Johnson Stormwater Master Plan

Final Report

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I. Disclaimer

The intent of this report is to present the data collected, evaluations, analyses, designs, and cost estimates for the Johnson Stormwater Master Plan under a contract between the Lamoille County Conservation District and Watershed Consulting Associates, LLC. Funding for the project was provided by the Vermont Department of Environmental Conservation's Clean Water Fund Grant. The plan presented is intended to provide the Town's stakeholders a means by which to identify and prioritize future stormwater management efforts. This planning study presents a recommended collection of Best Management Practices (BMPs) that would address specific concerns that have been raised for this area. There is great need to reduce stormwater impacts including phosphorus and sediment loading from stormwater runoff to receiving waters, especially within municipalities in the greater Lake Champlain Basin considering current and future regulation under the Lake Champlain Total Maximum Daily Load (TMDL). Although there are other BMP strategies that could be implemented in the study area, those presented in this document are the sites and practices that project stakeholders believe will have the greatest impact and probability of implementation. These practices do not represent a regulatory obligation at this time, nor is any property owner within the Town obligated to implement them. However, it should be noted that for properties with three or more acres of impervious cover without a current State stormwater permit, regulations require stormwater management for existing impervious areas. This stormwater master plan, and therefore its resultant strategies, is one of the actions in the Lamoille Tactical Basin Plan. The BMP strategies identified in this stormwater master plan will be put in queue for funding for implementation.

II. Glossary of Terms

Best Management Practice (BMP)- BMPs are practices that manage stormwater runoff to improve water quality and reduce stormwater volume and velocity. Examples of BMPs include gravel wetlands, infiltration basins, and bioretention practices.

Buffers- Protective vegetated areas (variable width) along stream banks that stabilize stream banks, filter sediment, slow stormwater runoff velocity, and shade streams to keep waters cool in the summer months.

Channel Protection Volume (CPv)- The stormwater volume generated from the one-year, 24-hour rainfall event. Management of this event targets preventing stream channel erosion.

Check Dam- A small dam, often constructed in a swale, that decreases the velocity of stormwater and encourages the settling and deposition of sediment. They are often constructed from wood or stone.

Detention BMP- A BMP that stores stormwater for a defined length of time before it eventually drains to the receiving water body. Stormwater is not retained in the practice. The objective of a detention BMP is to reduce the peak discharge from the BMP to reduce channel erosion and settle out pollutants from the stormwater. Some of these practices also include additional water quality benefits. Examples include gravel wetlands, detention ponds, and non-infiltration-dependent bioretention practices.

Drainage Area- The area contributing runoff to a specific point. Generally, this term is used for the area that drains to a BMP or other feature like a stormwater pipe.

Hydrologic Soil Group- A Natural Resource Conservation Service classification system for the permeability of soils. They are categorized into four groups (A, B, C, and D) with "A" having the highest permeability and "D" having the lowest.

Infiltration/Infiltration Rate- Water percolating into the ground surface. The rate at which this occurs (infiltration rate) is generally presented as inches per hour.

Infiltration BMP- A BMP that allows for the infiltration of stormwater into the subsurface soil as groundwater, which returns to the stream as baseflow. Mapped soils of Hydrologic Group A or B (sandy, well-drained soils) are an indicator of infiltration potential. Infiltration reduces the amount of surface storage required. Typical infiltration BMP practices include infiltration trenches, bioretention practices, subsurface infiltration chambers, infiltration basins, and others.

Outfall- The point where stormwater discharges from a system like a pipe.

Sheet Flow- Stormwater runoff flowing over the ground surface in a thin layer.

Stabilization- Vegetated or structural practices that prevent erosion from occurring.

Stormwater/Stormwater Runoff- Precipitation and snowmelt that runs off the ground surface.

Stormwater Master Plan (SWMP)- A comprehensive plan to identify and prioritize stormwater management opportunities to address current and prevent future stormwater related problems.

Stormwater Permit- A permit issued by the State for the regulated discharge of stormwater.

Swale- An open vegetated channel used to convey runoff and to provide pre-treatment by filtering out pollutants and sediments.

Total Maximum Daily Load (TMDL) – A TMDL is a calculation of the maximum pollutant loading that a water body can accommodate and still meet Vermont Water Quality Standards. The term TMDL also refers to the regulated management plan, which defines how the water body will be regulated and returned to its acceptable condition. This includes the maximum loading, sources of pollution, and criteria for determining if the TMDL is met.

Total Phosphorus (TP)- The total phosphorus present in stormwater. This value is the sum of particulate and dissolved phosphorus. It includes both organic and inorganic forms.

Total Suspended Solids (TSS)- The total particulate matter suspended in the water column.

Watershed- The area contributing runoff to a specific point. For watersheds like Gihon River, this includes the entire area draining to the point where the river discharges to the Lamoille River.

Water Quality Volume (WQv)- The stormwater volume generated from the first inch of runoff. This runoff is known as the 90th percentile rainfall event and contains the majority of pollutants associated with a runoff event.

1 Introduction

1.1 The Problem with Stormwater

Stormwater runoff is any precipitation including melting snow and ice that runs off the land. In undeveloped areas, much of the precipitation is infiltrated into the ground, taken up by plants, or evaporated back into the atmosphere. However, when human development limits or completely prevents this natural sponge-like effect of the land, generally through the introduction of impervious areas such as roads, parking lots, or buildings, the volume of stormwater runoff increases, sometimes dramatically. In addition to the increased volume of stormwater runoff, the runoff is also frequently laden with pollutants such as sediment, nutrients, oils, and pathogens. These stormwater runoff related issues decrease aquatic habitat health, increase flooding and erosion, threaten infrastructure, and prevent use and enjoyment of our water resources. Traditionally, stormwater management techniques have relied heavily upon gray infrastructure, where stormwater is collected and conveyed in a network of catchbasins and pipes, prior to discharging to surface waters (i.e. streams, rivers, ponds, lakes, and coastal waters). Although this approach is effective in removing stormwater from developed areas, it does not eliminate the problem and has proved to worsen negative stormwater effects such as erosion, flooding, and nutrient pollution. It is clear that something must change. This is where stormwater master planning comes into play. Funding is limited to implement projects that will improve water quality and reduce the negative impacts of uncontrolled stormwater runoff. As such, creating a plan of where and how to best use these funds to provide the greatest benefit to our water resources is key.

1.2 What is Stormwater Master Planning?

In the wake of rapid urban development and increasing rainfall intensity, stormwater management that seeks to mimic the undeveloped environment and treat stormwater runoff as close to the source as possible has become the focus of efforts to mitigate flooding and maintain the health of our waterways. Given the complexity of current stormwater issues, the development of the Stormwater Master Planning process provides communities with a range of possibilities for stormwater mitigation from small-scale (i.e. individual parcels) to large-scale (i.e. community-wide). Stormwater rarely follows political or parcel boundaries and tackling this problem from a strategic perspective is key to preventing future problems and addressing current sources of water quality degradation. This process was developed because many of the developed areas within the State of Vermont predate regulatory requirements for stormwater management, but these distributed and unmanaged areas are contributing to the impairments of our surface waters, including Lake Champlain. These unmanaged stormwater discharges can be identified and addressed through this Stormwater Master Planning process. The process allows for assessment and prioritization of areas most in need of mitigation while acknowledging that, for many areas, these types of stormwater retrofits are voluntary. Public awareness of both stormwater problems and stormwater management practices are critical to the Stormwater Master Planning process. As such, working with municipal officials, project stakeholders, and community members is key to implementation of and support for these plans. Stormwater Master Planning involves analysis of current and anticipated future conditions, and seeks to prioritize stormwater solutions, maximizing the potential for water quality improvement, flood mitigation, erosion reduction, and pollution prevention using a variety of best management practices (BMPs) and allocating limited funds in a planned and methodical way.

2 Guidelines

In May 2013, the State of Vermont Department of Environmental Conservation (VT DEC) issued a document titled *Vermont Stormwater Master Planning Guidelines*, designed to provide VT communities with a standardized guideline and series of templates. The document assists communities in planning for future stormwater management practices and programs. This Plan is a combination of Templates 2A: Hybrid site & community retrofit approach with green stormwater infrastructure (GSI) stormwater management, and 3A: Large watershed or regional approach with planned build out analysis and traditional (end of pipe or centralized) stormwater management.

Vermont has had stormwater regulations in place since 1978, with updates concerning unified sizing criteria made in 2002 and again in 2017. Recognizing that stormwater management can be a costly endeavor, the new guidelines are written to help identify the appropriate practices for each watershed, community, and site, in order to maximize the use of limited funds.

The guidelines encourage each stormwater master plan (SWMP) to follow the same procedures, and include:

- Problem Definition
- Collection of Existing Data
- Summary and Recommendations
- Existing and Proposed Program, Procedure, or Practice Evaluation
- Development of New Data

In keeping with these guidelines, we have prepared the following report.

3 Background

3.1 Existing Conditions

The study area for this Stormwater Master Plan (SWMP) includes the Town and Village of Johnson, Vermont (Figure 1). Focus areas within the Town include the VT-15 corridor through the Village Center and more heavily developed areas such as the Northern Vermont University (NVU) campus. Johnson is located in Lamoille County on the banks of the Gihon River and the Lamoille River, which ultimately drain to Lake Champlain. The study area spans 29,245 acres, approximately 82% of which is classified as forested while 1.6% of the Town is classified as urban (including urban open space). Of that area, there are 441 acres (1.5%) of impervious cover.

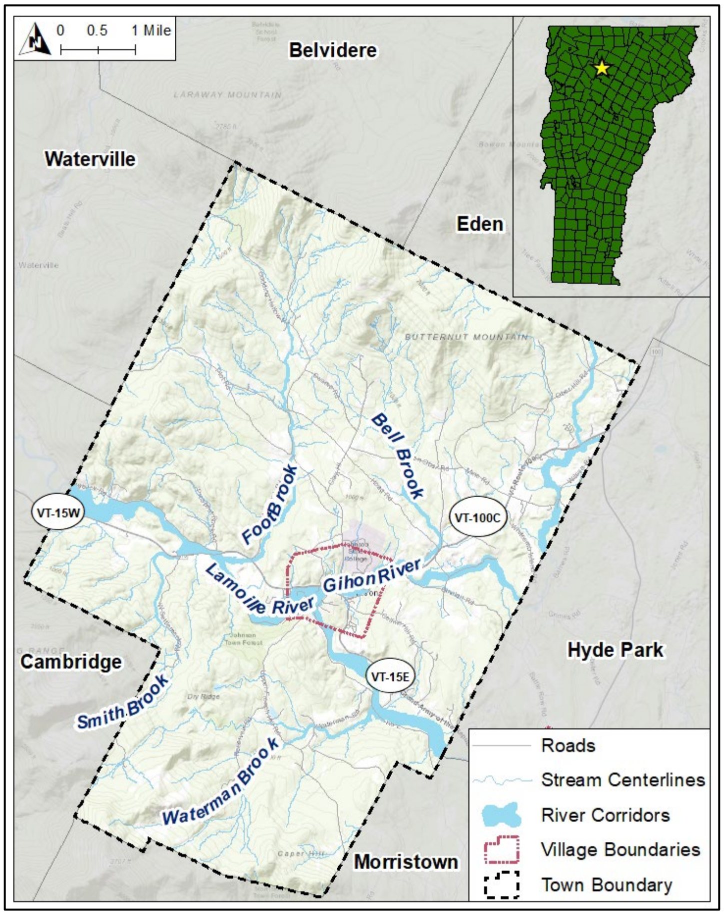

Figure 1. The Town of Johnson is located in Lamoille County, VT.

While much of the Town is considered rural, there are areas of urban, commercial, and industrial development found along Route VT-15. Mixed agricultural lands can also be found through the Town. 89% of soils in the study area are classified as either highly erodible or potentially highly erodible by the latest Natural Resources Conservation Service (NRCS) soil mapping data. Additionally, the majority of soils in the Town have low infiltration potential as indicated by NRCS Hydrologic Soil Group classifications where soils are classified from group A (highest infiltration potential) to group D (lowest infiltration potential). In the study area, most soils belong to Hydrologic Soil Group C (42%) while only 16% are in group A. 18% are in group B and 21% are in group D. The remainder are classified as water or unclassified. This combination of steep slopes with limited infiltration capacity and a highly erodible surface makes the area particularly susceptible to erosion.

A larger overview map of the Town and maps depicting existing watershed conditions can be found in Appendix 1 - Map Atlas. Maps include:

- river corridors, wetlands, and hydric soils;
- impervious cover;
- soil infiltration potential;
- soil erodibility;
- land cover;
- slope;
- stormwater infrastructure;
- stormwater permits;
- and parcels with ≥3 acres of impervious cover.

3.2 Problem Definition

Johnson is located primarily within the Brewster River-Lamoille River, Gihon River, and Kenfield Brook-Lamoille River watersheds, though a small portion falls within the North Branch Lamoille River watershed (Figure 2). All four watersheds are tributaries of the Lamoille River. The Lamoille River has numerous reaches that are adversely impacted by development.

Four segments of the Lamoille River are designated as impaired on the State's 303(d) list of waters due to numerous dams and elevated mercury levels measured in fish. One segment of the river is also on the State's 2016 Stressed Waters List due to elevated mercury levels measured in fish.

Although surface waters within the Town of Johnson are not currently designated as stressed or impaired, it is important that efforts remain focused on ensuring the future health of the Town's surface waters. With that in mind, waters just downstream of Johnson, including the North Branch of the Lamoille River and the Brewster River, have been negatively affected by human activities.

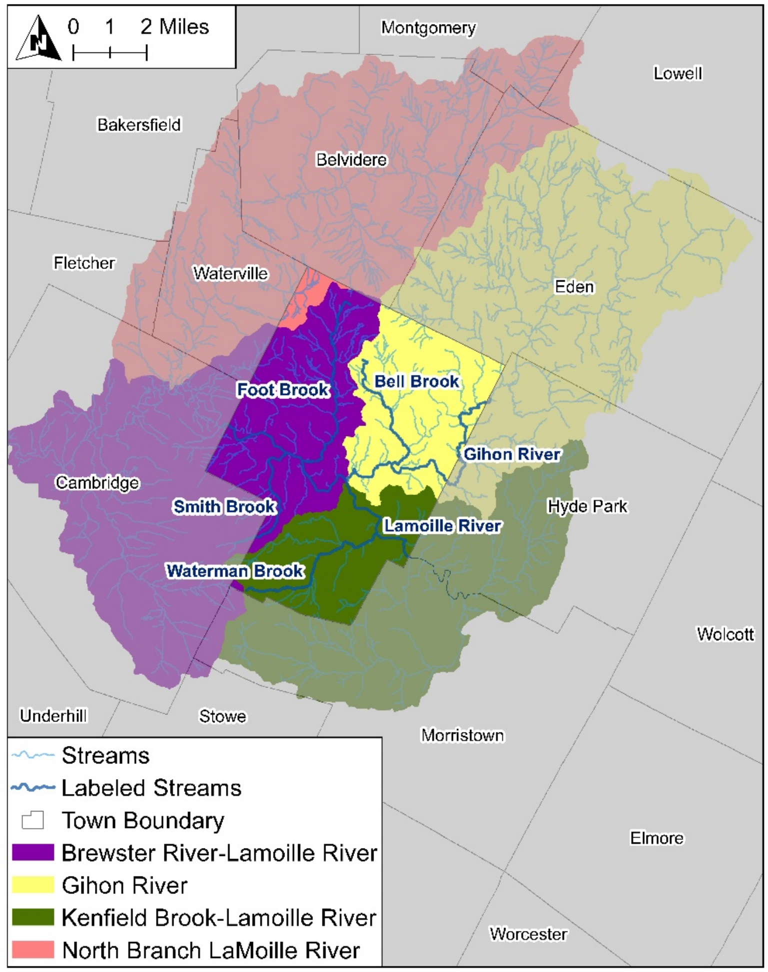

Figure 2. The Town of Johnson is located primarily within the Brewster River-Lamoille River (purple), Gihon River (yellow), and Kenfield Brook-Lamoille River (green) watersheds, tributaries of the Lamoille river.

The Village of Johnson faces many challenges as it includes developed areas that drain to the Gihon River and the Lamoille River. Areas of concentrated impervious cover include historic, industrial, commercial, and residential development. Many of the older developments within this area were constructed before current stormwater standards were developed, and they were constructed without any or with only minimal stormwater management. This has resulted in untreated stormwater draining developed lands, transporting pollutants and discharging to surface waters.

Johnson has experienced considerable development along Route 15 with expanding areas of impervious surfaces. Route 15 parallels the Lamoille River as it bisects the town with development falling in or close to the river corridor. Although less developed, Route 100C closely parallels the Gihon River and flows through the Village before its confluence with the Lamoille River by Railroad Street. Development around the Gihon River has constrained the river along both banks in some areas. In addition to expanding development along these corridors, Johnson experiences erosion as a result of steep slopes and poor soils, further contributing to sediment and nutrient loading in surface waters.

Outside of the development concentrated around the intersection of Route 100C and Route 15 in the Village of Johnson and along the Route 15 corridor, the remainder of the Town is more sparsely developed with scattered rural residential and agricultural development throughout. In addition to expanding development along the river corridors for the Lamoille and Gihon Rivers, Johnson has many steep gravel roads that further contribute sediment and nutrients to surface waters. These roads and associated infrastructure can also constrain smaller tributaries, especially during storm events. Many of these roads have steep slopes, and traverse large areas. Furthermore, the rural roads access residential driveways which often convey drainage into and through the Town road drainage system. This is a problem because runoff from private lands is negatively impacting the Town's overall drainage system.

The human-influenced stressors in the Town include commercial development and associated parking areas, construction of roads, residential development, and clearing of previously forested areas. Unmanaged stormwater runoff, particularly from impervious surfaces and landscaped pervious surfaces exacerbate the occurrence of nuisance flooding as well as more extreme flood events. The Lamoille River watershed and its tributaries, specifically the Gihon River, have experienced extreme flooding in the past, and these flood events are expected to occur more frequently due to the predicted increased frequency and intensity of extreme weather events associated with climate change. The stormwater management practices investigated seek to protect local river resources as well as the larger Lake Champlain Basin, which currently has a Total Maximum Daily Load (TMDL) in place that requires significant reductions in phosphorus loading to Lake Champlain.

4 Methodology

4.1 Identification of All Opportunities

4.1.1 Initial Data Review and Kickoff Meeting

Relevant prior watershed studies and work previously completed in the Town was reviewed in the context of this SWMP study. This includes the 2016 Lamoille River Tactical Basin Plan, the VT DEC's Stormwater Mapping Projects for the Town of Johnson and the Northern Vermont University Johnson Campus, the 2014 Lamoille County Road Erosion Assessment Report, the 2018 Foote Brook Phase I & II Geomorphic Assessment, the 2009 Gihon River Corridor Plan, and the 2010 Lamoille River Corridor Plan.

Relevant Geographic Information System (GIS) data was drawn from a variety of public resources including the Agency of Natural Resources' Atlas, Vermont Center for Geographic Information Open Geodata Portal, and data created by the University of Vermont's Spatial Analysis Lab. A file geodatabase was created to ensure organization and for ease of use. These data represent the "best available" data at the time of data collection (2019). See Appendix 2 - Data Review.

The project team met with Town and Village of Johnson and Northern Vermont University (NVU) stakeholders and the Lamoille County Conservation District (LCCD) on June 20th, 2019 to discuss the SWMP and solicit information on known problem areas. See Appendix 3 - Project Kickoff. During this meeting, a list of potentially important sites was discussed with the project team. This list included particular parcels as well as general areas of importance. These areas were noted and added to the list of sites identified during the desktop assessment (Section 4.1.2.1).

4.1.2 Desktop Assessment and Digital Map Preparation

4.1.2.1 Desktop Assessment

A desktop assessment was completed to identify additional potential sites for stormwater BMP implementation. This process involved a thorough review of existing GIS resources and associated attribute data as well as other resources.

Two such resources include the Town of Johnson Stormwater Mapping Project completed by the VT DEC in 2012 and the Northern Vermont University Johnson Campus Stormwater Mapping Project completed by the VT DEC in 2018. These stormwater infrastructure mapping projects provided current drainage maps and potential locations of stormwater retrofit sites for the municipality and school. Designated priority areas, noted in the Town of Johnson's Stormwater Mapping Project, were assessed as part of this SWMP (see Appendix 2 – Data Review for report and maps). Priority areas were not designated for the Northern Vermont University Johnson Campus Stormwater Mapping Project.

Another resource utilized during the desktop assessment was the Lamoille County Road Erosion Assessment Report. This assessment was conducted in the field season 2014 by the Lamoille County Planning Commission with assistance from Watershed Consulting Associates, LLC. The inventory was completed to help the Town prepare for compliance with the (then pending) Municipal Roads General Permit (MRGP), issued in early 2018. The assessment looked at how well hydrologically connected road segments were complying with MRGP standards such as road crown, berm issues, ditches, cross culverts, driveway culverts, outfalls, and presence of rill or gully erosion.

GIS data was then reviewed. Data included, but was not limited to, storm sewer infrastructure, soils classifications, parcel data, wetlands, and river corridors. This data was used to identify and map stormwater subwatersheds with high impervious cover, stormwater subwatersheds that are more directly connected to water bodies (direct pipes to streams or via overland flow), and areas that may have worsening stormwater impacts in the future. A point location was created for each identified site or area for assessment in the field.

During this initial BMP identification, and after incorporating problem areas noted by the Town, a total of 37 locations were identified for field investigation. See Appendix 4 - Desktop Assessment.

4.1.2.2 Digital Map and App Preparation

In order to maximize efficiency in the field and better understand site-specific conditions, digital base maps were created for the Town. The maps show parcel boundaries, public parcels, stormwater infrastructure, hydrologic soils groups, river corridors, hydric soils, and wetlands. This information was used in the field to assess potential feasibility issues for proposed practices and to better identify preliminary BMP locations.

The base layers were pre-loaded into a project-specific mobile app that was customized for this project using the Fulcrum platform[1]. The app was also pre-loaded with the 37 point locations for the potential BMP sites. These points allowed for easy site location and data collection in the field (Figure 3).

The app was used to collect information including site suitability, photographic documentation, follow-up notes, and other pertinent data. All collected data was securely uploaded to the Cloud for later use.

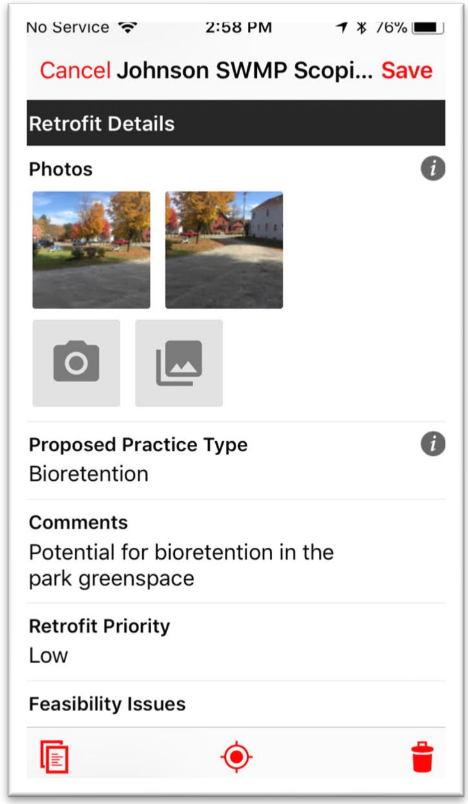

Figure 3. Example screen from data collection app.

4.1.2.3 Field Data collection

Sites were field assessed during the Fall of 2019 and data was collected about each site in the mobile app. A total of 35 sites were assessed as part of this survey. Four of the sites previously identified for field assessment were unable to be assessed due to the lack of required landowner permission. Through the course of the field visits, two additional stormwater retrofit sites were identified that were not included in the initial desktop assessment. One location that seemed like a potential opportunity for BMP implementation, Public Works - Salt Shed, was excluded from further analysis as this site is not a priority for stormwater retrofit given observed site conditions. Following this process, a total of 38 sites remained as potential BMP opportunities (including the four sites not assessed due to private ownership). A large map of these sites with associated site names, summary sheets, and a memo reviewing the field survey process can be found in Appendix 5 - Field Survey.

[1] www.fulcrumapp.com

4.2 Preliminary BMP Ranking

After the initial field visits were completed, a preliminary ranking system was utilized to prioritize 33 of the 38 previously identified projects (Figure 4). Four projects, not field assessed due to private ownership, were removed from the prioritization following landowner outreach as responses were not received for these sites. An additional project was removed after receiving feedback that the property owner was not interested in participating in the plan.

The goal of this ranking was to identify the 10 sites that would provide the greatest water quality benefit and have a high likelihood of implementation. This prioritization was accomplished by completing an assessment of project feasibility and benefits including drainage area size, pollutant load reduction potential, proximity to water, ownership, and feasibility issues. See Appendix 6 - Initial Project Ranking for the complete list of factors utilized in the preliminary ranking. Also included in Appendix 6 is the completed ranking for each potential site, and one-page field data summary sheets with initial ranking information.

The list of sites was distributed to the Town and Village of Johnson, NVU, and the LCCD. The project team met with the stakeholders on February 18th, 2020 to discuss the proposed project sites. See Appendix 6 - Initial Project Ranking for a memo summarizing stakeholder feedback. During this meeting, the stakeholders nominated the Top 10 projects to be included in the plan, and the Top 3 priority projects for which 30% concept designs and cost estimates would be developed. Following this meeting, the list was refined to reflect the Town's priorities. The Top 10 sites, listed in Table 1 below, reflects the results of the preliminary ranking as well as stakeholder priorities and any feasibility issues previously unknown to the project team. The Top 10 point locations are shown in Figure 5. The numbers on the map correspond to the Map ID included in Table 1 below. See Appendix 7 – Top 10 Sites for more information on these sites.

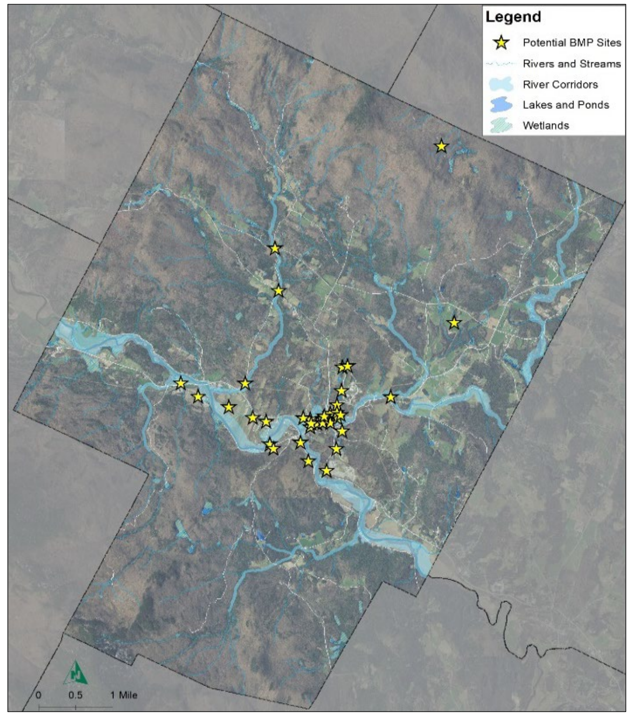

Figure 4. 33 potential sites for BMP implementation were prioritized.

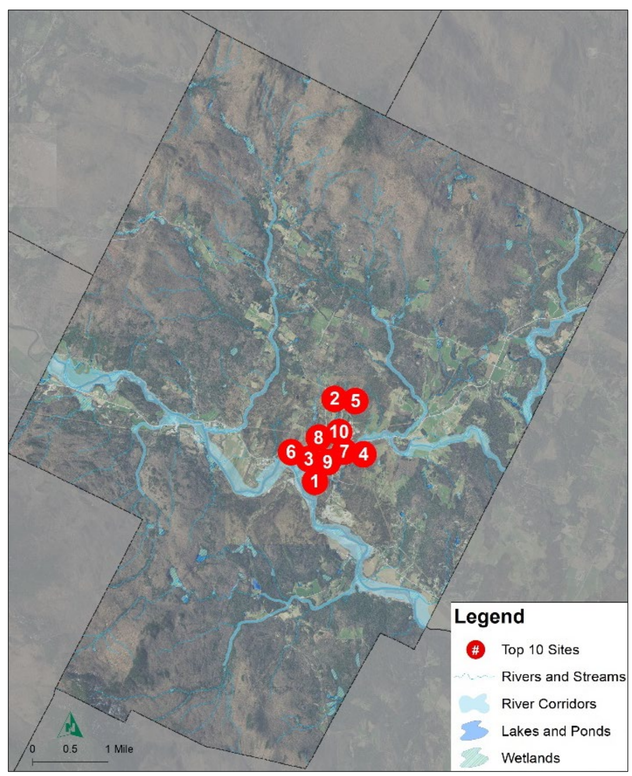

Figure 5. Top 10 proposed BMP implementation sites.

Table 1. The Top 10 BMPs selected for the Johnson SWMP.

Map ID	Project Name	Proposed BMP Type
1	Railroad Street	Subsurface Sand Filter
2	NVU - College Apartments	Bioretention
3	Sterling Market	Subsurface Sand Filter
4	College Hill Parking	Underground Storage / Infiltration
5	NVU - Maintenance Garage	Sediment Trap, Step Pools
6	Town Offices & Fire Department	Bioretention
7	Johnson Elementary School	Bioretention
8	VSC - Wolf Kahn Studios	Bioretention
9	Village Green	Underground Storage / Infiltration, Bioretention
10	NVU - McLelland Parking	Sand Filter

4.3 Top 3 Sites - Potential BMPs

Selection of the Town's Top 3 sites considered the results from Watershed Consulting's initial site investigations, preliminary ranking, and input from project stakeholders concerning project priorities. See Appendix 8 – Top 3 Sites for meeting minutes summarizing landowner outreach efforts. The sites selected within the Town of Johnson are listed in Table 2.

Table 2. The Top 3 BMP sites for the Town of Johnson.

Project Name	Address	Proposed BMP Type
Railroad St	14 Railroad St	Subsurface Sand Filter
NVU - College Apartments	988 College Hill	Bioretention
Sterling Market	131 Lower Main St W	Subsurface Sand Filter

A map showing these three BMP locations is included as Figure 6. A larger version is available in Appendix 8 - Top 3 Sites.

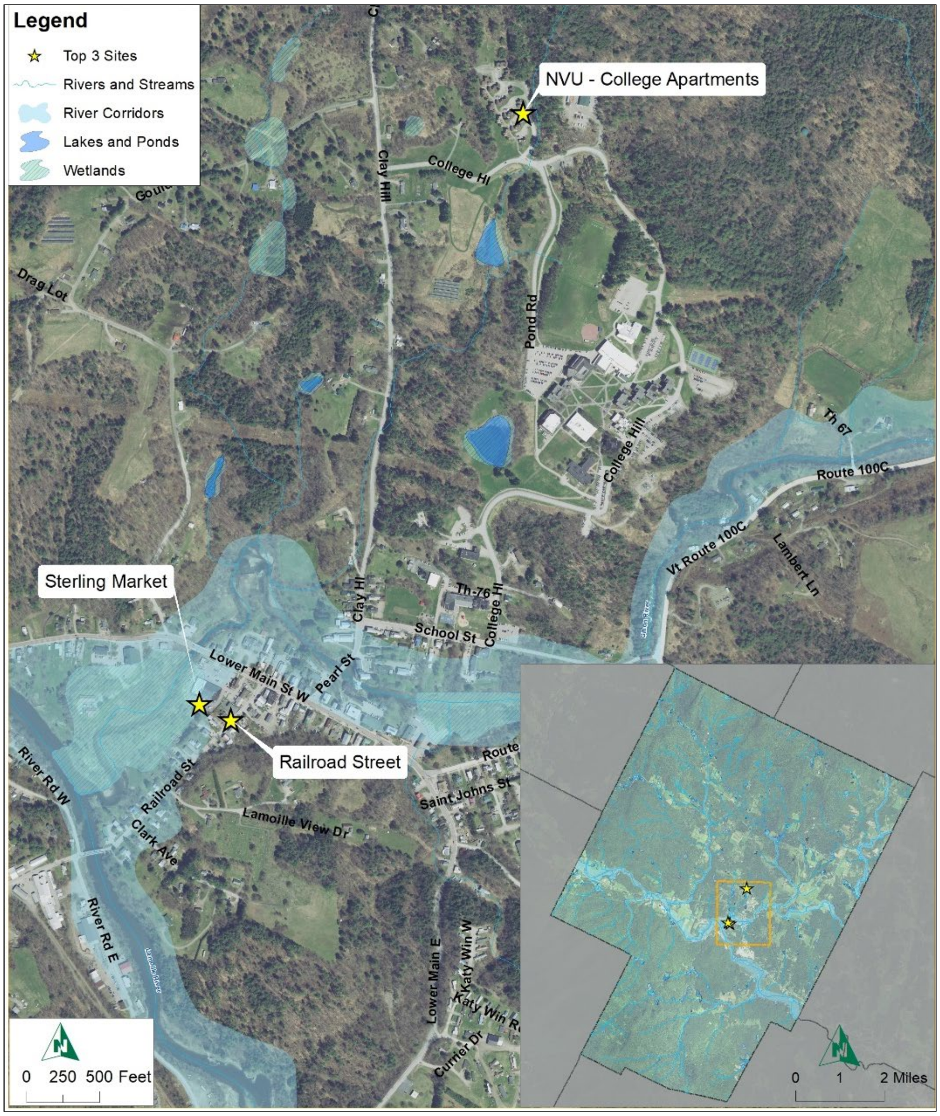

Figure 6. Top 3 BMP sites.

4.4 Top 3 Sites - Modeling

Modeling was completed for each of the Top 3 sites. This modeling allowed for accurate sizing of the proposed practices as well as an understanding of the water quality and quantity benefits. The contributing drainage area of each of the BMPs was defined using the best available topographic data and land use/land cover was digitized using the best available aerial imagery. Drainage areas were then refined as needed based on field observations. Each of the sites was modeled in HydroCAD to determine the appropriate BMP size and resultant stormwater volume benefits. See Appendix 8 - Top 3 Sites for drainage area delineation maps and HydroCAD modeling results.

The Top 3 sites were also modeled to understand the existing condition pollutant loading and pollutant loading reductions associated with the proposed BMPs. This was completed using two methods. The first method utilized the VT Department of Environmental Conservation's Stormwater Treatment Practice (STP)

Calculator[2]. This model is used within the Lake Champlain Basin for estimation and tracking of BMP pollutant load reductions. The STP Calculator is currently only programmed to provide total phosphorus (TP) loading and reductions and cannot at this time be used to estimate total suspended solids (TSS). As such, pollutant loading estimates were also calculated using the Source Loading and Management Model for Windows (WinSLAMM) to determine the annual TSS loading from the drainage area of each site. The modeling yielded expected annual pollutant removal loads (lbs) and rates (%).

The modeled volume and pollutant loading reductions are shown in Table 3. Complete modeling results are provided in Appendix 8 - Top 3 Sites.

Table 3. Annual modeling results for the Top 3 projects are shown below.

Project Name	Volume Managed (ac-ft)	Volume Infiltrated (ac-ft)	TSS Removal (lbs)	TSS Removal (%)	STP Calculator TP Removal (lbs)	STP Calculator TP Removal (%)
Railroad Street	0.01	0	495	3.9%	1.1	4.2%
NVU - College Apartments	0.11	0	1,170	65.2%	2.7	51.0%
Sterling Market	0.04	0	2,366	37.7%	1.7	35.6%

4.5 Top 3 Sites - Final Project Prioritization

A final site prioritization matrix was utilized to quantitatively describe each of the Top 3 projects. Considerations that factored into the description of the BMP projects included factors such as:

- Impervious area managed
- Ease of operation and maintenance
- Volume managed
- Volume infiltrated
- Permitting restrictions
- Land availability
- Flood mitigation
- TP removed
- Other project benefits
- Project cost

This methodology utilized the VT DEC Unified Scoring Matrix and the complete ranking table includes additional project specific information. Each of these factors are listed and explained in Appendix 8 - Top 3 Sites.

5 Priority BMPs

The selected Top 3 BMP sites are briefly described below; their locations within Johnson are shown in Figure 6 above. These opportunities are located on Town, College, and private property. Individual drainage area maps and an overview map of these Top 3 sites are provided in Appendix 8 - Top 3 Sites.

[2] https://anrweb.vt.gov/DEC/CleanWaterDashboard/STPCalculator.aspx

Site: 1
Project Name: Railroad St
Description: The site includes a Railroad St, just south of the intersection with Lower Main St W. The drainage includes residential development along Lamoille View Dr and Barrows Dr, commercial development at the intersection of Railroad St and Lower Main St W, and sections of Railroad St and Lower Main St W. Stormwater is currently collected in catchbasins via surface flow along Lamoille View Dr and Railroad St (Figure 7) and sheet flow to and along Railroad St prior to being discharged to the Gihon River to the west. The concept for this site includes installing a subsurface sand filtration practice under the parking area for the Town Library.

Outreach: Railroad St and the Library are owned by the Town of Johnson, so no additional outreach was carried out.

Figure 7. The practice would manage stormwater from a section of Railroad St.

Site: 2
Project Name: NVU – College Apartments
Description: The site includes the NVU apartments just north of College Hill including the access driveway, rooftops, and parking areas. Stormwater currently sheet flows through this area and is collected in several catchbasins and discharged to the east of the access drive to a tributary of the Gihon River. The southern section of the site drains south in a vegetated swale and also discharges to the east of the access drive to the tributary of the Gihon River. To manage the drainage from this site, stormwater is proposed to be directed down the access drive in new piping to an underdrained bioretention practice in the area of the existing grass swale (Figure 8).

Figure 8. A grass swale transports stormwater to the intersection with College Hill where a bioretention practice is proposed (shown with a star).

Outreach: The Director of Facilities for Northern Vermont University, Mike Stevens, gave verbal confirmation that NVU was in favor of pursing this project during a meeting held with project stakeholders on February 18th, 2020. Follow up email communication was conducted to obtain written confirmation.

Site: 3
Project Name: Sterling Market
Description: The site includes the Sterling Market building and associated parking lot (Figure 9). The property is located southwest of the intersection of Lower Main St W and Railroad St. Currently, drainage is discharged to the Gihon River west of the site via sheet flow and in a series of pipes and catchbasins. The concept for this site includes collecting the stormwater in a subsurface sand filter along the western edge of the parking lot. Soils are mapped as being very good at this site (Hydrologic Group A), but infiltration is not proposed due to the high groundwater anticipated considering the site's proximity to the Gihon River.

Figure 9. A subsurface sand filter is proposed to manage the impervious cover at Sterling Market.

Outreach: Watershed mailed a preliminary outreach letter to property owners Pomerleau Family LLC on October 18th, 2019. Confirmation to proceed with further assessment and concept design was received via a phone call. Follow up conversations were conducted with Steve Ploesser (VP Construction Management) from Pomerleau Family LLC via email and phone communications.

When implemented, these three BMPs would treat approximately 34.8 acres, 8.5 acres (24.4%) of which is classified as impervious. Modeled pollutant reductions for each of the projects, shown in Table 3, indicate that these BMPs will prevent approximately 4,031 lbs of TSS and 5.5 lbs of TP from reaching receiving waters annually.

6 30% Designs

30% designs were developed for each of the Top 3 sites. Site-specific concepts are discussed in the following sections. Plans can be found in Appendix 9 - 30% Designs.

6.1 Railroad St

6.1.1 30% Concept Design Description

The Railroad St site is located south of the intersection of Railroad St with Lower Main St W. Currently drainage from a largely pervious area travels overland and is collected in a series of catchbasins along Lamoille View Dr and Railroad St. The stormwater is then discharged to the Gihon River to the west of Railroad St. This area is located just north of the Gihon River's confluence with the Lamoille River. Currently, there is no water quality management for this stormwater runoff. Frequent flooding has been observed in this area and the existing stormwater system is old and failing. The Town and Village have plans to redevelop this area and replace this outdated infrastructure. It is recommended that this practice be scheduled to coincide with this redevelopment.

Along Railroad St, soils are mapped as having very good infiltration potential, Hydrologic Soil Group A. However, a soil assessment conducted at this location did not support the high predicted infiltration capacity of the soils. The soil report is included in Appendix 8 - Top 3 Sites.

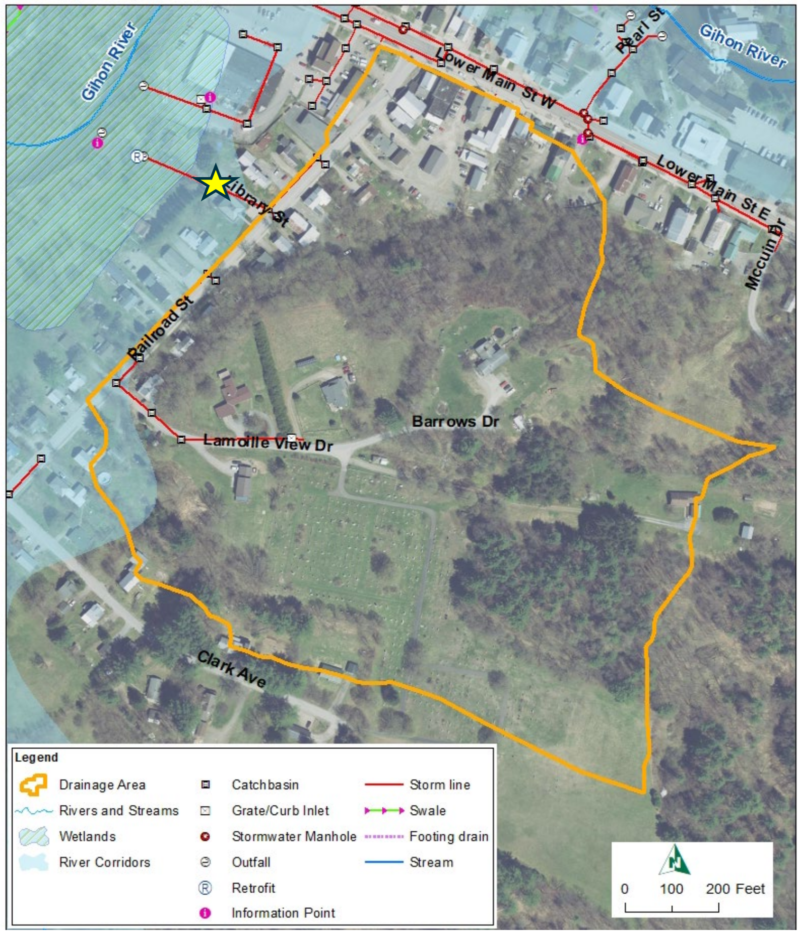

Figure 10. The drainage area for the proposed BMP is shown in orange for the Railroad St site. The proposed BMP location is in the Town Library parking lot along Railroad St, which is shown with a star.

The proposed retrofit for this location involves installing a subsurface sand filtration system under the Town Library parking lot. This system would slow and filter this previously unmanaged drainage. The system will discharge to the Gihon River. The drainage area for this practice is approximately 30 acres, 4.8 acres (16%) of which is classified as impervious. See Figure 10 for a map of the drainage area. The general area for the stormwater treatment practice is shown with a star on this map.

This practice will provide a significant water quality benefit and will reduce the velocity of stormwater volumes discharged to the Gihon River (Table 4). A 30% design plan is provided in Appendix 9 - 30% Designs.

6.1.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 1.1 lbs of total phosphorus (TP) and 495 lbs of TSS from entering receiving waters annually. The design standard used for this retrofit was filtration of one half of the water quality volume (1/2WQv, or 0.5" of rain in a 24-hour period), equal to 416 ft^3 of runoff. See Table 4 for the benefit summary table.

Table 4. Railroad St benefit summary table.

TSS Removed	495 lbs
TP Removed	1.1 lbs
Impervious Treated	4.8 acres
Total Drainage Area	29.9 acres

6.1.3 Cost Estimates

The total estimated cost for this project was calculated during development of the 30% design. The itemized cost estimate is available in Appendix 9. In total, this project is estimated to cost $107,000.

- The cost per pound of phosphorus treated is $97,273.
- The annual cost per kg of phosphorus treated following the methodology utilized by the VT DEC in the Vermont Clean Water Initiative 2020 Performance Report is $8,878.
- The cost per impervious acre treated is $22,292.
- The cost per cubic foot of runoff treated is $257.

6.1.4 Next Steps

As this site is owned and operated by the Town of Johnson, it is recommended that the Town proceed with further design of this retrofit. Further design will involve refinement of the 30% retrofit concept with respect to size, outlet design, and routing to ensure that the target volume can be completely filtrated and that larger storms bypass the system safely.

6.1.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix 10 - Permit Review Sheets. In summary:

Act 250 Permit

The site does not hold an Act 250 permit.

Local Permitting

No local permits are anticipated.

Other Permits

This site should be reviewed by a river scientist prior to final design as the proposed practice will intercept an existing stormline that drains into an outfall within the river corridor of the Gihon River. The existing stormline drains to an outfall ~150 feet southeast of the Gihon River (within the river corridor). However, the project will reduce the velocity of runoff to the outfall.

6.2 Site 2 – NVU - College Apartments

6.2.1 30% Concept Design Description

The Northern Vermont University (NVU) College Hill apartments are accessed via an access drive north of College Hill. This area will be subject to the Vermont "3-acre" permit, which requires all previously unpermitted sites with ≥3 acres of impervious cover to comply with stormwater standards. The parking areas are unpaved and the access drive partially paved (southern section) and partially unpaved (northern section). The area also contains several clusters of multi-unit apartment buildings and mowed lawn areas. An unnamed tributary to the Gihon River flows south along the eastern edge of the access drive to the apartments. Currently, stormwater is discharged to this unnamed tributary in four locations to the east of the access drive (see mapped stormwater infrastructure in Figure 11) without any stormwater management.

Figure 11. The drainage area for the proposed BMP is shown in orange. The proposed BMP location is shown with a star.

Soils are mapped as having very good infiltration potential, Hydrologic Soil Group A, for the northern half of the site. For the southern half of the site, soils are mapped as having good infiltration potential (Hydrologic Soil Group B). However, soils were assessed at three locations where potential BMPs were initially proposed. Assessments showed that soils were generally silty clay and not appropriate for an infiltration-based BMP. The three soils reports can be found in Appendix 8.

The proposed retrofit for this location involves installing additional piping along the west side of the access drive to direct the stormwater south to the greenspace along College Hill (shown with a star on the drainage area map in Figure 11). The drainage will then be managed with an underdrained bioretention practice. This practice would discharge to the west and enter the existing culvert that passes under College Hill.

The drainage area for this proposed BMP is 3 acres, approximately 63% of which (1.9 acres) is classified as impervious. This practice will provide a significant water quality benefit (Table 5) and is also a high visibility site on the NVU campus and could thus provide awareness and education about water quality issues. It is recommended that an educational sign be installed in conjunction with the retrofits.

A 30% design plan is provided in Appendix 9 - 30% Designs.

6.2.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 1,170 lbs of total suspended solids (TSS) and 2.7 lbs of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was filtration of the water quality volume (WQv, or 1" of rain in a 24-hour period), equal to 4,966 ft^3 of runoff. See Table 5 for the benefit summary table. See Appendix 8 – Top 3 Sites for a further breakdown of these pollutant and stormwater volume reductions.

Table 5. NVU – College Apartments benefit summary table.

TSS Removed	1,170 lbs
TP Removed	2.7 lbs
Impervious Treated	1.9 acres
Total Drainage Area	3.0 acres

6.2.3 Cost Estimates

The total estimated cost for this project was calculated during development of the 30% design. The itemized cost estimate is available in Appendix 9. In total, this project is estimated to cost $248,000.

- The cost per pound of phosphorus treated is $91,852.
- The annual cost per kg of phosphorus treated following the methodology utilized by the VT DEC in the Vermont Clean Water Initiative 2020 Performance Report is $8,420
- The cost per impervious acre treated is $130,526.
- The cost per cubic foot of runoff treated is $50.

6.2.4 Next Steps

As this site is owned and operated by NVU, it is recommended that they proceed with further design of this retrofit. Further design will involve refinement of the 30% retrofit concept with respect to size, outlet design, and routing to ensure that the target volume can be completely filtrated and that larger storms bypass the systems safely.

6.2.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix 10 - Permit Review Sheets. In summary:

Act 250 Permit

The site already has an existing permit (5L0087) for the construction of 50 married student and faculty apartments. This site may require an amendment to this Act 250 permit.

Local Permitting

No local permits are anticipated.

Other Permits

This site should be reviewed by a river scientist prior to final design as the project. This site will also be subject to a State 3-acre permit.

6.3 Site 3 – Sterling Market

6.3.1 30% Concept Design Description

Sterling Market is located southwest of the intersection with Lower Main St W and Railroad St along the banks of the Gihon River. Currently this site, including the Sterling Market roof and parking lot, drains either via sheet flow or through a series of catchbasins and stormwater pipes to the Gihon River without any water quality management practices. This area has experienced significant and repeated flood events and is located primarily within the river corridor.

Soils are mapped as having very good infiltration potential (Hydrologic Soil Group A). However, due to the site's location along the banks of the Gihon River and presumably high groundwater table, an infiltration practice is not recommended at this site.

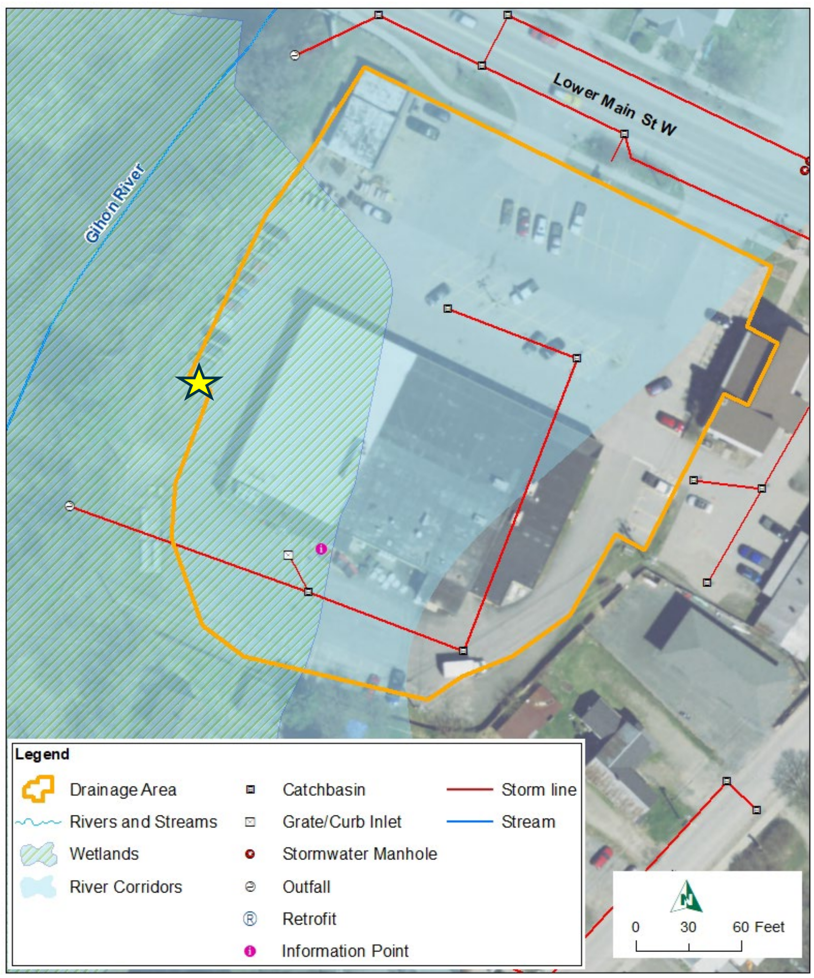

Figure 12. The drainage area for the proposed BMP is shown in orange. The proposed BMP location is shown with a star.

The proposed retrofit for this location involves intercepting and directing stormwater to the west and intercepting the sheet flow from the parking lot area via a grass swale to a subsurface sand filter (see starred location in Figure 12). The feature will outlet to the Gihon River. This practice should be designed so that no fill is added in the river corridor.

The drainage area for this proposed BMP is 1.8 acres, nearly 100% of which is classified as impervious. This practice will provide a significant water quality benefit (Table 6) but is also a high visibility site within the Town, and this practice could spur additional retrofits and awareness of stormwater issues in the area. It is recommended that an educational sign be installed in conjunction with the retrofit.

A 30% design plan will be provided in Appendix 9 - 30% Designs.

6.3.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 2,366 lbs of total suspended solids (TSS) and 1.7 lbs of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was filtration of half of the water quality volume (1/2WQv, or 0.5" of rain in a 24-hour period), equal to 1,861 ft^3 of runoff. See Table 6 for the benefit summary table.

Table 6. Sterling Market benefit summary table.

TSS Removed	2,366 lbs
TP Removed	1.7 lbs
Impervious Treated	1.8 acres
Total Drainage Area	1.8 acres

6.3.3 Cost Estimates

The total estimated cost for this project was calculated during development of the 30% design. The itemized cost estimate is available in Appendix 9. In total, this project is estimated to cost $175,000.

- The cost per pound of phosphorus treated is $102,941.
- The annual cost per kg of phosphorus treated following the methodology utilized by the VT DEC in the Vermont Clean Water Initiative 2020 Performance Report is $9,443.
- The cost per impervious acre treated is $97,222.
- The cost per cubic foot of runoff treated is $94.

6.3.4 Next Steps

This site is owned by Pomerleau Family, LLC and it is recommended that they proceed with further design of this retrofit. Further design will involve refinement of the 30% retrofit concept with respect to size, outlet design, and routing to ensure that the target volume can be completely filtered and that larger storms bypass the system safely.

6.3.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix 10 - Permit Review Sheets. In summary:

Act 250 Permit

The site already has two existing permits. Pomerleau Real Estate holds one permit (100021) for a building addition to the existing building and the second permit (5L0546) for the expansion of the existing Grand Union and construction of a new post office. The practice may require an Act 250 permit amendment.

Local Permitting

No local permits are anticipated.

Other Permits

This site should be reviewed by a river scientist prior to final design as it is located within the river corridor. The existing stormline will be intercepted by a flow splitter that will divert runoff from small storms into the sand filter practice and direct additional runoff through the existing pipe. This site should be reviewed by a wetland ecologist prior to final design as there are wetlands mapped within the project site.

7 Final Recommendations

The results of this SWMP have identified a number of potential BMP concepts and locations that would have a positive impact on water quality in the Town of Johnson and receiving waters. Although designs were only be advanced for the Top 3 projects, this plan also serves to highlight these other opportunities throughout the Town. The momentum developed during this study should be strengthened and continued.

The practices proposed in this study all stand to have a substantial impact on abating water pollution and setting a precedent for integrating GSI in Johnson's landscape. It is our recommendation that the Town, in partnership with the LCCD, NVU, and private landowners Pomerleau Family, LLC move to implement the Top 3 practices. The project renderings completed for these projects in conjunction with the 30% designs (see Appendix 11 – Site Renderings) can be utilized as outreach tools and to support grant applications.

It is also recommended that the Town, Village, and LCCD also move forward with additional design and implementation of other projects presented in this plan (see Appendix 12 - Projects for Watershed Projects Database for projects identified to the DEC to be input into the Watershed Projects Database). As these practices are the result of a stormwater master planning effort under a VT DEC Clean Water Fund grant, they are well-suited as candidates for an implementation grant from this same source. We recommend the following steps in proceeding with this:

- For priority projects being developed to the 30% concept level, consider grant applications for final design and implementation.
- Submit grant funding requests for higher scoring projects that may include both preliminary and final design.

One area that was highlighted through this study was Foote Brook Road. Stormwater flowing over Foote Brook has become increasingly turbid during precipitation events and has been a growing concern of residents. Although the road was included as part of this study in a cursory way, a more comprehensive, stand-alone master planning assessment is highly recommended for this area to evaluate potential sources of sediment loading to the brook.

It is further recommended that a stormwater-specific ordinance and snow storage plan be developed for the Town of Johnson. Freestanding policies would more clearly define best practices for stormwater and snow management throughout the Town. Additionally, it would make the standards more accessible to Town residents and would be easier to update in response to new research and legislation.

The Vermont Agency of Transportation (VTrans), as part of their Transportation Separate Storm Sewer System (TS4) General Permit, will be completing their own retrofit assessment of VTrans-owned impervious surfaces throughout the Town. Projects identified in this plan that involve VTrans drainage should be coordinated with the VTrans TS4 permitting efforts to allow for potential collaboration.

To map and interact with watershed modeling results related to non-point total phosphorus loading sources within the Vermont portion of the Lake Champlain Basin, we recommend using the Clean Water Roadmap (CRW)[3]. This web-based tool supports the VT DEC's tactical basin planning and outreach efforts related to Lake Champlain Phosphorus TMDL.

Regulatory requirements under Act 64 will require management of sites with ≥3 acres of unmanaged and unpermitted (current State stormwater permit) impervious cover. Sites listed on the VT DEC's draft list of 3-acre sites, produced on June 25th, 2019, is provided below in Table 7. These sites were assessed as part of this plan and it is recommended that water quality improvements be implemented on these parcels in the future.

Table 7. Unpermitted 3-acre sites

Owner/Permit Name	Location	Mapped Impervious (acres)
Ship Sevin li LLC	1 Katy Win Rd	4.35
Vermont Electric Coop Inc	42 Wescom Rd	3.61
Vermont State Colleges	College Hill	5.84
Vermont State Colleges	College Hill	18.64

[3] https://anrweb.vt.gov/DEC/CWR/cwr-tool.vbhtml