines:

An additional method to identify illicit discharges is to use either a push or track camera, depending on pipe type and size, to obtain video of pipe cross connections, leaks, or other means by which non-stormwater discharges may be entering storm pipes. This method is most effective when combined with line flushing using dyed water. This method was utilized for outfalls 29/29.1 as part of this study.

2.4.2 Smoke Testing with Vermont Rural Water Association:

Smoke testing using non-toxic liquid smoke was used during this study. The general procedure for smoke testing is as follows:

- Smoke is blown into a manhole or catchbasin structure (storm) and the system is allowed to pressurize with smoke until all (or nearly all in the case of larger systems) are observed emitting smoke.
- Visual observations are made of surrounding sanitary infrastructure (manholes are opened adjacent to the storm infrastructure, building sewer gas vent stacks are scrutinized for smoke escaping, and at times, buildings are entered, with permission, to check for smoke in basements or other areas). This is to check if there are any direct or semi-direct connections between sanitary and storm sewers.
- The test is then conducted in reverse where smoke is blown into sanitary sewer infrastructure and the storm system is inspected, via manholes and catchbasins, for smoke intrusion. Watershed has found this to be one of the most efficient, reliable means of identifying possible illicit discharges, especially when infrastructure is poorly mapped or understood. Smoke testing from sanitary sewer infrastructure also has the benefit of discovering bad or faulty plumbing issues within residences (cracked sewer pipes or other issues that could allow sewer gas to enter homes).

2.4.3 Environmental Canine Services Alerts:

Environmental Canine Services (ECS) uses specially trained canines to detect the presence or absence of sanitary sewage. Watershed has used this method before in Vermont with success. There are two primary methods to use with ECS. The first method is the 'ship and sniff' method where a sample is collected in a sterile plastic Whirl-Pak bag. The outside of the bag is rinsed in distilled water and double-bagged in a resealable plastic bag. These samples are then shipped to ECS in Maine where they are evaluated by the canines and their handlers. A summary report is prepared of the results. If a dog alerts on a sample, that outfall is then flagged for additional follow-up investigation. This method provides a good screening of outfalls that, based on previously measured water quality parameters, may have illicit discharges to them. The second method involves bringing a canine and handler to a storm sewer system and doing on-site field investigations of structures. During the course of this study, field investigation was not used.

3 RESULTS

3.1 Drainage Systems – Resolved

What follows are summaries for drainage systems where the investigation established conclusively an illicit discharge, or other confirmed or plausible explanation for the water quality results seen at the outfall or at other infrastructure within the network. These are the systems that require no further work at this time and should only be checked semi-annually to ensure that no new non-stormwater discharges are present. Each outfall has an associated map on which work is described as well.

3.1.1 Outfall 29 / 29.1

Smoke and dye testing of this system was coordinated with the City of St. Albans and the facilities manager at the Department of Homeland Security and performed in the 2019 field season. Smoke was blown into the storm and sanitary sewer systems in order to observe any potential crossover between the two systems. No smoke was observed at this time.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system. It is our suspicion that elevated detergent levels in the parking lot catchbasins are due to backflow from Stevens Brook.

3.1.2 Outfall 37

NOTE - What follows is the summary from the 2018 Progress Report: No work was performed on this outfall in 2019, though we do believe that additional smoke testing should occur for the part of the system that was not investigated in 2018. See the map for further explanation.

The system leading to Outfall 37, located on Pearl, North Elm, Cedar, and Walnut Streets, was bracket testing to determine if water quality indicators could be used to determine the source of a potential illicit discharge. These results can be seen on the investigation summary map. Water quality samples at the outfall (the nearest adjacent manhole was sampled as the outfall itself was backwatered by Stevens Brook) revealed ammonia at 0.5mg/L, detergents (as MBAS) at 0.5ppm, and E. coli at 550 MPN. Further testing of the system of the system upstream of the outfall was also conducted. One of the of the most suspect results came from SWMH-40, a stormwater manhole at the intersection of Pearl and North Elm Streets from the 'North pipe' (the pipe running north up North Elm Street). Ammonia was very high at 1.94 mg/L, indicating the possible presence of large amounts of decaying organic matter.

During smoke testing, Watershed found smoke coming from a catch basin opposite 67 North Elm Street while blowing smoke into the sanitary sewer from a manhole on lower Pearl Street (noted on the summary map). Watershed then blew smoke from the sanitary manhole directly adjacent to the catch basin - smoke immediately came out of the catch basin rim from the lower pipe in the catch basin. Watershed then cleared the line of smoke and blew smoke into the stormwater sewer from a nearby catch basin. Smoke came in from the upper pipe in the catch basin. The catch basin opposite 67 North Elm Street is tied to both the sanitary and storm sewer. As the pipe to the storm sewer is considerably higher than the pipe to the sanitary sewer, it would require a surcharge from the sanitary sewer of between 5-5.5' to cause sewage to flow into the stormwater sewer. However, this potential discharge should be eliminated as soon as possible.

The City installed a temporary disconnect on this outfall to mitigate the discharge. During a follow up visit in early 2020, Watershed was unable to sample from the outfall as it was backwatered from Stevens Brook. Samples instead were taken from the nearest upstream catchbasin.

Based on the results of this testing, we believe that the illicit discharge has been resolved.

3.1.3 Outfall 38

Smoke testing of this system was performed in May of 2019 from the storm sewer systems in order to observe any potential crossover between the storm and sanitary sewers. Smoke was blown into two different stormwater manholes (indicated on the map). No smoke was observed coming from sanitary sewer vent pipes on adjacent buildings or entering the sanitary sewer pipes. Smoke was not blown into the sanitary sewer system on that day due to time constraints. However, crossover was deemed unlikely based on the smoke blown into the storm system. Additionally, Watershed believes that the water quality results don't necessarily support the potential for an illicit discharge to this system. Typical water quality parameters were low and only the result from ECS canines indicate an illicit discharge. However, that result could be related to backwatering of Outfall 38 by Stevens Brook.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.1.4 Outfall 46

Smoke testing of this system was performed in May of 2019 from both the storm and sanitary sewer systems in order to observe any potential crossover between the two systems. Smoke was blown into two different stormwater manholes (indicated on the map). No smoke was observed coming from sanitary sewer vent pipes on adjacent buildings or entering the sanitary sewer pipes. Smoke was then blown into the sanitary sewer system from a manhole on Spruce Street. No smoke was observed entering the storm sewer system.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.2 Drainage Systems – Unresolved (or Requiring Further Investigation)

3.2.1 Outfall 14

Investigation of this outfall was performed in 2019. Water quality sampling was conducted in five locations in this system and *E. coli* levels were found to be most elevated at the outfall. This indicates that a possible illicit discharge is occurring below the first sampling location at the intersection of Bishop St and Lincoln Ave.

Smoke testing was conducted from multiple locations below the Bishop St and Lincoln Ave intersection and a smoke alarm was heard going off in a house between Fairfield St and Ferris St. A second round of smoke testing was conducted between Fairfield St and Ferris St. No crossover was observed at this time.

We believe that this outfall should be further investigated using dye testing and camera inspections to isolate the illicit discharge. This should be accomplished under a separate scope of work and will require homeowner outreach prior to testing.

3.2.2 Outfall 15

Investigation of this outfall was performed in 2019. Water quality sampling was conducted at the outfall as well as at one upstream manhole (see map for details).

Water Quality Results – Outfall 15:

Flow (CFS)	Temp. (C)	pH	Cond. (uS/cm)	Ammonia (mg/L)	Physical Indicators	E. Coli (MPN)	TP (mg/L)	MBAS (mg/L)	Overall Characterization
.003	6.5	8.28	839	0.18	None	82	.079	.25	Possible

In addition to these results, sampling with ECS canines was conducted. The sample was positive for sewage according to the canine team. However, water quality results do not seem to indicate this. It is possible that the source is very dilute.

Additionally, sampling was conducted at an upstream manhole for Outfall 15.

Water Quality Results – Outfall 15 – SWMH-3:

Flow (CFS)	Temp (C)	pH	Cond. (uS/cm)	Ammonia (mg/L)	Physical Indicators	E. Coli (MPN)	TP (mg/L)	MBAS (mg/L)	Overall Characterization
.003 (from OF-15 data)	6.5 (from OF-15 data)	8.47	637	0.25	None	100	N/A	.25	Possible

ECS testing was also conducted for this structure. The results were positive for sewage.

We believe that this outfall should be further investigated using smoke and/or dye testing to check for potential crossover between the storm and sanitary sewer systems. This work should be accomplished under a separate scope of work.

Additionally, extensive testing of Stevens Brook water was conducted based on discussions with the City of St. Albans as Watershed was informed that part of the City's sewer line was routed underneath the Brook at some point in the past and that may be the source of some discharge to the Brook. However, results from ECS canine testing were inconclusive – while certain samples returned positive results for sewage, there was not a clear pattern (i.e. a point below which all samples were positive and above which all samples were negative). This may indicate that there are multiple sources or that the stream is mixing and/or diluting samples, resulting in inconclusive results from the canines.

We believe that if the City wants to investigate the sewer line under the stream to a greater degree, it would be accomplished using camera investigation, potentially coupled with dye testing. This work should be performed under a separate contract.

3.2.3 Outfall 16

No investigation of this outfall was performed in 2018 or in 2019. The issue was studied in 2014 and found to be a sanitary sewer crosstie into the stormwater sewer at North Main and Hudson Streets. The City of St. Albans was planning to disconnect this tie. No further study of this outfall should occur until this repair occurs as it could mask other potential illicit discharges to the stormwater system. As of 2019, it is not known if this issue has been resolved or not.

3.2.4 Outfall 40

No investigation of this outfall was performed in 2019. The system associated with this outfall is relatively small and residential. As a result, it was decided that smoke testing would be the most efficient follow up method. This should be conducted under an additional scope of work.

4 RECOMMENDATIONS FOR FUTURE ACTION

4.1 Outfall 14

- ❖ Homeowner outreach should be conducted in order to facilitate dye testing and camera inspection to confirm the location of a suspected illicit discharge.

4.2 Outfall 15

- Smoke testing of this outfall should be conducted to determine if prior water quality results were due to an illicit connection or to groundwater flow contaminated with farm field runoff as previously thought.
- The reach of Stevens Brook near Outfall 15 should be investigated using camera and / or dye testing (and potentially a day of field time by the ECS canine field team).

4.3 Outfall 16

- Camera inspection should be completed for the Hudson and Main St connection.
- Water quality bracketing should be completed in area of suspected cross-tie.
- After an approximate area has been identified, smoke test the sanitary and storm lines in this area to locate exact sources.

4.4 Outfall 40

- Smoke testing should be conducted to confirm the location of the suspected illicit discharge.

5 CONCLUSIONS

Of the 7 systems investigated for non-stormwater discharges to the stormwater system in 2019:

- 7 systems were further investigated for illicit discharge (Outfalls 14, 15, 16, 29/29.1, 37, 38, and 46).
- 4 systems were resolved and are considered to have no illicit discharges to the stormwater system (Outfalls 29/29.1, 37, 38, and 46).
- 1 system (Outfall 15) was investigated but a definitive source was not identified (this investigation includes work on Stevens Brook).
- 4 outfalls need to be investigated further (Outfalls 14, 15, 16, and 40).

6 REFERENCES

Brinkmeyer R, Amon RMW, Schwarz JR, Saxton T, Roberts D, Harrison S, Ellis N, Fox J, DiGuardi K, Hochman M, Duan S, Stein R, Elliott C. Distribution and persistence of Escherichia coli and Enterococci in stream bed and bank sediments from two urban streams in Houston, TX. Science of the Total Environment 2015; 502:650-658.

Byappanahalli MN, Fowler M, Schively D, Whiteman R. Ubiquity and persistence of *Escherichia coli* within a midwestern stream. Appl Environ Microbiol 2003; 69: 4549–55.

Center for Watershed Protection and Pitt, Robert, Illicit Discharge Detection and Elimination: A Guidance for Program Development and Technical Assessments, October, 2004.

Center for Watershed Protection, Illicit Discharge Detection and Elimination Tracking Guide, December, 2011.

Hartel, P., Rodgers, K., Fisher, J., McDonald, J., Gentit, L., Otero, E., Rivera-Torres, Y., Bryant, T., Jones, S., Survival and regrowth of fecal enterococci in desiccated and rewetted sediments, Proceedings of the 2005 Georgia Water Resources Conference, April, 2005.

Rutland Natural Resources Conservation District and Stone Environmental, Inc., Detecting and Eliminating Illicit Discharges in Rutland County to Improve Water Quality – Final Report, March, 2014.

U.S. EPA, 2002, Onsite Wastewater Treatment Systems Manual, US Environmental Protection Agency, Office of Water, February, 2002, EPA/625/R-00/008.

Vermont Dept. of Environmental Conservation and Aldrich & Elliott, PC, Missisquoi River Basin Advanced Illicit Discharge Detection and Elimination (IDDE) Study – Final Report, October, 2014.

Vermont Dep. Of Environmental Conservation and Stone Environmental, Inc., Detecting and Eliminating Illicit Discharges to Improve Water Quality in the Lamoille River Basin – Final Report, July, 2014.