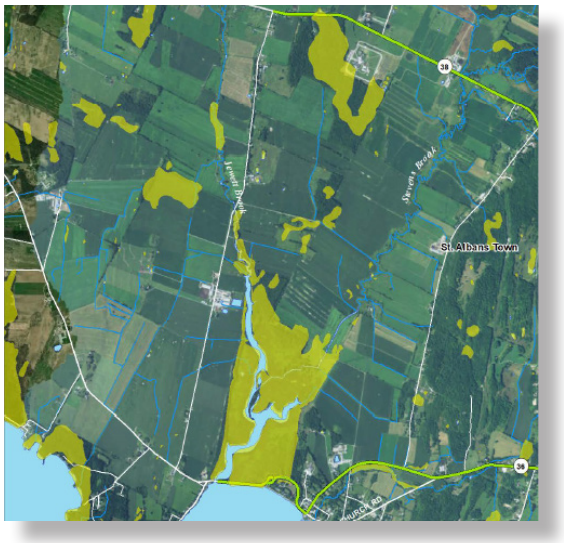
Lake Champlain Basin Program

TECHNICAL REPORT NO. 85

Feasibility Evaluation of Phosphorus Removal via Engineered Ecosytems in the St Albans Bay Watershed



August 2018

Final Report

Prepared by:
Gabe Bolin and Dave Braun
Stone Environmental

For:
The Lake Champlain Basin Program and
New England Interstate Water Pollution Control Commission

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Feasibility Evaluation of Phosphorus Removal via Engineered Ecosystems in the St. Albans Bay Watershed

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Jewett Brook Treatment Train: Regulatory Feasibility Evaluation

STONE ENVIRONMENTAL

PROJECT NO.

16-184

PREPARED FOR:

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Executive Summary

Development of a treatment train facility to remove phosphorus from Jewett Brook prior to discharge to St. Albans Bay has the potential to accelerate water quality improvements in St. Albans Bay. Jewett Brook has chronically elevated concentrations of phosphorus. Implementing a treatment train facility on Jewett Brook would involve withdrawing, treating, and releasing a portion of the streamflow. This facility could extend and enhance ongoing agency programs focused on implementation of agricultural conservation practices and nutrient management and bring the St. Albans Bay phosphorus targets within reach.

Representatives of the local, state, and federal government bodies that will determine the outcome of this project were convened to evaluate the regulatory feasibility of developing a treatment facility on Jewett Brook. The evaluation served to clarify which resource concerns were paramount as well as possible ways to avoid or mitigate impacts to these resources. The resource concerns that emerged as most challenging are 1) entrainment of fish (specifically larvae) in intake pumps; 2) potential impacts to aquatic organisms and their habitats due to warming of water at the discharge location; and 3) potential impacts to fish species recruitment due to alteration of the natural hydraulic flow within Jewett Brook and the Black Creek Wildlife Management Area.

Stone has given some consideration to methods by which resource concerns could be avoided or mitigated and will examine these concerns further in the technical feasibility evaluation phase of the project. Most of the resource concerns discussed could be addressed through appropriate siting and design of the treatment facility. Although creation of constructed wetlands is proposed, development of this project will involve considerable efforts to avoid and minimize impacts to natural wetlands. Facility siting and design will determine which specific permits will need to be filed and the conditions that will need to be met to construct the facility. Other resource concerns could be addressed in the operation of the facility, including adjusting the timing and rate of water withdrawal and discharge to minimize heating and entrainment of larval fish.

Stone is confident based on our committee discussions, regulation review, and preliminary analyses that a treatment train facility project can and should advance to the technical evaluation, conceptual design, and costing stage.

Jewett Brook Treatment Train: Regulatory Feasibility Evaluation

Cover Photo: Black Creek Wetland near confluence with St. Albans Bay

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1. Introduction

For many years, a top priority of lake managers and the agricultural sector in Vermont has been reducing phosphorus (P) runoff from farmland through the implementation of agricultural conservation practices. These practices, however, may not be sufficient to address the problem in Lake Champlain's eutrophic St. Albans Bay. The Lake Champlain TMDL Phase 1 Implementation Plan states that higher nutrient loading from agricultural runoff in a handful of subwatersheds, including St. Albans Bay, will require implementation of creative solutions and innovative restoration techniques – measures that extend and enhance ongoing agency programs – to achieve the goals of the Lake Champlain TMDL (Vermont Agency of Natural Resources, 2016).

Phosphorus inputs to St. Albans Bay are dominated by tributary loading. The tributary with the highest median phosphorus concentration – nearly 400 μg/L in the 2009-2015 period – is Jewett Brook (VT DEC). Internal flux of phosphorus, from the Bay's sediments to the water column, represents a second substantial input (Druschel et al. 2005). Chemical treatment options to sequester P in the bay's sediments have been considered, but not pursued, largely because high tributary P loadings are predicted to negate the effectiveness of in-lake treatments over a relatively short period of time (ENSR 2007). Therefore, reducing watershed P loads is a necessary precursor to any in-lake treatments.

Many of the phosphorus interventions contemplated explicitly in the TMDL Phase 1 Implementation Plan rely on the completion of substantial but dispersed, watershed-based nutrient reduction actions. The cumulative effects of these practices will take time – certainly years and possibly decades – to produce significant measured improvements in Lake Champlain's water quality. It is clear there are areas of the lake, including St. Albans Bay, in need of more immediate relief, and thus requiring more aggressive intervention.

One innovative P reduction approach that is starting to gain attention in Vermont is the development of treatment systems to remove P from streamflow before it reaches Lake Champlain. In theory, treating streamflow in certain priority watersheds would complement existing conservation programs and achieve more certain, near-term P reductions. Though technologies capable of removing significant quantities of P from surface waters are in their infancy, there have been successful applications of these systems on tributaries of Grand Lake St. Marys (GLSM) in Ohio. The largest of three treatment train systems at GLSM draws up to 2.5 million gallons per day from Coldwater Creek and removes approximately 80% of total P and 50-60% of soluble reactive P during the spring and summer seasons when it operates most efficiently (Stephen Jacquemin, personal communication, January 24, 2018).

Implementing a treatment train facility on Jewett Brook would involve withdrawing and treating a portion of the streamflow. The first treatment structure could be a phosphorus precipitation cell with a coagulant/flocculent dosing unit. The water would then pass by gravity through a series of constructed wetlands that would assimilate additional nutrients, before returning to Jewett Brook.

Development of such a treatment facility in the St. Albans Bay watershed will be a multiyear effort. In 2017, Stone Environmental, Inc. (Stone) initiated a project with the Lake Champlain Basin Program (LCBP) to evaluate the regulatory feasibility of developing a treatment train system to remove phosphorous from Jewett

Brook prior to discharge into St. Albans Bay. This report summarizes the findings of this feasibility evaluation, describes potential solutions to regulatory concerns, and offers a path forward for future project phases, which include technical feasibility evaluation, site identification, engineering design and permitting, and construction and operation.

1.1. Project Purpose and Description

The purpose of this project is to assess the feasibility of developing a facility to treat streamflow in the Jewett Brook watershed, considering whether, given the current regulatory environment, the project could obtain all required permits and be executed. This evaluation focused on the following tasks:

1. Engagement of federal, state, and local officials in considering the potential benefits of and challenges to development of a facility to treat Jewett Brook streamflow;
2. Discussions with personnel involved in the design, construction, and operation of the GLSM treatment trains;
3. Identification and review of relevant state and federal regulations;
4. Interviews with agency contacts to increase our understanding of particular rules and regulations and their applicability to the project;
5. Leading advisory committee meetings to discuss applicable regulations, resource concerns, and potential permit conditions;
6. Considering design elements to mitigate resource concerns; and
7. Preliminary considerations regarding facility siting.

1.2. Rationale

Operation of a facility that would remove phosphorus from streamflow prior to discharge to Lake Champlain holds certain advantages not present at the scale of individual farms or developments. Treatment technologies could be applied that are not be feasible at smaller scales. Such a facility would have electric power to run pumps, chemical feeds, and mixers. It would have reliable, year-round access, which can be a challenge with on-farm practices. It would be staffed by a trained operator, who would follow standard operating procedures, maintain equipment, and monitor system performance. Treatment performance could be optimized throughout the year by adjustment of pumping rates and chemical dosing, considering the flow rate, temperature, and nutrient and sediment concentrations of the streamflow. With the possible exception of winter operation, the facility would remove phosphorus continuously, because, in contrast to farm-scale practices, the streamflow is perennial.

Given the potential for a stream treatment facility to remove significant quantities of P, it is incumbent on resource managers to consider this option where required nonpoint source P load reductions may be difficult to achieve through BMP implementation alone. The Lake Champlain P TMDL requires a 24.5% reduction in the nonpoint source P load to St. Albans Bay and a 34.5% reduction in the agricultural nonpoint source P load. Implementing a treatment train system could extend and enhance ongoing agency programs focused on BMPs and nutrient management and bring the St. Albans Bay targets within reach.

2. Advisory Committee Meetings

Stone convened an Advisory Committee comprised of state, federal, and local officials to assist with this regulatory feasibility evaluation. Members of the committee are listed in Table 1.

Table 1. Advisory Committee Members

Individual	Organization	Contact Information
Matthew Vaughan	Lake Champlain Basin Program	mvaughan@lcbp.org
Neil Kamman	VT DEC	Neil.Kamman@vermont.gov
Bernie Pientka	VT Fish & Wildlife	Bernie.Pientka@vermont.gov
Ned Connell	Town of St. Albans	nconnell@stalbanstown.com
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Ben Gabos	VT Agency of Agriculture, Food & Markets	ben.gabos@vermont.gov
Laura Lapierre	VT Wetlands Program (DEC)	Laura.Lapierre@vermont.gov
Mike Adams	U.S. Army Corps of Engineers	Michael.S.Adams@usace.army.mil
Mike Kline	VT Rivers Program (DEC)	Mike.Kline@vermont.gov
Angela Shambaugh	VT DEC Lakes and Ponds Program	angela.shambaugh@vermont.gov

Two committee meetings were held over the course of the project. The following is a description of each meeting:

- Meeting 1, January 25, 2018: The purpose of this meeting was to introduce the treatment train concept to the Advisory Committee and to discuss potential benefits, applicable regulations, and potential resource concerns.

- Meeting 2, February 20, 2018: The purpose of this meeting was to further discuss challenges facing the project, particularly resource concerns related to potential fish impacts and streamflow alteration. A second objective was to measure support for the project among state and local government officials.

3. Grand Lake St. Marys Example

Conditions in the Grand Lake St. Marys (GLSM) watershed are similar in many respects to those in the Lake Champlain Basin. Intensive agricultural production and increased development over the last century have adversely impacted lake water quality (Overcash and Pfeiffer, 2014). Like St. Albans Bay, GLSM has regularly experienced algal blooms due to excessive nutrient loading. In 2010, algal blooms were of such magnitude and duration that the Ohio EPA was forced to close the lake to all recreational activity.

Since 2012, Ohio EPA has been working with the GLSM Restoration Commission to implement a series of treatment trains – or "engineered ecosystems" – that use a combination of engineered (alum coagulation/flocculation), biotechnical (constructed wetlands), and natural (restored wetlands) treatment systems to improve the quality of water flowing to GLSM. The approach being used in GLSM involves drawing off a pre-determined amount of flow from a tributary stream and pumping it to a sedimentation pond, from which it flows by gravity through a series of shallow constructed wetlands that process and assimilate additional P. Once treated, the water flows into restored, littoral wetlands for further attenuation and dispersal into GLSM.

The first GLSM treatment train is near the mouth of Prairie Creek (Figure 1). It began operating in June 2013. Prairie Creek has a watershed of 6 mi^2 (16 km^2) of which approximately 95% is in agriculture use. The Prairie Creek treatment train treats 0.75 MGD and removes an estimated 71% of P and 31% of N (Overcash and Pfeiffer, 2014). Due to the success of the Prairie Creek treatment train, two additional treatment train

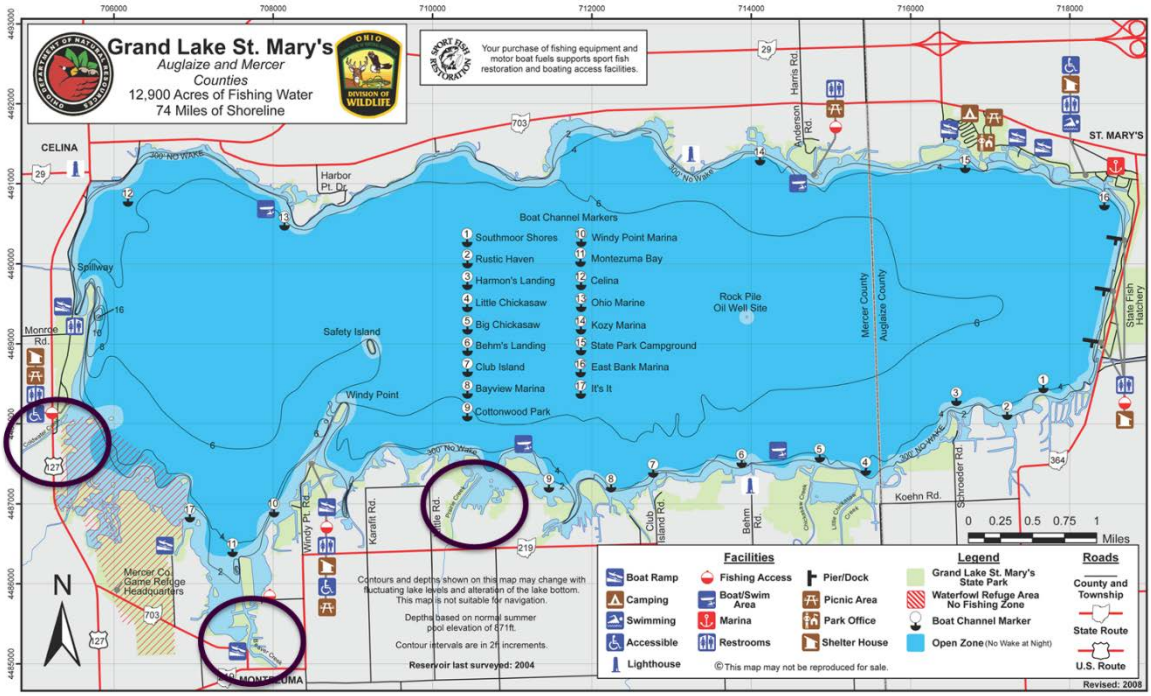

Figure 1. Locations of the three treatment trains in the Grand Lake St. Marys watershed

facilities were constructed in 2015. The Coldwater Creek treatment train has a treatment capacity of 2.5 MGD, substantially greater than the Prairie Creek facility. Coldwater Creek drains a 20 mi^2 (52 km^2), largely agricultural watershed. This facility reportedly removes about 80% of total P and 50-60% of soluble reactive P during the spring and summer months (Stephen Jacquemin, personal communication, January 24, 2018). Total P removal efficiency declines in the fall to approximately 30% and soluble reactive P removal is negligible. The system is shut down in the winter. There is little information available about the third treatment train constructed at GLSM, a modified vegetated swale in the Beaver Creek watershed. Treatment train facilities are now being planned for the four remaining tributaries flowing to the southern shore of GLSM.

For both the Prairie Creek and the Coldwater Creek facilities, the design flow rate represents approximately one-third of the annual streamflow volume. While alum was used initially to improve P removal, alum use was discontinued at both facilities due to cost and the high P removal rates achieved in the constructed wetlands.

The information presented below on the Prairie Creek and Coldwater Creek treatment trains was gathered in communications with Ohio EPA and the GLSM Lake Facilities Authority, a primary manager of the treatment train facilities.

Ownership and management

- Mercer County owns the land on which the Prairie Creek and Coldwater Creek facilities are located. Mercer County is currently working with the Ohio Department of Natural Resources to transfer ownership to the State of Ohio.
- At present, there is no dedicated source of long-term funding for operating the treatment trains. The Lake Facilities Authority has taxing authority, but it has not exercised this authority to generate revenue. Operating funds are obtained through grants, support from Mercer and Auglaize Counties, and private donations. Both Mercer and Auglaize Counties have civic foundations that have raised operating funds. Recently the Mercer County Foundation purchased a new pump.

Operations

- The target hydraulic residence time at both facilities is three days.
- Lake Facilities Authority representatives believe that if they could afford to use alum, the residence time could be lowered without compromising treatment performance, enabling treatment of a greater proportion of streamflow.
- No attempts have been made to optimize P removal by timing water withdrawal in relation to storm events.
- The settling basins and wetland cells are accumulating sediment and have never been dredged. At Prairie Creek, the main settling basin was originally 15 feet deep and is now only 4 feet deep. The Lake Facilities Authority expects to dredge accumulated sediment and is currently looking into options for sale of dredged material (fill, potting soil, etc.).

Impacts to fisheries

- The intake pipe at both facilities has a screen to minimize entrainment of aquatic organisms and debris. Adult and juvenile fish are not pulled into the treatment train. However, larval fish with swim speeds less than 50 cm/s may be entrained.
- The intake pipe size and the pumping rate may be adjusted to reduce water velocity at the intake.
- Water temperature is monitored at the outflow. In spring there is a difference in temperature between the stream and the discharge location; however, dilution results in no temperature plume in GLSM. In summer, streams draining to GLSM heat up and little temperature increase is observed between the stream and the discharge location.

3.1. Operation Details of Coldwater Creek Facility

Representatives of the GLSM Lake Facilities Authority view the facility at Coldwater Creek as a significant improvement over the earlier Prairie Creek facility. It is also more comparable in design and scale to Stone's conceptual model for a treatment facility in the St. Albans Bay watershed. Therefore, certain aspects of the design and operation of this facility are described here.

The Coldwater Creek facility includes 17 acres of constructed wetlands (Figure 2). As shown in Figure 2, the wetland cells are mostly oblong, intended to facilitate periodic dredging. There is a road network between the ponds, sufficient for truck and excavator access.

Water pumped from Coldwater Creek enters an initial settling pond that is approximately 15 feet deep (Figure 2). Flow from this pond is split evenly between two series of wetland cells of decreasing water depth. Figure 3 illustrates one of these wetland cells. Of the 17 acres of constructed wetlands, the settling pond comprises 10-15% of the area, wetlands with depths of 3-5 feet comprise 10-15% of the area, and shallow water wetlands 1-2 feet deep occupy 70% of the area. Flow from the shallow water wetlands discharges into a canal and eventually out into a 250-acre littoral wetland along the edge of GLSM. This littoral wetland was enhanced by construction of a berm that encloses a shallow portion of the lake. Emergent vegetation in the littoral wetland is thought to increase nutrient removal, although this additional removal has not been quantified.

Routine operations at Coldwater Creek require about 3-4 hours per week of staff time. Additional staff time is required at certain times of year to adjust pumping rates. For example, in the spring the pumping rate is set lower to maintain low water levels in the cells as the emergent wetland vegetation begins growing. Regular water quality monitoring is used to inform operations. For example, the pumping rate may be decreased if the P removal rate declines. A lower pumping rate will increase hydraulic residence time, which theoretically should result in improved P removal. Ohio Department of Natural Resources staff assist by operating pumps and mowing the wetland cell berms. Since chemical treatments were discontinued soon after construction, operations do not include time to maintain and/or operate a chemical treatment system.

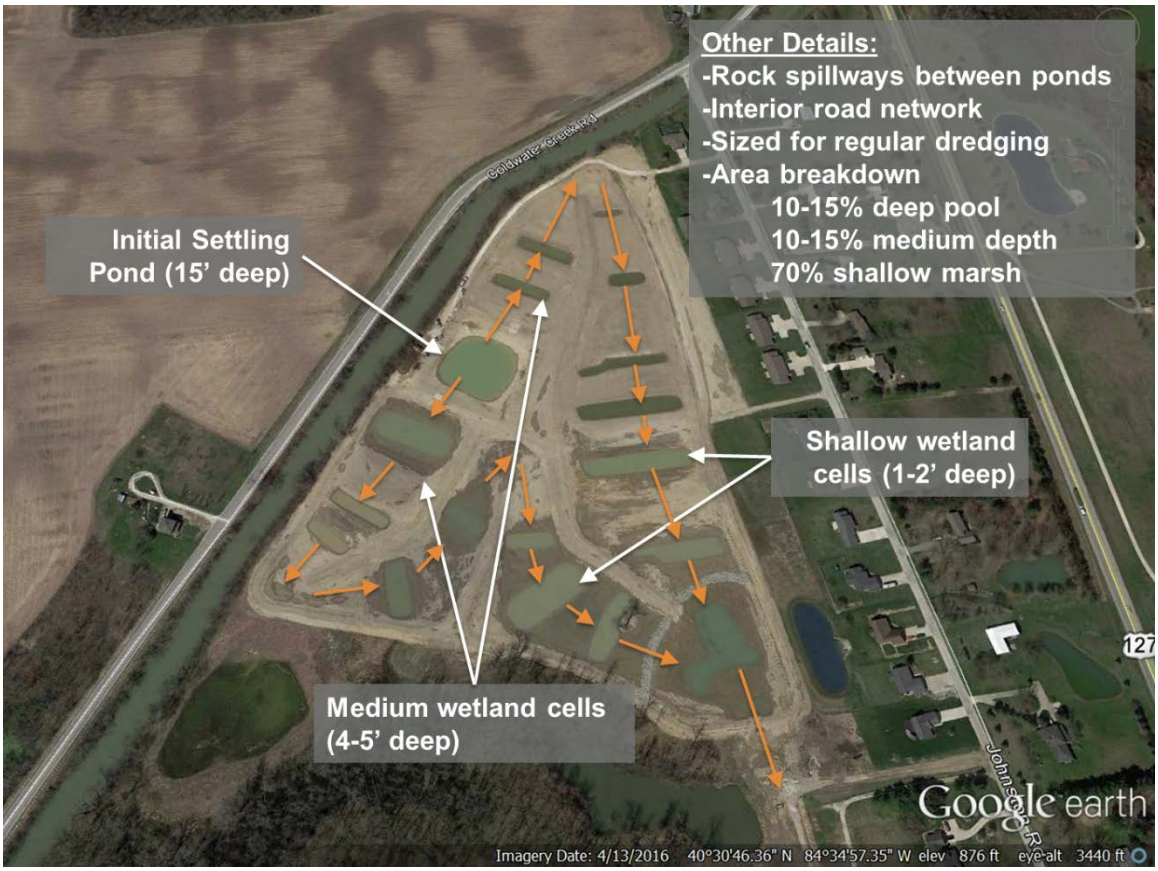

Figure 2. Coldwater Creek Treatment Train during construction

Figure 3. Wetland cell in the Coldwater Creek Treatment Train

4. Resources in the Lower Jewett Brook Watershed

In initial consultations with Vermont DEC, resource managers indicated that water withdrawals that lowered the stage of Jewett Brook significantly, reducing its wetted perimeter, would not be acceptable. Potential impacts to aquatic organisms would be minimized if water were withdrawn from the backwater zone in which the stage in Jewett Brook is influenced by the elevation of Lake Champlain. When streamflow is at a minimum, typically in September or October, the water level in Jewett Brook will not fall below lake level (Figure 4).

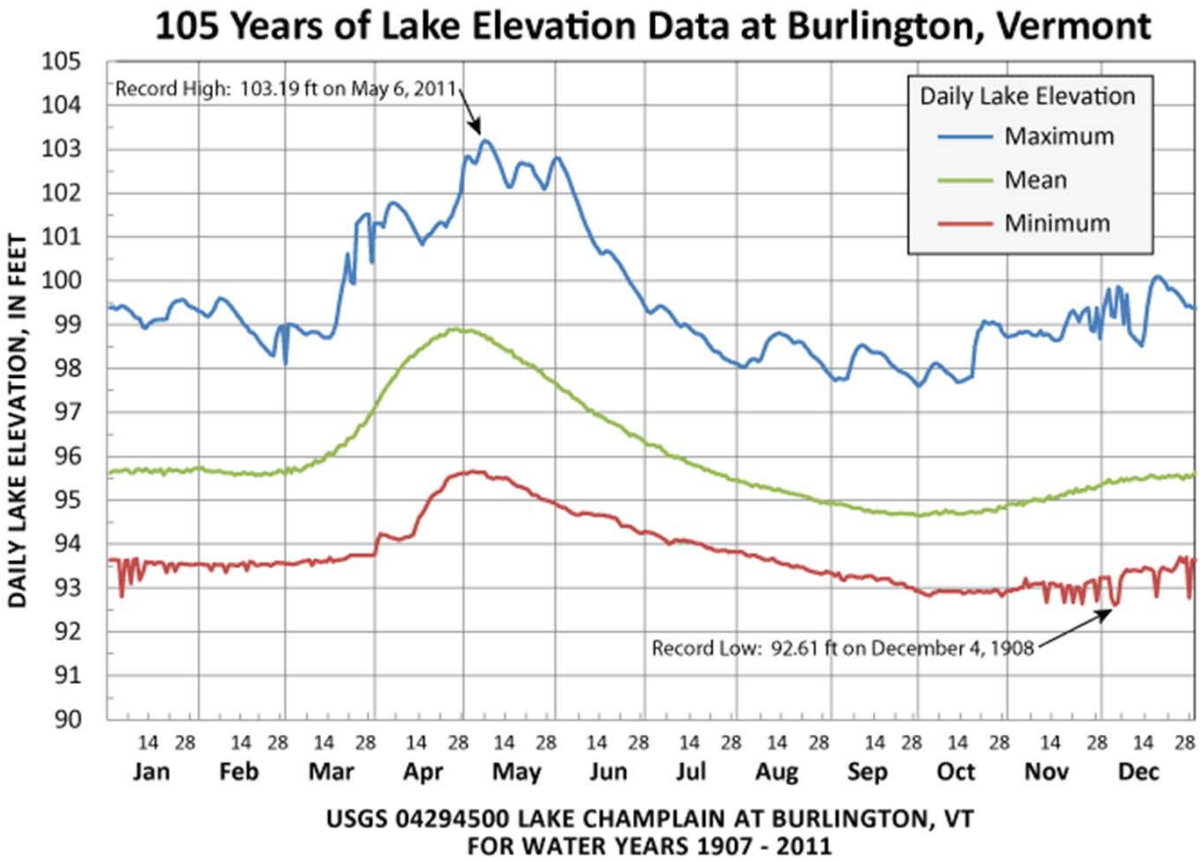

Figure 4. Daily mean lake surface elevation of Lake Champlain

The high water elevation in Lake Champlain typically occurs in late April (Figure 4). The daily mean high water elevation in late April is approximately 99 ft. At this water surface elevation, the lake's backwater effect should extend approximately as far up Jewett Brook as the Dunsmore Road bridge. At exceptionally high lake levels, the backwatered zone must extend considerably north of the Dunsmore Road bridge. For example, at a

lake surface elevation of 102 ft, the backwatered segment of Jewett Brook should extend approximately 2,500 ft north of the bridge.

The lake backwater zone extends further up the Jewett Brook channel than water mixing should occur. Therefore, under most conditions it should be possible to withdraw streamflow with relatively high P concentrations from the backwater zone without affecting the water level in the stream.

Given the importance of avoiding any impacts on the water level in Jewett Brook, the preferred location for a water intake and treatment facility would be in the lower Jewett Brook watershed, south of the Dunsmore Road bridge. The following resource review is therefore limited to this lower portion of the Jewett Brook watershed.

4.1. Floodplains

In Vermont, municipalities administer the review and permitting of development in floodplains according to locally-adopted Hazard Area Bylaws. Under Vermont Statue (24 V.S.A. §4424) the State reserves the right to review all floodplain applications. For certain types of activities, Vermont DEC administers the permit review.

There are no Flood Hazard Areas defined in the lower Jewett Brook watershed. In addition, there are no soil mapping units in this area that have been identified to flood. However, it is common knowledge that the Black Creek Wetland and adjacent areas to the north will become inundated when the level of Lake Champlain is high.

4.2. Soils

Mapped soils in the lower Jewett Brook watershed are dominated by heavy clay soils such as Covington (Cv) and Kingsbury (Kb). These soils have low permeability and high natural fertility, and are classified as hydrologic soil group D. There are smaller areas of stony loams in the area including St. Albans (Sa) and Georgia (Ge). Within and immediately adjacent to Black Creek wetland, there are also some areas of deep organic soils such as Carlisle Muck (Ce) and Terric Medisaprists (Tm).

4.2.1. Prime agricultural soils

The State of Vermont defines Primary Agricultural Soils as soils that are mapped by NRCS as “prime” and/or “statewide” agricultural soils (10 V.S.A. § 6001). Prime soils have been determined to have the best physical and chemical characteristics for growing food and fiber. Statewide soils are soils that fail to meet one of the requirements for prime soils, but which are considered important to the state for agricultural production.

Soils in the lower Jewett Brook watershed are a mixture of prime and statewide soils. Almost all the soils in the area have been identified as either prime or statewide important (Figure 5). Soils in the areas immediately adjacent to the Black Creek Wetland to the north are not prime or statewide important.

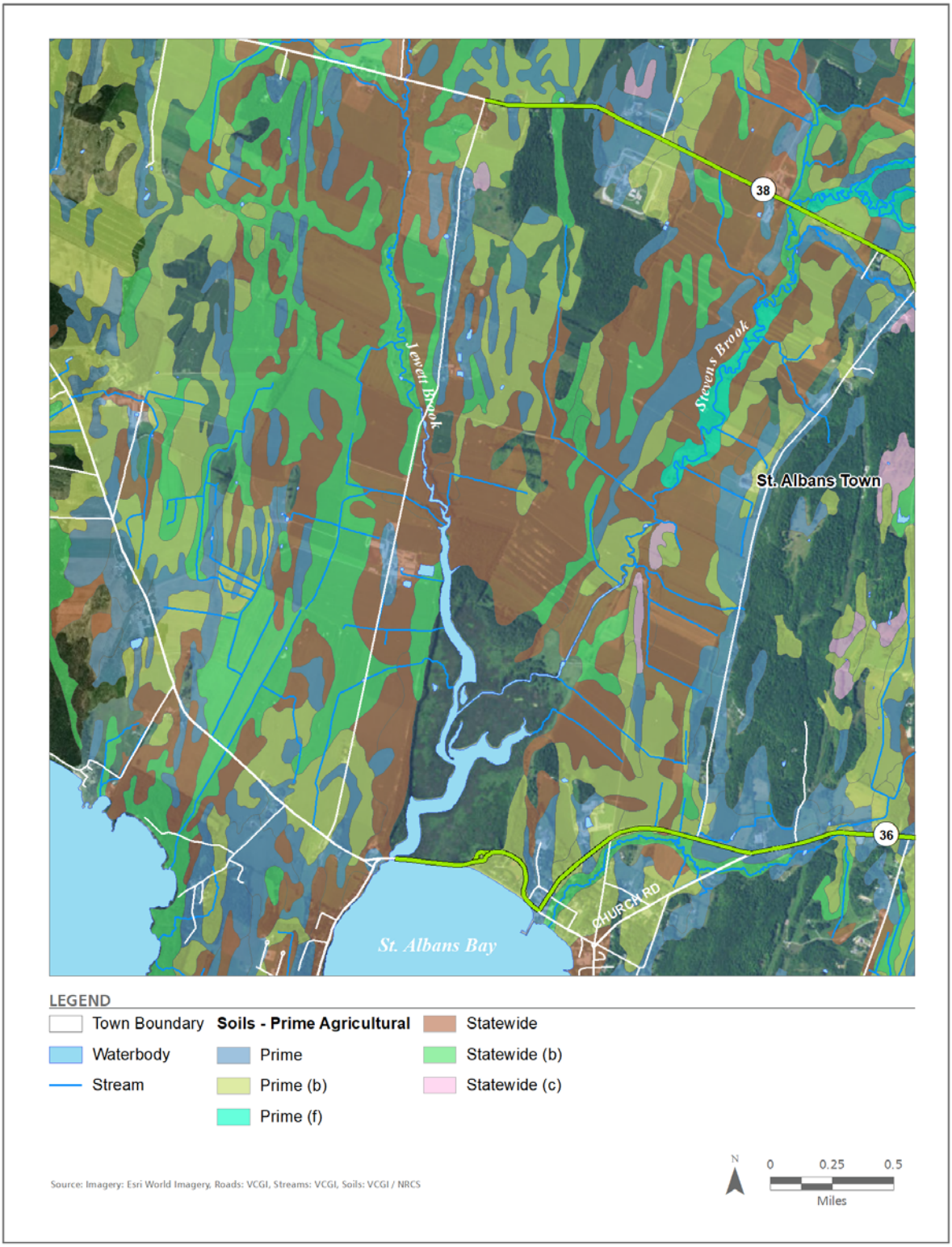

Figure 5. Important farmland (colored areas are soils of prime or statewide importance)

4.3. Wetlands

The Black Creek Wetland is a Vermont Wildlife Management Area (WMA) with significant fisheries and wildlife values (Figure 6). Obviously, it is desirable to locate all components of the treatment train outside of the WMA. The WMA encompasses the entire eastern side of lower Jewett Brook. Any treatment facilities on this side of the Brook would directly impact the WMA to some extent and would be within the wetland. On its western side, the WMA boundary extends to the centerline of Jewett Brook. Construction of a treatment facility on the western side of the Brook in this location would not directly impact the WMA.

The entire Black Creek WMA is mapped as a Class II wetland, as are contiguous wetland areas around the WMA (Figure 7). These mapped wetlands (Vermont Significant Wetland Inventory) extend a considerable distance to the north, east, and southwest. Whereas, on the northwestern side of Jewett Brook there is only a narrow strip of mapped wetland between Jewett Brook and the adjacent farmland.

Wetlands that are subject to regulation include areas that meet defined wetland criteria; they are not restricted to those areas appearing on the VSWI map layer. Potential wetland areas can be identified using in-office tools such as hydric soils maps and aerial photography that show wet ground conditions. The predominant soils in this area are Kingsbury, Covington, and Terric Medisaprists. Both the Covington and Terric Medisaprists are identified as hydric soils that occur in wet areas and typically support hydrophytic vegetation. The Terric Medisaprists are a deep organic soil. Covington is a heavy soil with a high clay content and low permeability. Kingsbury soils also have a high clay content, but this soil series is not classified as hydric.

Mapped hydric soils extend beyond the VSWI mapped wetlands on the north and west sides of the WMA into fields that are used for hay and corn production (Figure 8). Hydric soil inclusions and pockets of wetland could occur beyond these mapped hydric soils, especially in the areas mapped as Kingsbury soil.

The 2013 Vermont Orthophotos were flown in the spring of the year and are particularly useful in showing wet ground conditions. These are seen as darker areas on the photography. There are obvious wet areas adjacent to the WMA to the east, north and west (Figure 9). Only small pockets of wet areas are visible in the agricultural fields between Jewett Brook and Dunsmore Road.

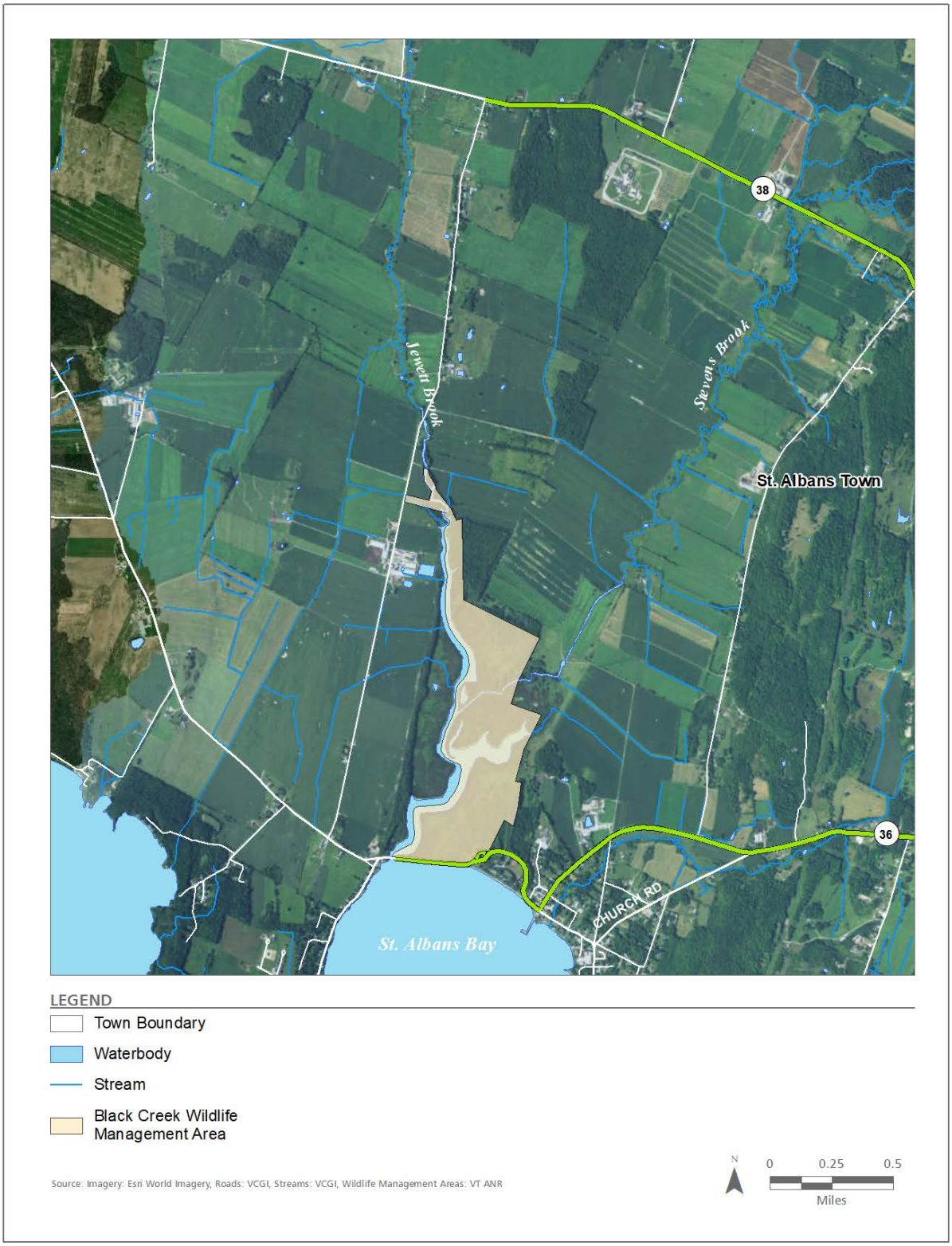

Figure 6. Black Creek Wildlife Management Area

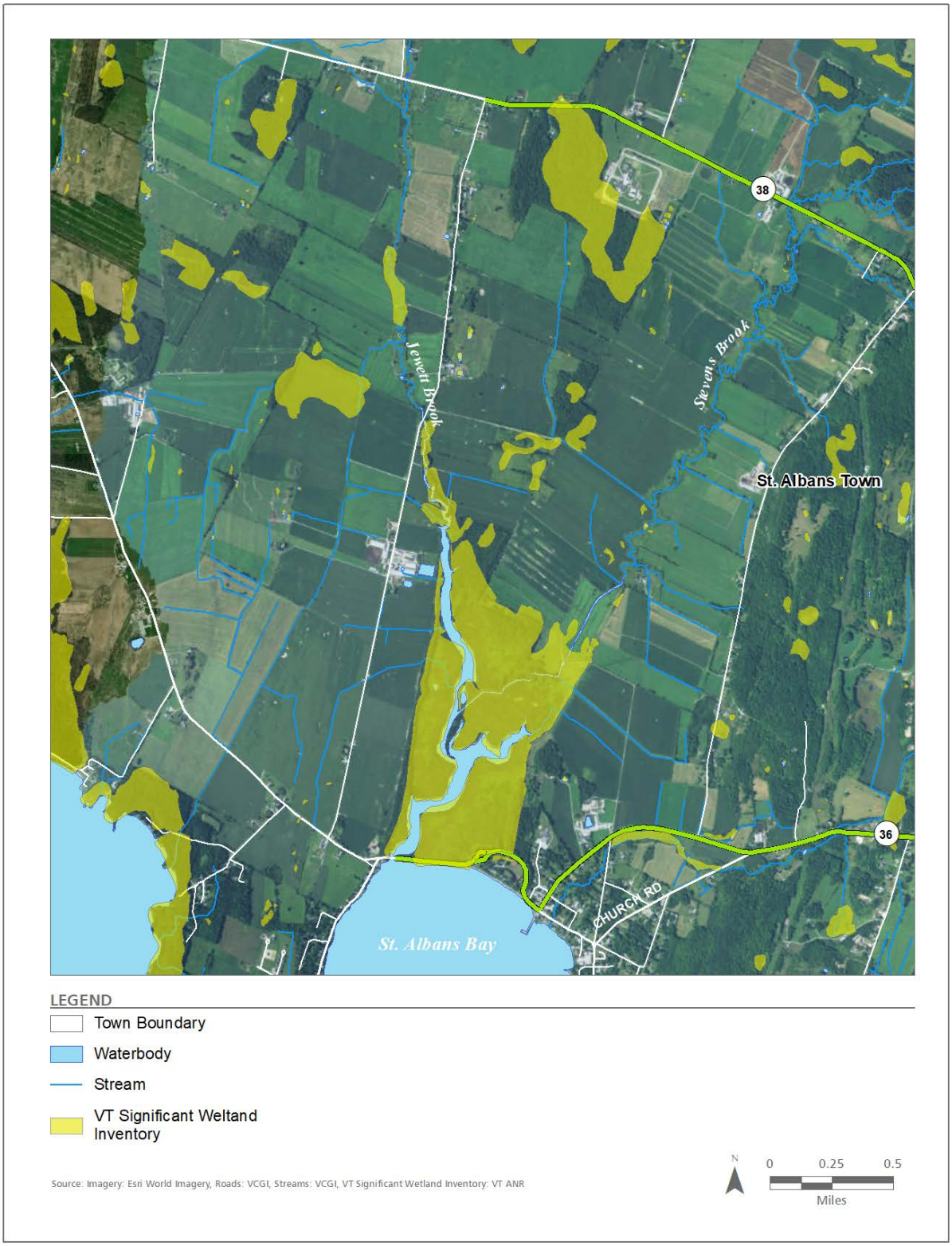

Figure 7. Vermont Significant Wetland Inventory map

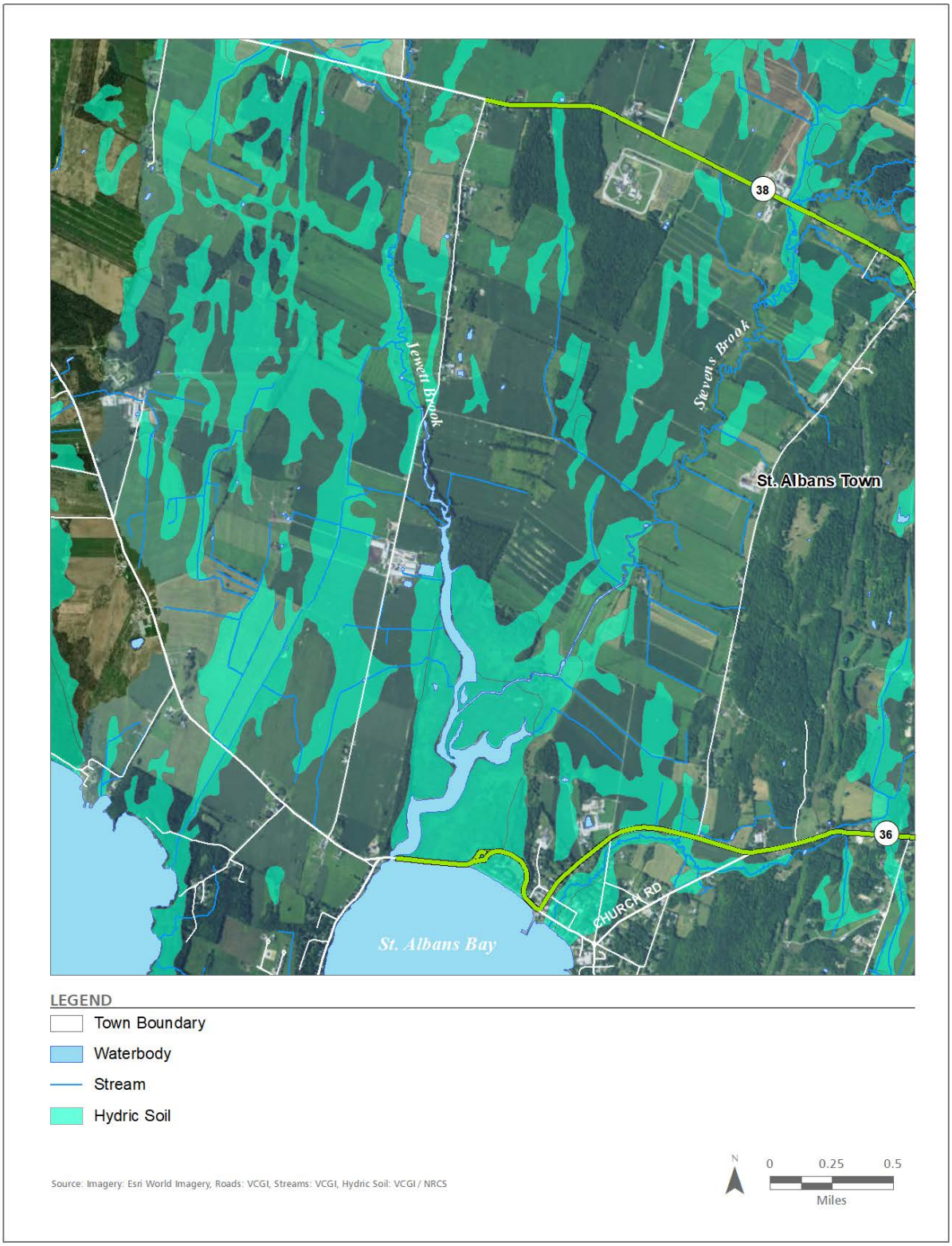

Figure 8. Hydric soils

Figure 9. Vermont 2013 orthophoto

Based on available map data there appear to be significant areas of wetland to the east and north of lower Jewett Brook. On the western side of Jewett Brook, the adjacent wetland appears to narrow towards the northern end of this area. Wetlands may extend westward into the agricultural fields along Dunsmore Road.

The State of Vermont regulates wetlands under the Vermont Wetland Rules (Vt. Code R. 12 004 056, updated January 26, 2017). The State regulates impacts to: 1) all wetlands on the VSWI maps, 2) other wetlands determined to have significant functions and values, and 3) the 50-ft buffer zone adjacent to these wetlands. Under the Vermont Wetland Rules, general permits are available for some activities in wetlands, but these would not apply to the project under consideration. As part of the individual permit process it must be shown that all reasonable efforts have been made to avoid impacts to wetlands. The functions and values of the wetlands must be assessed, and it must be demonstrated that there will be no undue, adverse impact to these functions and values. Areas that have low potential for restoration as a natural wetland are more likely to get permitted than areas with a high potential for restoration. It is also recommended that a decommissioning plan for the treatment train be included in any wetland permit application. An impact fee is assessed on any impacted wetlands according to the area of impact.

The U.S. Army Corps of Engineers under Section 404 of the Clean Water Act has jurisdiction over all Waters of the U.S., including wetlands. Under this regulatory program it must be demonstrated that all reasonable alternatives have been considered to avoid and minimize impacts to jurisdictional wetlands. Upon notification to the Corps, a State Program General Permit might be available if the area of wetland impact is less than 10,000 ft^2. Individual permits are required for larger or more significant wetland impacts and would require an acceptable wetland mitigation plan or payment of an in-lieu fee. Under Section 404, the Corps also requires a State 401 Water Quality Certification (WQC) and an archaeological assessment of any areas proposed for ground disturbance. The 401 WQC would also be reviewed under Section 10 of the U.S. Rivers and Harbors Act. This Act places restrictions on structures (length and height of structure) being built in navigable waterways.

During the next phase of the project, property owners will be contacted regarding their interest in sale or lease of an appropriate parcel. During this phase site specific wetland delineations will be conducted where allowed and a site will be proposed that will avoid and minimize wetland impacts to the extent possible.

4.4. Farmland Conservation Easements

The Vermont Housing and Conservation Board (VHCB) administers and coordinates a farmland conservation program in Vermont. In Franklin County there are now large blocks of conserved agricultural land. These easements restrict the use of the land for development or other non-agricultural uses. Approval is required from VHCB for any use of the land that is prohibited under the conservation easement.

In the lower Jewett Brook watershed there is conserved agricultural land west of Dunsmore Road and north of the Black Creek Wetland (Figure 10). The farmland immediately adjacent to Jewett Brook to the west and east is not conserved. There is a narrow strip of conserved land where Jewett Brook crosses Dunsmore Road. As currently envisioned the project would not impact conserved agricultural land.

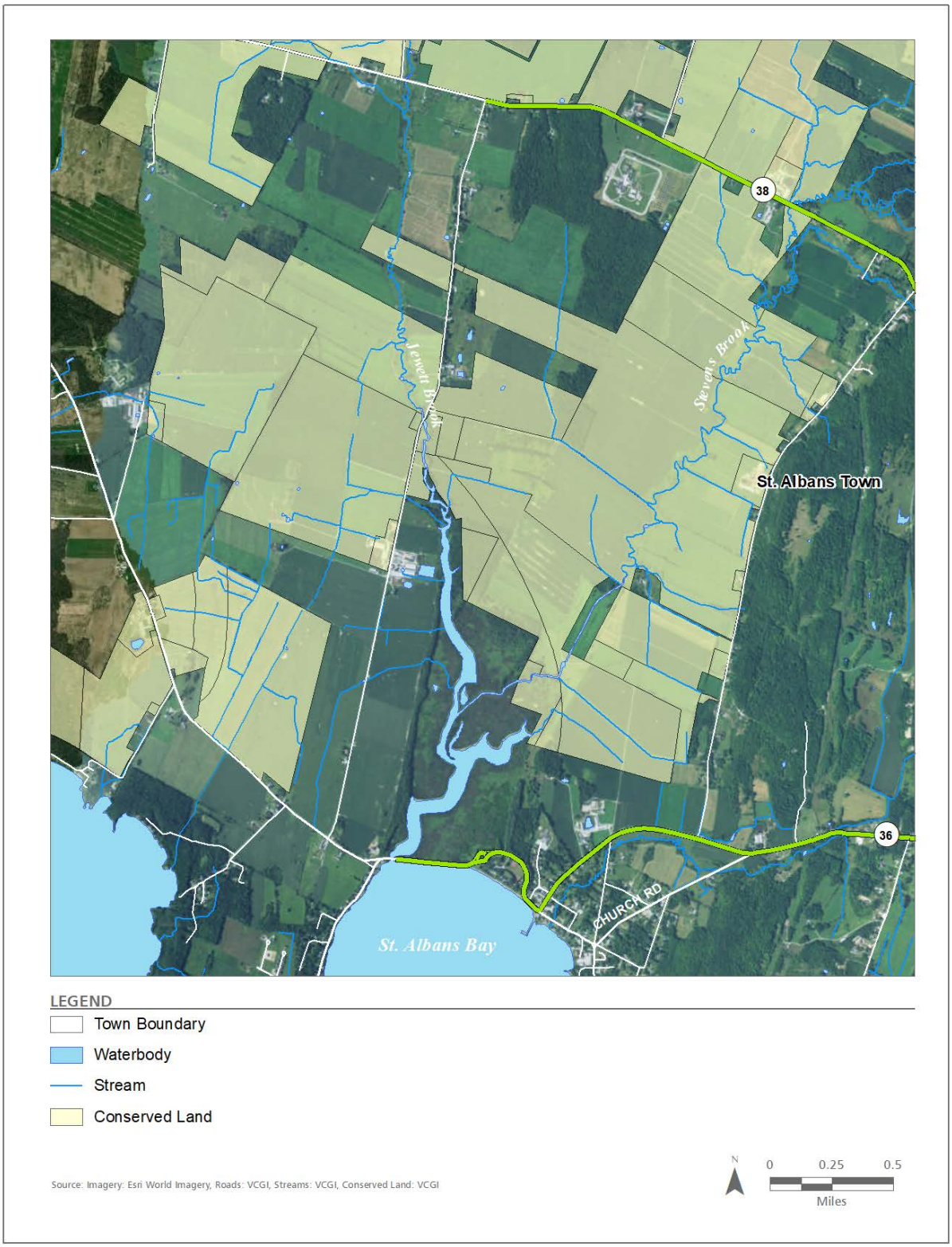

Figure 10. Conserved farmland

4.5. Cultural Resources

Vermont's historic cultural resources include buildings, structures, landscapes, and archeological sites. If a project is supported with federal or state funds, or licenses or permits, it must be reviewed by the State Historic Preservation Office (SHPO) for potential impacts to Historic Resources. Any district, site, building, structure, or object meeting the National Register Criteria for Evaluation must be reviewed and assessed under this procedure.

The Vermont Division of Historic Preservation maintains a confidential list and map of know historic and archeologic sites. The Vermont Archaeological Inventory (VAI) contains over 6,000 known sites and is maintained as a confidential database. Most ground disturbing projects require a trained archeologist to evaluate the site for historic or archeological resources. Potential impacts to historic or cultural resources must be avoided and/or minimized to the extent possible. The area around Black Creek Wetland may contain archeological sites due to its proximity to water and significant sources of food.

4.6. Hydrology

A USGS stream gauging station (#04292810) is located on Jewett Brook at the stream crossing on Lower Newton Road. For the calculation period October 2008 through September 2017, mean daily flows ranged from 0.1 to 34 cfs (Figure 11). This gauging station is significantly upstream of potential facility sites in the lower Jewett Brook watershed. However, flow data at this station could be adjusted to approximate flow rates

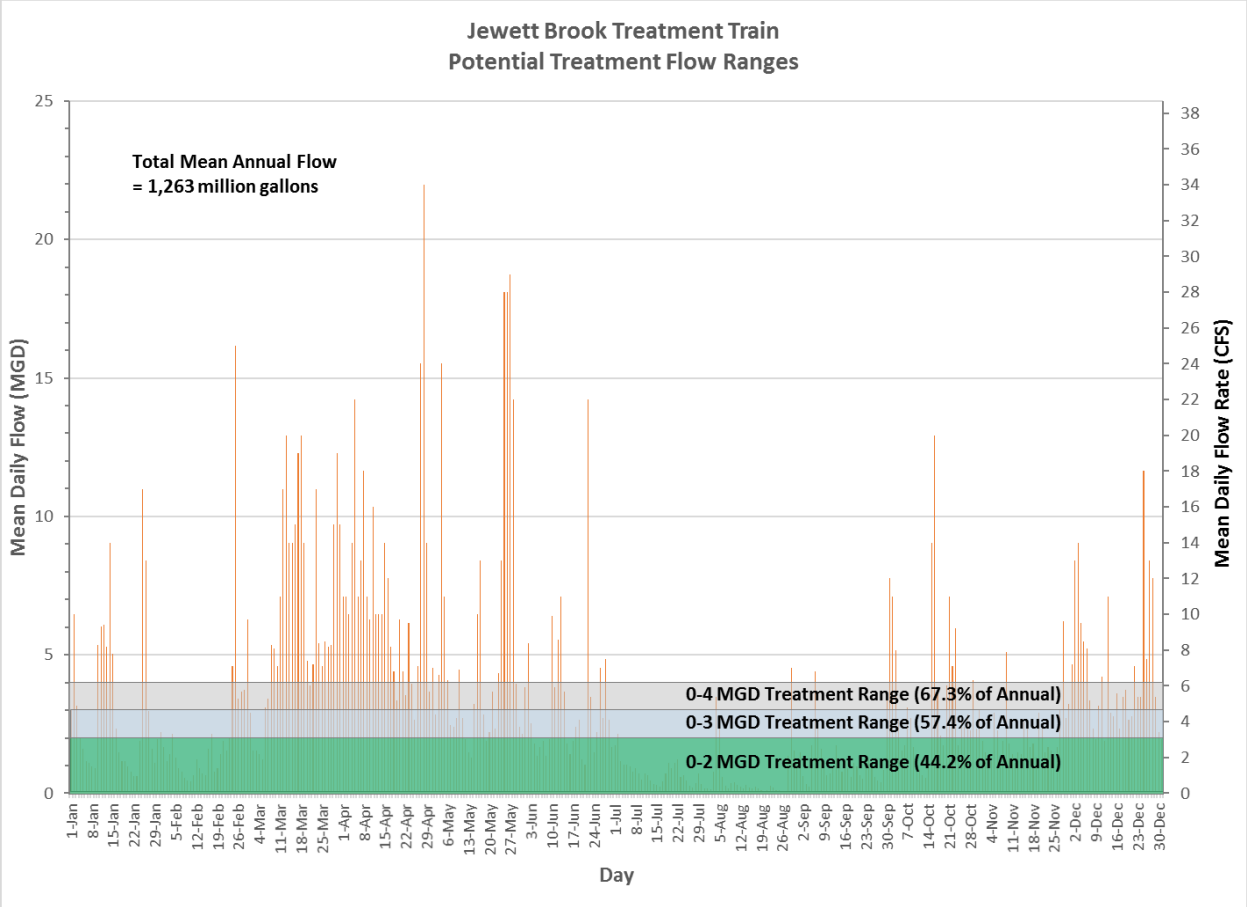

Figure 11. Mean daily streamflow and potential capacity of a treatment facility on Jewett Brook

in lower Jewett Brook for use in designing a treatment train facility. As one would expect, flow rates are highest between March and May, decline through the summer months, interrupted by short duration storm flows, and rise again in October through December. Figure 11 illustrates the proportion of total streamflow volume that would be treated per year assuming differing treatment capacities. This analysis assumes that the maximum withdrawal rate would be the lesser of the treatment capacity (2, 3, or 4 MGD) or the streamflow rate, such that water withdrawal would not exceed streamflow. Following this assumption, water withdrawal would be limited by streamflow 53, 39, and 29 percent of the time for treatment capacities of 2, 3, and 4 MGD, respectively.

5. Applicable Federal and State Laws, Regulations, and Procedures

Stone has interviewed federal and state resource managers and reviewed numerous laws, regulations, and procedures to identify any conditions that must be met in developing a treatment train facility.

This section provides an overview of such considerations in evaluating the feasibility of a treatment train system from a regulatory perspective. The information is organized by the program or agency responsible for administering the pertinent regulations and procedures. Information and insights gathered in meetings between resource managers and Stone personnel are also presented.

5.1. Regulations Related to the Vermont DEC Rivers Program

The Vermont DEC Rivers Program is responsible for protecting and restoring natural river and floodplain processes to enhance water quality, ecological health, and flood resilience. River resource protection is achieved through a combination of permitting, regulatory/non-regulatory technical assistance, assessment, planning, education, and outreach. *[Source: http://dec.vermont.gov/watershed/rivers]*

5.1.1. Vermont Stream Alteration Rule

Reference: Environmental Protection Rule, Chapter 27, Effective March 10, 2017

Purpose: The purpose of this Rule is to clarify how the Agency shall manage stream alterations during emergencies and otherwise. *[Source: §27-102, Policy, Sub-Chapter 1, Vermont Stream Alteration Rule]*

Summary: It is the policy of the State to promote and protect the natural maintenance and natural restoration of dynamic equilibrium conditions of streams and rivers. The state recognizes that structures/properties exist within the river corridor where natural processes take place to accommodate that equilibrium and acknowledges that those structures/properties are highly vulnerable to fluvial erosion hazards. Stream alterations made to protect these properties can have negative impacts on stream balance near the property and downstream within the corridor. The state acknowledges the conflict that exists at times between maintaining natural river processes and protecting existing property and infrastructure. Therefore, the state regulates stream alterations to attain and maintain equilibrium conditions within stream and river corridors and floodplains upstream and downstream of settled areas so that streams can over-top their banks and release their flood energy and materials in these less-developed areas. *[Source: §27-102, Policy, Sub-Chapter 1, Vermont Stream Alteration Rule]*

Meetings:

- Individual Meeting – November 2, 2017
  - Attendees: Gabe Bolin, Stone; Mike Kline, VT DEC Rivers Program; Neil Kamman, VT DEC; Laura LaPierre, VT DEC Wetlands Program
- Committee Meetings – January 20, 2018 and February 25, 2018

Interpretations:

- To comply with the Stream Alteration Rule, the project must provide for continuity of flow and sediment transport, fish passage, and passage of wood and natural debris.
- The intake structure requires authorization under the Stream Alteration General Permit. The design and placement of the structure would need to meet the equilibrium and connectivity performance standards and the statutory criteria of no significant damage to fish life and wildlife.
- Unless the intake structure is configured as a cross-channel weir, (i.e., creating discontinuity in the stream bed and an aquatic organism passage obstruction), a stream alteration authorization should not be a regulatory obstacle for a treatment train project.
- Any placement of treatment ponds that would require new channelization or relocation of small perennial streams would not be permittable under the Stream Alteration Rule.
- The DEC Rivers Program would assist Vermont Fish & Wildlife and the Wetlands and Lakes Programs in their habitat evaluations as part of the 401 Water Quality Certification.

5.1.2. Streamflow Procedure

Reference: Agency Procedure for Determining Acceptable Minimum Stream Flows, Vermont Agency of Natural Resources, Effective July 14, 1993

Purpose: The intent of this procedure is to ensure that a consistent process is used in determining acceptable minimum streamflows when there are existing or potentially competing uses of the water. This does not necessarily mean that a uniform minimum streamflow number will be reached in every case. What it does mean is that the minimum streamflow values will be derived using a consistent procedure.

Summary: The foundation of state statutes protecting the natural flow of Vermont's rivers and streams is that the natural flow should be protected and maintained in the public interest. All reasonable alternatives to altering streamflow and water conservation measures should be evaluated before reduction of the natural flow rate is considered. Only when a comprehensive analysis of such measures is completed can a reasoned and rational balance be defined between legitimate but competing users of the stream. *[Source: Introduction, Agency Procedure for Determining Acceptable Minimum Stream Flows]*

Meetings:

- Individual Meeting – November 2, 2017
  - Attendees: Gabe Bolin, Stone; Mike Kline, VT DEC Rivers Program; Laura LaPierre, VT DEC Wetlands Program
- Committee Meetings – January 20, 2018 and February 25, 2018

Interpretations:

- Regarding proposed water withdrawal rates, the project must provide for acceptable minimum stream flows.

- If the intake is being placed at a location and elevation where the withdrawal of water would not affect the depth and wetted perimeter of the channel (i.e., there would always be sufficient backwater from the lake that there would essentially be no change in water levels in Jewett Brook), then the Rivers Program would not be looking at compliance through the lens of the Stream Flow Procedure.
- If the Project involves more than a de minimis withdrawal of streamflow (de minimis is less than 5% of the 7Q10 streamflow), the 401 Water Quality Certificate issued by ANR for the project will include conditions to ensure that the withdrawal will meet the Water Quality Standards for the protection of designated uses, including the existing aquatic communities, aquatic habitat, and aesthetics appropriate to the body of water in question (i.e., the ANR Procedure for Determining Acceptable Minimum Stream Flows (1993) will be used to set operational conditions).
- Proponents of a stream water withdrawal for utilization of a treatment train will be required to either meet the minimum seasonal flow requirements established in the Streamflow Procedure or complete a site-specific study to determine the conservation flows necessary to meet the applicable Water Quality Standards. Projects that cannot maintain minimum flows to meet the Water Quality Standards will not be certified.
- Projects involving a lake or lake backwater segment of a stream will not be subject to the minimum streamflow requirements of the ANR Streamflow Procedure if a site-specific study shows that there will be no change to the wetted perimeter of the stream or backwatered stream segment. This study will need to show that water levels are maintained and explain any change in water flow (direction and velocity) or bed-load deposition patterns that may affect movement of the channel or the movement/impingement of different life stages of fish. The study will also need to demonstrate that the withdrawal and movement of water through the treatment train will not result in a warmed discharge that results in a violation of the temperature criteria of the Water Quality Standards.

5.1.3. Flood Hazard Area and River Corridor Protection Procedure

Reference: 2.0 Statutory Authority, Flood Hazard Area and River Corridor Protection Procedure, Vermont Agency of Natural Resources, Effective September 7, 2017

Purpose: The purpose of this procedure is varied and is best summarized in Section 1.0 (Purpose) of the procedure document.

Summary: Between 2010 and 2014, the Vermont General Assembly passed four separate Acts directing the Agency of Natural Resources to establish a River Corridor and Floodplain Management Program and to promote and encourage the identification and protection of flood hazard areas and river corridors to reduce flood and fluvial erosion hazards. Under this Procedure, DEC works in cooperation with municipalities, Regional Planning Commissions, and other state agencies to map flood hazard areas and river corridors to ensure compliance with the National Flood Insurance Program and state law, and to meet the policy objectives of protecting the health, safety, and welfare of the public from flood and fluvial erosion hazards.

The Vermont State Hazard Mitigation Plan (2013) identifies flooding as the most common natural hazard event in Vermont. Damages from flooding are due to inundation and fluvial erosion. Flooding, exacerbated by debris and ice jams, historic channelization practices, or the plugging and failure of stream crossing structures, can threaten public safety, stress emergency services, cause widespread damage and property loss, bring about socio-economic disruption, and result in significant recovery costs for property owners, municipalities, the state, and the federal government. Nationally, flooding accounts for more losses in lives and damages to property and crops than any other type of natural disaster. *[Source: 3.0 Introduction, Flood Hazard Area and River Corridor Protection Procedure]*

Meetings:

- Individual Meeting – November 2, 2017
  - Attendees: Gabe Bolin, Stone; Mike Kline, VT DEC Rivers Program; Laura LaPierre, VT DEC Wetlands Program
- Committee Meetings – January 20, 2018 and February 25, 2018

Interpretations:

- Regarding the National Flood Insurance Program, any work in a regulatory floodplain might require a permit from the town. Ultimately it would depend on the town's regulations. If a local land use permit is required, then the Rivers Program would review and comment on the Municipal Flood Hazard Permit. If the treatment train facility ends up being a state-owned facility not regulated by the municipality under their flood hazard bylaw, it would need to get a State Floodplain Permit.
- If the project falls under the jurisdiction or regulatory review of the Agency of Natural Resources, (i.e., an activity exempt from municipal regulation, which includes agricultural development covered under the Required Agricultural Practices) or the activity requires an Act 250 permit or amendment, then the Flood Hazard Area and River Corridor Rules/Protection Procedure applies. Structures regulated by the state must meet the *no adverse impact* (NSI) standard of the Rule/Procedure, including the compensatory storage and river corridor performance standards. Where State jurisdiction applies:
  - The treatment train facility shall not be placed in a FEMA mapped "floodway" unless a hydrologic and hydraulic analysis shows that it will not increase base flood elevations or velocities. Fill-type development in the flood fringe (i.e., the FEMA-mapped,100-year Flood Hazard Area outside of the floodway) would require compensatory storage. Given the flexibility engendered in a new design, it is not anticipated that the NSI standard would be difficult for a treatment train project to meet, as the pump-house could be placed outside a mapped floodway, and the ponds are excavations and not new fills.
  - The treatment train and associated facilities shall not be placed in a river corridor unless it meets the river corridor performance standard (i.e., it will not limit lateral stream channel migration within the river corridor). If a treatment train is proposed as a new encroachment in a river corridor and it does not meet the performance standard, then it would not be authorized by the Agency of Natural Resources. In the case of a treatment train near a lake-influenced stream (such as the lowest reach of Jewett Brook), the river corridor protection standards will not be applied, if it is demonstrated that the stream segment is nearly always under the influence of lake backwater hydrology (i.e., there is no evidence that the stream adjusts its slope due to the erosion and deposition processes associated with bed-load sediment transport).

5.1.4. Conclusions Regarding the Vermont DEC Rivers Program

At this time, considering the proposed location of the project adjacent to the backwater zone of Jewett Brook, it appears that the rules and procedures administered by the Rivers Program do not pose any insurmountable barriers to the development of a treatment train facility. A Stream Alteration General Permit will be required since the intake structure requires authorization; however, the expected effort for preparing that permit appears low. We expect that any small perennial streams in the project area can be avoided, so we do not expect any new channelization or relocation of streams.

Stone anticipates that further technical analyses will demonstrate no change to the wetted perimeter of the stream resulting from the proposed water withdrawal. It is difficult at this stage to speak to the potential for

changes in water flow (direction and velocity) or bed-load deposition patterns; however, at this time it seems likely that those potential impacts will be minimal. Therefore, Stone anticipates that the project will not be subject to the minimum streamflow requirements of the Stream Flow Procedure.

The potential for exceedance of the temperature criteria in the Water Quality Standards is difficult to assess at this stage. The thermal effects of the treatment train will be considered further in the technical feasibility evaluation phase. Stone expects that thermal effects could be minimized through accommodations in the design and operation of the facility.

Stone anticipates that either a State Floodplain Permit or a Municipal Flood Hazard Permit will need to be obtained, depending on final ownership of the project site. Given that there is no regulatory floodway along the lower reach of Jewett Brook, and that the project will be located above the maximum flood stage of Lake Champlain, we do not anticipate difficulty obtaining either permit.

5.2. Regulations Related to the Vermont DEC Wetlands Program

5.2.1. Vermont Wetland Rules

Reference: Vermont Wetland Rules (as amended), Vermont Agency of Natural Resources, Effective April 1, 2017

Purpose: It is the policy of the State of Vermont to identify and protect significant wetlands and the values and functions which they serve in such a manner that the goal of no net loss of such wetlands and their functions is achieved.

Summary: The Vermont Wetland Rules outline classification of significant wetlands and their buffers; specify how wetlands shall be delineated; provide a framework of functional criteria for evaluating a wetland's significance; define allowed uses; and detail required procedures for filing a permit application for uses not allowed under the rule. A listing of designated Class One Wetlands is also provided.

Sections 5.3 (Fish Habitat) and 5.4 (Wildlife Habitat) of the Vermont Wetland Rules are directly relevant to the proposed project and location. Section 5.3 states that wetlands that provide spawning areas for northern pike are considered significant wetlands. Section 5.4 states that wetlands may be considered significant according to the amount and type of breeding waterfowl that are supported, or if habitat for other wildlife and migratory birds is provided. It is anticipated that these sections of the permit will play a key role in the wetlands application and review.

Meetings:

- Individual Meeting – November 2, 2017
  - Attendees: Gabe Bolin, Stone; Laura LaPierre, VT DEC Wetlands Program; Mike Kline, VT DEC Rivers Program
- Committee Meetings – January 20, 2018 and February 25, 2018

Interpretations:

- If proposing to construct hard infrastructure in a wetland or wetland buffer, the project will require a wetland permit. Impacts to wetland functions and values will need to be evaluated and an avoidance and minimization sequence must be followed.

- The Wetlands Program has a log of wetland areas that have been filled in the past. Their preference is to minimize installation of hard infrastructure in places where the restoration potential for wetlands is high.

5.2.2. Conclusions Regarding the Vermont DEC Wetlands Program

Although the treatment train facility is conceptual at this point, it is almost certain that a pump house will need to be installed near the shoreline of the backwatered stream channel, likely within the 50-foot wetland buffer. While the location of the constructed wetland cells is less certain, they are anticipated to be outside of the Jewett Brook wetlands buffer. At a minimum, the wetlands permit application will need to include a wetland functions and values assessment and an avoidance and minimization sequence for construction of the pump house.

With respect to the constructed wetlands, Stone will evaluate the extent of Class 3 wetlands that may be impacted by the treatment train facility during the technical feasibility evaluation phase. Although Class 3 wetlands are outside the jurisdiction of the Vermont Wetlands Program, the U.S. Army Corps of Engineers regulates Class 3 wetlands and requires mitigation or payment of an in-lieu fee if more than 10,000 square feet of Class 3 wetlands are impacted.

It is anticipated that in Phase 2, Stone will consult with the Wetlands Program regarding their log of wetland areas that have been filled in the past within the project vicinity. For those project components (primarily the pump house) that will be installed within the Class 2 wetlands buffer, Stone will attempt to site those components in areas where there is low potential for wetland restoration.

5.3. Regulations Related to the Vermont Fish & Wildlife Department

The Vermont Fish & Wildlife Department does not administer any relevant permit programs. However, the Department typically comments on certain permits, including those related to the following rules and procedures, already summarized above:

- Environmental Protection Rule, Chapter 27, Vermont Stream Alteration Rule (Effective March 10, 2017)
- Vermont Agency of Natural Resources Streamflow Procedure, Agency Procedure for Determining Acceptable Minimum Stream Flows (Effective July 14, 1993)
- Vermont Agency of Natural Resources, Vermont Wetland Rules (Adopted February 7, Amendments adopted January 26, 2017, Effective April 1, 2017)
- Army Corps of Engineers permits
- Section 401 of the Clean Water Act Water Quality Certification

Meetings:

- Individual Meeting – November 29, 2017
  - Attendees: Gabe Bolin, Stone; Bernie Pientka, Vermont Fish & Wildlife Department
- Committee Meetings – January 20, 2018 and February 25, 2018

Interpretations:

- Minimum streamflows between the intake and discharge points of the project must be maintained.
- Temperature fluctuations or temperatures outside their normal range can lead to physiological impacts on fish and other aquatic organisms. Drawing off water from the stream and conveying the

flow through a series of constructed wetlands of varying depth and solar exposure could result in discharge of warmer, treated water to Jewett Brook. As northern pike are known to spawn in Jewett Brook and the Black Creek Wetland, avoiding temperature impacts on pike populations is a primary concern.

- Concerns exist regarding the potential for impingement and entrainment of fish larvae and other aquatic organisms at the intake pipe. The Black Creek Wetland and Jewett Brook are potential spawning locations for many warm water species. Northern pike populations use these backwater areas for reproduction and lay eggs in flooded vegetation. Larval fish are especially vulnerable to impingement and entrainment at intakes due to their low swim speeds.
- Impacts to existing circulation patterns is also a concern. Existing currents and circulation patterns in the backwatered area are typical of a bay system receiving fluvial flows. The usual flow regime is from Jewett Brook and Stevens Brook through the Black Creek Wetland to Lake Champlain. Fish and other animals are affected by water circulation patterns as they change from season to season.

5.3.1. Conclusions Regarding the Vermont Fish & Wildlife Department

Minimum Flows

The Vermont Fish & Wildlife Department has expressed concerns regarding maintaining minimum streamflows. Most of these concerns would be addressed by locating the intake in the backwatered segment of Jewett Brook. The technical feasibility phase of this project will include confirmation that operation of the facility would not result in any change to the wetted perimeter of Jewett Brook (i.e., no change in water levels will occur).

Temperature Impacts

The backwatered segment of Jewett Brook is approximately 8-10 feet deep. The impact of potentially warmer water discharged from the treatment train to the backwatered segment of the stream are not quantifiable at this time. Evaluating the resultant temperature changes will be one of the primary objectives of the technical feasibility evaluation phase of the project. Jewett Brook is classified as Warm Water Fish Habitat (VT ANR 2017). Accordingly, the applicable temperature standards for Jewett Brook—assessed at the boundaries of a 200-ft long mixing zone about the discharge point—are as follows (VT ANR 2017):

Table 2. Temperature Change Standards for Jewett Brook

Stream temperature (°F)	Allowable temperature change at mixing zone boundary (°F)
>66	1
63 - 66	2
59 - 62	3
55 - 58	4
<55	5

Mitigation strategies to minimize potential thermal impacts include decreasing pumping rates during periods of high temperatures and low streamflows, withdrawing and discharging water during the morning hours

when the stream water and water retained in the wetland cells would be coolest, and shading wetland cells. Another possibility is designing a deep, narrow, shaded pond as the last component of the treatment train.

Impingement and Entrainment of Fish Larvae

Impingement and entrainment of larval fish are concerns we expect can be minimized through accommodations in the design and operation of the facility. Mitigation strategies to reduce the potential for larval fish impingement and entrainment could include installation of screens, sizing the intake pipe appropriately to reduce flow velocity, and reducing pumping rates during peak spawning periods. For a given flow rate, increasing the intake pipe size will result in lower water velocities at the intake. During design phases, Stone will investigate intake pipe sizes and intake velocities to balance pumping rates and the risk of entrainment and impingement of larvae and juveniles. Stone plans to work closely with the Vermont Fish & Wildlife Department to address this issue in the facility design.

Circulation Patterns

When streamflows are high in the spring, impacts from the treatment train system are not expected. We also do not believe the facility could have any appreciable effect on circulation patterns in the Black Creek Wetland downstream of the discharge location. However, during low flow conditions changes may occur in the circulation pattern between the intake and the discharge location in the backwatered segment of Jewett Brook. Potential mitigation strategies include reducing pumping rates during periods of low streamflow. The potential for significant changes in the circulation patterns in the backwatered segment of Jewett Brook will be characterized in the technical feasibility evaluation.

5.4. Regulations Related to the Vermont DEC Lakes and Ponds Program

5.4.1. Lake Shoreland Protection Standards

Reference: 10 V.S.A. Chapter 49A: Lake Shoreland Protection Standards

Purpose: The purposes of these standards are varied and are best summarized in 10 V.S.A. Chapter 49A, Subsection 1441, Purpose.

Summary: The Lake Shoreland Protection Standards provide standards related to the creation of impervious surfaces or cleared areas adjacent to lakes and ponds; mitigate, minimize, and manage impacts of new impervious surfaces and cleared areas; mitigate damage from floods and erosion in lands adjacent to lakes; accommodate creation of impervious surfaces and cleared lands to allow for reasonable growth; protect rights for views and uses of lakes; and preserve economic benefits of lakes and their shorelines. These rules provide for the stability of shorelines, the protection of aquatic biota and the habitat of wildlife and aquatic life, and the prevention of water quality degradation. *[Source: Subsection 1441, Purpose, V.S.A. 10 Chapter 49A, Lake Shoreland Protection Standards]*

Meetings:

- Individual Meeting – February 2, 2018 (via phone)
  - Attendees: Gabe Bolin, Stone; Perry Thomas, VT DEC Lakes and Ponds Program
- Committee Meeting – February 25, 2018 (Angela Shambaugh representing the Lakes and Ponds Program)

Interpretations:

- A Shoreland permit will be required if constructed wetlands are planned within 250 feet of the mean water elevation of Lake Champlain, which is 99.5 feet (assumed to reference the NGVD 29 vertical datum).

5.4.2. Management of Lakes and Ponds

Reference: 29 V.S.A. Chapter 11: Management of Lakes and Ponds

Purpose: Lakes and ponds which are public waters of Vermont and the lands lying thereunder are a public trust, and it is the policy of the State that these waters and lands shall be managed to serve the public good, as defined by Section 405 of this title, to the extent authorized by statute. *[Source: 401, Policy, Management of Lakes and Ponds]*

Summary: Encroachment means: 1) To place or cause to be placed any material or structure in any lakes and ponds which are public waters; or 2) To alter, or cause to be altered, the lands underlying any public waters; or 3) To place or cause to be placed any bridge, dock, boathouse, cable, pipeline, or similar structure beyond the shoreline delineated by the mean water level of any lakes and ponds which are public waters, and to the lower sections of tributaries to Lake Champlain, Lake Memphremagog, and the Connecticut River. Any project that proposes work at, below, or beyond mean water level may require a Lake Encroachment permit. *[VT DEC website at: http://dec.vermont.gov/watershed/lakes-ponds/permit/encroachment]*

Meetings:

- Individual Meeting – February 2, 2018 (via phone)
  - Attendees: Gabe Bolin, Stone; Perry Thomas, VT DEC Lakes and Ponds Program
- Committee Meeting –February 25, 2018 (Angela Shambaugh representing the Lakes and Ponds Program)

Interpretations:

- An encroachment permit will be required if an intake pipe extending into the lower section of Jewett Brook is larger than 2 inches in diameter. A statement that this project provides for the public good will be required.

5.4.3. Conclusions Regarding the Vermont DEC Lakes & Ponds Program

The Shoreland Program is primarily focused on land clearing, the creation of impervious surfaces, and activities within the 250-foot buffer of public waters. Projects need to be sited a minimum of 100 feet from the shoreline unless development already exists in that area. It is likely that a portion of the constructed wetland area will lie between 100 and 250 feet of the shoreline delineated by Lake Champlain's mean water level. Although the project would result in a change to the existing land use (say, from a corn field to a constructed wetland) the question becomes: is the project actually improving the condition of the shoreline? This can be posed to the Lakes and Ponds Program prior to any filing of the permit. Additionally, the project introduces the possibility of a 'naturalization' project, wherein, in addition to the constructed wetlands, trees or other natural elements could be installed to further improve the condition of the shoreline.

Regarding 29 V.S.A. Chapter 11, because an intake pipe of 12-inch or larger diameter is anticipated, the filing of this permit is clearly required. The statement regarding public good, which will be part of this application, will state that the purpose of the treatment train system is to remove phosphorous from the Jewett Brook and St. Albans Bay system, with the goal of improving the water quality of the bay and the quality of life of nearby residents.

5.5. Regulations Related to the Vermont DEC Wastewater Division

5.5.1. Federal Clean Water Act

Regulation Summary: The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

Meetings:

- Individual Meeting – February 16, 2018 (via phone)
  - Attendees: Gabe Bolin, Stone; Jessica Bulova, VT DEC Wastewater Program
- Committee Meetings – none

Interpretations:

- The goal is to show that there is minimal to no impact on pH and on the temperature of the receiving water.
- If alum is to be used in treatment, a Reasonable Potential Analysis/Determination (RPD) will be performed by the Wastewater Division.
- A review can take up to 150 days.

5.5.2. Conclusions Regarding the VT DEC Wastewater Division

Assuming a chemical agent is used to coagulate and precipitate phosphorus, Stone would assist the Wastewater Division in preparing an RPD. We do not anticipate that this process will pose a regulatory obstacle to the project.

5.6. Regulations Related to the U.S. Army Corps of Engineers

5.6.1. Water Quality Certification (Section 401)

Regulation Summary: Under Section 401(a)(1) of the Clean Water Act (33 USC § 1341), states have the authority to review and approve, condition, waive, or deny water quality certification for any activity that is subject to a federal permit or license and that may result in a discharge to waters of the United States.

In Vermont, Section 401 Water Quality Certification (WQC) applications are reviewed to determine if the proposed activity will comply with the Vermont Water Quality Standards and other state requirements. Section 401 authority applies, for example, to projects requiring a permit from the U.S. Army Corps of Engineers (USACE) or a hydropower license from the Federal Energy Regulatory Commission (FERC). *[Source: http://dec.vermont.gov/watershed/business-support/water-quality-certification-section-401]*

Meetings:

- Individual Meetings – January 19, 2018 and February 6, 2018 (both via phone)
  - Attendees: Gabe Bolin, Stone; Mike Adams, USACE
- Committee Meetings – January 20, 2018 and February 25, 2018

Interpretations:

- The project will most likely trigger USACE jurisdiction due to either temporary or permanent impacts in wetlands. It may also trigger jurisdiction if excavating to install an intake and discharge pipe.

- If impacting more than 10,000 ft^2 of wetlands (regardless of class), it will be necessary to either provide for mitigation or pay an in-lieu fee.
- This may require an individual water quality certification.

5.6.2. Conclusions Regarding the U.S. Army Corps of Engineers

Stone expects that the Vermont DEC Rivers Program, the Lakes and Ponds Program, and the Vermont Fish & Wildlife Department will provide comment on the WQC application. It is possible other programs will provide comments as well. We expect the technical analyses conducted in Phase 2 and further analyses to support full engineering design of the facility in Phase 3 will demonstrate compliance of the proposed treatment train facility with Vermont Water Quality Standards.

6. Permits and Mitigation of Regulatory Concerns

6.1. Permits

Execution of the regulatory feasibility phase of this project has produced two lists that will prove useful in moving the project forward. The first is a list of permits that Stone believes will be required.

- VT DEC – Stream Alteration General Permit (for the intake structure)
- VT DEC – Wetlands Permit
- VT DEC – Lakes and Ponds Encroachment Permit
- VT DEC – Wastewater Program Discharge Permit
- State Floodplain Permit – or – Municipal Flood Hazard Permit, depending on site ownership
- Town of St. Albans Building Permit
- USACE – 401 Water Quality Certification (including conditions identified by Vermont Fish and Wildlife to protect fish populations)

The following additional permits may need to be filed, depending on the proposed site and design (as described in parentheses):

- VT DEC – Streamflow Protection Rule (if the intake is moved upstream above the backwatered channel)
- VT DEC – Lakes and Ponds Shorelands Permit (if constructed wetlands are within 250 feet of the shoreline at the mean water level)
- USFWS permit related to incidental taking of a threatened or endangered animal or plant (to be considered during Phase 2 of the project).

6.2. Mitigation of Regulatory Issues

In addition to the lists of permits above, communication with program administrators and staff produced a significant list of concerns regarding the project, as discussed in Section 5. These concerns are summarized in Table 3. Potential solutions to address each concern are listed in the right most column of the table. For clarity, the concerns that need to be further addressed under Phase 2 or during a subsequent phase are shown in bold; those that are thought not to be an issue at this point are not bold. Some of the concerns that need to be addressed under Phases 2 and 3, specifically flow/current and water temperature impacts, are discussed in more detail in Section 7.

Note that many of these concerns would be addressed by locating the facility in the backwatered segment of Jewett Brook. If the preferred location does not work due to land acquisition or other obstacles, and the project needs to move upstream where there is no lake backwater condition, an individual VT DEC Stream Alteration Permit will have to be filed and the Streamflow Protection Rule stipulations will need to be

addressed in the Stream Alteration and Wetland Permits and in the USACE 401 Water Quality Certification. A 'special low flow study' may also be required.

Table 3. Regulatory Concerns and Potential Mitigation Strategies

Agency	Rule/Procedure	Concern	Potential Mitigation
VT DEC Rivers Program	Stream Alteration Rule	Assuming most P load is conveyed during storm events, suggest determining P load in base flow vs. storm events	To be addressed during technical feasibility phase
VT DEC Rivers Program	Minimum Stream Flows	Reduced minimum streamflows during low flow periods due to water withdrawal	Withdraw water from backwater zone
VT DEC Rivers Program	Minimum Stream Flows	Need to maintain streamflows between intake and discharge	Withdraw water from backwater zone
VT Fish & Wildlife	General concern for fish and wildlife	Fish impingement and/or entrainment of fish larvae at system intake	Installation of innovative screens Sizing the intake pipe to reduce flow velocities Reducing pumping rates during peak spawning periods
VT Fish & Wildlife	General concern for fish and wildlife	Negative physiological effects to aquatic organisms due to temperature fluctuations outside of the normal range at discharge location	Considering alternate outlet structures Decreasing pumping rates during periods of high temperatures and low streamflows Withdrawing and discharging water during hours when the stream and wetland cells would be coolest Shading wetland cells using emergent vegetation and shrubs Designing a deep, shaded pond as the last component of the treatment train
VT Fish & Wildlife	General concern for fish and wildlife	Potential for impacts to natural hydrology and flow regime/currents within backwatered area of Jewett Brook	To be addressed during technical feasibility and facility design phases
VT Fish & Wildlife	Minimum Stream Flows	Loss of water depth during dry/wet weather conditions	Withdraw water from backwater zone

Agency	Rule/Procedure	Concern	Potential Mitigation
VT Fish & Wildlife	Minimum Stream Flows	Fish entrapment due to water surface fluctuations	Withdraw water from backwater zone
VT Fish & Wildlife	General concern for fish and wildlife	Impacts to WMA overall, i.e. impacts to fish and waterfowl habitat	Continue to investigate BMPs to eliminate or reduce impacts to northern pike and waterfowl and their habitat
VT DEC Wetlands Program	Wetland Rules	Need wetland functions and values assessment to determine if functions and values have been adversely affected	A functions and values assessment will be provided as part of the permit application
VT DEC Wetlands Program	Wetland Rules	A decommissioning plan is recommended	A decommissioning plan will be provided as part of the permit application
VT DEC Wetlands Program	Wetland Rules	Need to evaluate all practicable alternatives to the system and show that in selecting the facility location all options that do not impact wetlands were exhausted	An avoidance and minimization analysis will be provided as part of the permit application
VT DEC Wetlands Program	Wetland Rules	Wetland restoration potential: If project area has low wetlands restoration potential, that would be more favorable; if project is in an area with high wetlands restoration potential, it would not be as favorable	This will be taken into consideration during site selection
USACE	General Concern	Most likely to trigger USACE jurisdiction with either temporary or permanent impact in wetlands, regardless of wetland class (typically a 10,000-ft^2 threshold is applicable to required mitigation or in-lieu fee payments)	This will be taken into consideration during design and site selection
USACE	General Concern	Be aware of archaeological issues with respect to site selection	This will be taken into consideration during site selection
USACE	General Concern	Be aware of endangered species, particularly northern long eared bat and Indiana bat with respect to any tree clearing and construction	This will be taken into consideration during timing of construction
USACE	General Concern	Be certain to reference the NGVD29 vertical datum on all engineering plans	Future engineering and design plans will reference the NGVD29 vertical datum

7. Future Steps

Anticipating a successful outcome of the Regulatory Feasibility Evaluation phase and the award of funding for subsequent phases of the project, the following provides a project schedule, taking us from the current Regulatory Feasibility phase through implementation of the treatment train facility. Note that this schedule is preliminary, and it is most likely that the primary tasks and anticipated timelines provided, especially for Phases 3 through 5, will be modified as the project advances.

Table 4. Proposed Schedule

Phase	Primary Tasks	Anticipated Timeline
Phase 1 – Regulatory Feasibility Evaluation	Evaluate feasibility from a regulatory standpoint Establish level of interest/support among federal, state, and local government bodies	March 2018
Phase 2 – Technical Feasibility and Cost Analysis	Analyze P loading patterns and potential for achieving TMDL loading targets Assess streamflow treatability Evaluate potential facility sites Delineate wetlands on potential site(s) Evaluate need for determinations related to threatened and endangered animals and plants Evaluate potential temperature impacts Perform preliminary assessment of changes in flow regime Develop conceptual design Perform cost analysis Analyze alternatives (more BMPs)	May – Dec. 2018
Phase 3 – Engineering and Permitting	Prepare final design and permit applications	2019
Phase 4 – Land Ownership and Facility Operations	Acquire land Establish facility operating agreements and procedures	2020
Phase 5 – Construction	Construction	2021

References

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