Moon Brook Rutland City Stormwater Master Plan

Final Report

December 1, 2019

SUBMITTED TO:

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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 Moon Brook Stormwater Master Plan under a contract between the Rutland Natural Resources Conservation (RNRCD) 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 watershed'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 from stormwater runoff to receiving waters within the municipalities and the greater Lake Champlain Basin considering current and future regulation under the Lake Champlain Total Maximum Daily Load requirements. 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 watershed 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 will require management of existing impervious areas. This stormwater master plan, and therefore its resultant strategies, is one of the actions in the Otter Creek Tactical Basin Plan. This will put the BMP strategies in queue for state 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- Stormwater 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 soil particulate matter suspended in the water column.

Watershed- The area contributing runoff to a specific point. For watersheds like Chase Brook, this includes the entire area draining to the point where the river discharges to Mill Brook.

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.

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

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

3 Background

3.1 Existing Conditions

The Moon Brook watershed extends across portions of Rutland City, Rutland Town, and Mendon and is within Rutland County (see starred location in Figure 1). The Moon Brook watershed has an area of 5,031 acres with a mix of developed and undeveloped lands. Development is more concentrated within Rutland City and more distributed within the Town of Rutland and the Town of Mendon. Within Rutland City, there are 403 acres of impervious cover (28% of the total area). In the Town of Rutland and the Town of Mendon, impervious cover accounts for 9% and 2% of the watershed area respectively. The watershed includes Moon Brook and its tributary Mussey Brook. Moon Brook drains to the west and into Otter Creek. Otter Creek flows north and west to ultimately drain to Lake Champlain.

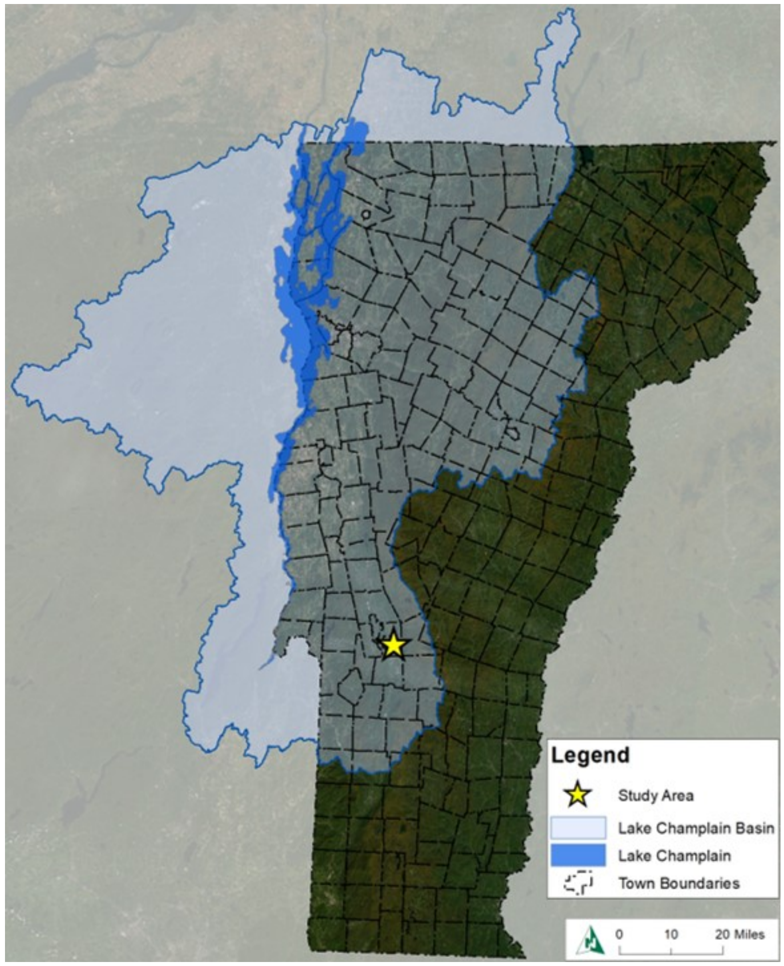

Figure 1. The study area is located in Rutland City within the Lake Champlain Basin.

The study area for this Stormwater Master Plan (SWMP) includes the Rutland City portion of the Moon Brook watershed, which accounts for approximately 28% of the watershed by area. 41% of the watershed is in Mendon and the remaining 31% is in Rutland Town.

Sections of the watershed within Rutland City are connected to the combined sewer, meaning that the stormwater draining to these areas is comingled with the City's wastewater and subsequently treated by the wastewater treatment plant. Although disconnecting these areas from the combined sewer area would be beneficial in preventing combined sewer overflows during storm events and some identified BMPs do serve to disconnect portions of the combined sewer, it was not a focus of this SWMP.

71% 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. 20% are classified as not highly erodible and the remainder are not rated or classified as water. Additionally, the majority of the soils in the watershed have very 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, the majority of areas belong to Hydrologic Soil Group C or D (66%) while 34%

are in group A or B. This combination of erodible soils, low infiltration capacity, and significant impervious cover contribute to the stormwater issues within the study area.

Maps depicting existing watershed conditions can be found in Appendix A. Maps include:

- river corridors, wetlands, and hydric soils;
- impervious cover;
- soil infiltration potential (i.e., hydrologic soil group);
- soil erodibility;
- land use / land cover;
- slope;
- stormwater infrastructure and stormwater permits; and
- parcel boundaries.

3.2 Problem Definition

The study area faces several challenges as it includes significant commercial and residential development with limited greenspace for management of stormwater (Figure 2). City-owned land is also very limited within the watershed, and, as such, opportunities for large aboveground BMPs are nearly absent in the study area. 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. This watershed has been classified as stormwater impaired due in part to stormwater runoff from developed surfaces since 2006, and a Total Maximum Daily Load (TMDL) was developed in 2008 to address the biological impairment observed as a result of this stormwater impairment. The TMDL requires the development of a Flow Restoration Plan (FRP) to reduce high flows in the watershed by 11.9%, 9.02% of which has been allocated to Rutland City (2.82% has been allocated to

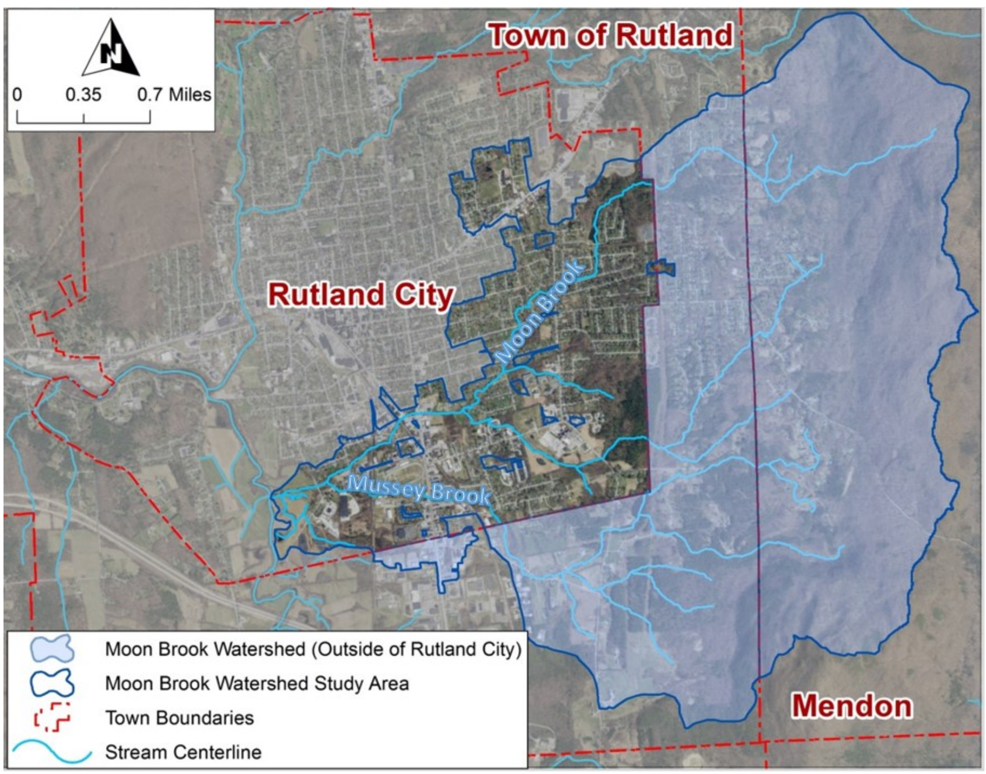

Figure 2. The Moon Brook watershed covers portions of Rutland City, Rutland Town, and Mendon.

Rutland Town and the remaining 0.06% is the responsibility of the Vermont Agency of Transportation (VTrans)).

Moon Brook is classified as cold water fish habitat, and, as such, stream temperature is important to aquatic ecosystem health, but due to on-stream ponds and the lack of riparian buffers for shading, the stream is classified as impaired due to temperature.

As this watershed is part of the greater Lake Champlain Basin, it is therefore subject to the need within that Basin to reduce phosphorus input from developed surfaces as required by the Lake Champlain Phosphorus TMDL.

This SWMP will serve as a guide to improving water quality and reducing stormwater volume, nutrient loading, and sediment loading in the watershed for Rutland City.

4 Methodology

4.1 Identification of All Opportunities

4.1.1 Data collection and review

All relevant prior watershed studies and any studies that could inform planning in the project area were assembled and reviewed in the context of this SWMP study. These include documents such as past studies conducted within the watershed, the stormwater infrastructure mapping report, geomorphic assessments, information regarding the two ponds on Moon Brook, and other relevant documents. A study is currently being completed by Malone and MacBroom to determine the optimal solution for mitigating the adverse temperature impacts of the two on-stream ponds.

Relevant Geographic Information System (GIS) data was drawn from a variety of public resources including the Agency of Natural Resources Atlas and Vermont Center for Geographic Information Open Geodata Portal. 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 (2018/2019). The information collected and reviewed for the creation of this SWMP as well as a summary memo describing the data review process are included as Appendix B.

The project team met with stakeholders from the City of Rutland as well as Nanci McGuire (Rutland NRCD) on January 24, 2018 at the Rutland NRCD office in Rutland City to discuss the SWMP and solicit information on specific stormwater-related problems in the study area as well as any planned developments or other relevant activities. The noted areas included specific parcels and general areas of importance. Meeting minutes from this meeting are included in Appendix C.

4.1.2 Desktop Assessment

A desktop assessment was completed to identify additional potential sites for stormwater best management practice (BMP) implementation. This process involved a thorough review of existing GIS resources and associated attribute data. Data included, but was not limited to, storm sewer infrastructure, soils classifications, parcel data, wetlands, impervious cover, and river corridors. This data was used to identify and map stormwater subwatersheds with particularly high impervious cover, stormwater subwatersheds that are more directly connected to water bodies (direct pipes to streams or via overland flow), areas where infill development may occur, areas that may have worsening stormwater impacts in the future, and parcels with ≥3 acres of impervious cover without a current stormwater permit as these areas will be subject to permitting. A point location was created for each identified site or area for assessment in the field.

A green streets assessment was conducted to identify any road segments throughout the study area potentially appropriate for green stormwater infrastructure retrofit opportunities. Streets were evaluated and scored according to right-of-way width, slope, and soil permeability utilizing a methodology adapted from the "Promoting Green Streets" report published by the River Network (July 2016). Generally, targeted street segments were wide and flat with moderate to high infiltration potential.

Points were also created for locations with existing drainage problems or concerns as identified during the meeting held with the Rutland NRCD and representatives from Rutland City (see Appendix C for meeting minutes).

In total, 40 potential locations for stormwater BMPs were identified. Point locations were generated for each site and an overview map was created displaying these points, their ID numbers, site names, and approximate locations. This information and a descriptive memo can be found in Appendix D. For a map of these sites, see Figure 3 below.

Figure 3. The 40 sites identified for field assessment are shown with dark blue stars.

4.1.3 Digital Map and App Preparation

In order to maximize efficiency in the field and better understand site-specific conditions, developed data products were used to create digital maps for field investigations of potential stormwater management sites. Base layers included parcel boundaries, stormwater infrastructure, hydrologic soils groups, river corridors, and wetlands. These layers are hosted in the Cloud to reduce necessary storage, and for fluid integration with the mobile data collection app hosted on the Fulcrum platform[1] that was customized for this project. This information was used in the field to assess potential feasibility issues for proposed practices and to better identify preliminary BMP locations. A screenshot of the mobile data collection app with several of these layers displayed is shown in Figure 4.

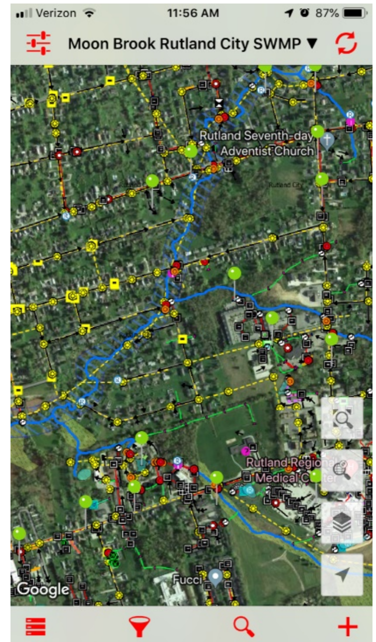

Figure 4. Data collection points are shown with green pins in the customized mobile data collection app.

The app was pre-loaded with the 40 point locations for the potential BMP sites, which included locations of problem areas and potential opportunities. These points allowed for easy site location and data collection in the field (see green pins in Figure 4).

4.1.4 Field Data collection

Watershed conducted targeted investigations of all sites identified on the initial retrofit list as well as several sites identified during the course of field work. These investigations involved a visit to the prospective BMP location to assess the best retrofit appropriate for site specific conditions. Watershed also made an initial assessment of project feasibility. Factors considered included but were not limited to:

- potential utility conflicts,
- ownership of site,
- space,
- poor soils,
- steepness,
- current and future use of site,
- contamination, and
- natural resource (i.e., wetlands and river corridor) constraints.

During the assessment, the team also determined if there were any ancillary benefits to the project (i.e., educational, flood mitigation, etc.), obtained photo documentation, and noted any potential questions about the site for follow-up (i.e., parcel ownership, location of utilities, road right-of-way width, etc.).

Through the course of these field visits, 6 additional stormwater retrofit sites were identified that had not been included in the initial desktop assessment. A total of 46 sites were assessed as part of this plan. Some site locations that seemed like potential opportunities for BMP implementation were excluded from further analysis due to specific, prohibitive site conditions or where BMPs were already in place that adequately managed stormwater runoff. Following this process, a total of 32 sites remained as potential BMP

[1] www.fulcrumapp.com

opportunities. A map of these sites can be found in Figure 5. A larger map of the sites, a detailed list of the sites, and a descriptive memo can be found in Appendix E.

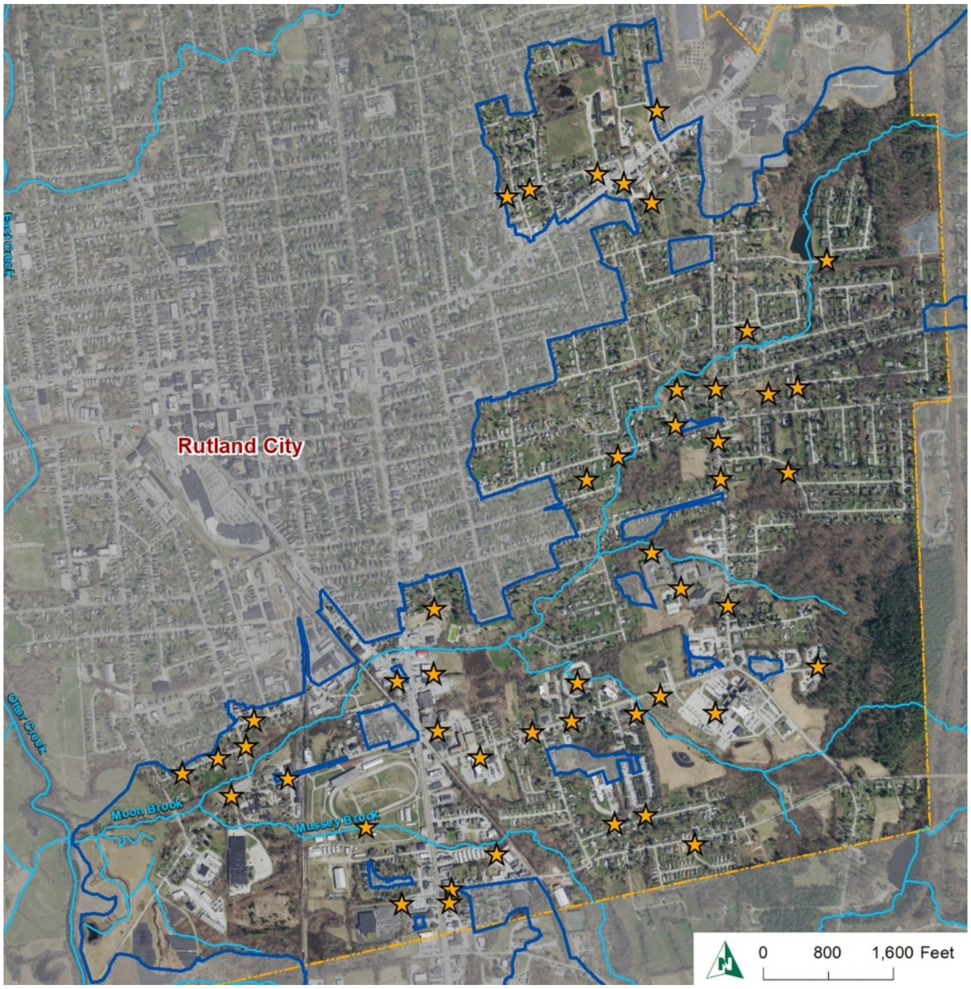

Figure 5. The sites assessed during field investigations are show with orange stars.

4.2 Preliminary BMP Ranking

An initial project ranking was completed in order to prioritize the identified projects. Each project was scored using a qualitative ranking system developed by Watershed and using best professional judgment. The ranking was created with the understanding that reducing peak flows is a priority for the watershed. Following project scoring, a rank was assigned to each project. The location of these projects within the study area can be found below in Figure 6. The ranked projects including an overview map, individual BMP summary sheets, and a descriptive memo can be found in Appendix F.

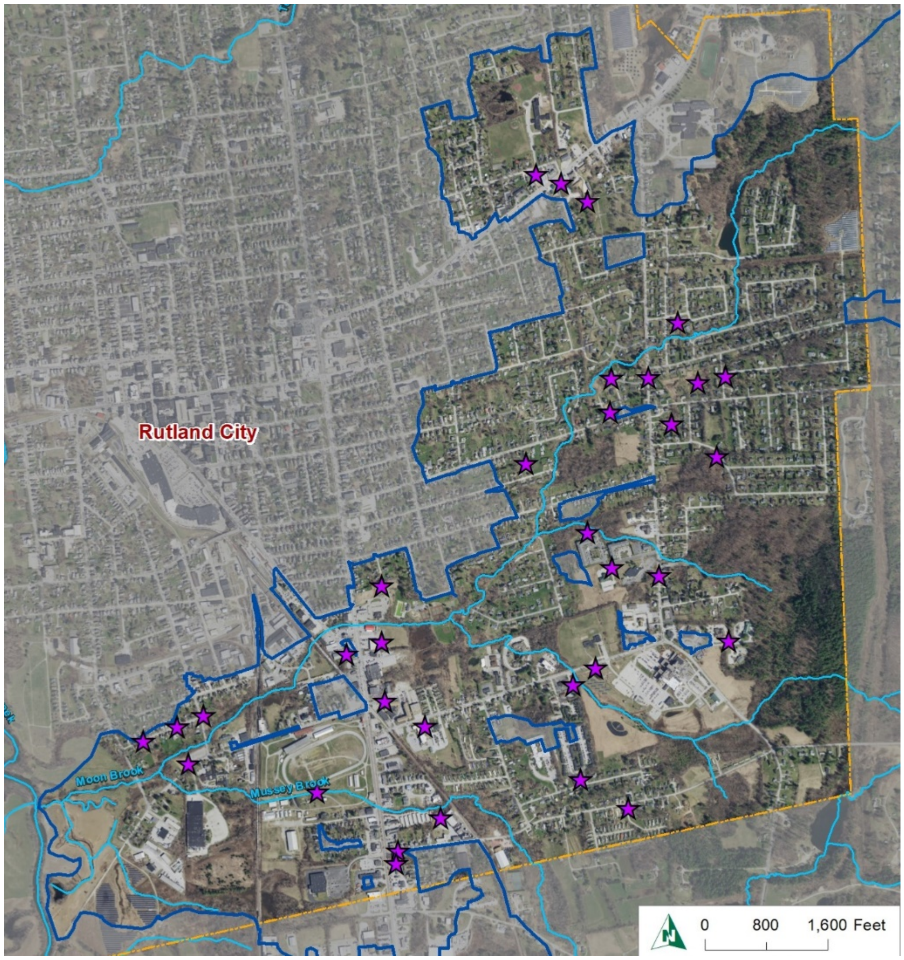

Figure 6. The location of the BMPs ranked during the initial preliminary ranking are shown with purple stars.

Project stakeholders including representatives from the City of Rutland and the Rutland NRCD met with the project team on August 23, 2018 to review this ranking. Each of the projects were reviewed for feasibility and desire for implementation. Minutes from this meeting can be found in Appendix G. Following this meeting, the projects were then re-ranked to reflect these priorities. Several projects were reassessed in the field to ensure that all applicable data was collected.

The final version of the preliminary ranking included 30 projects as two projects were removed as a result of the discussions held during the stakeholder meeting. The location of these projects within the study area can be found in Figure 7. A larger overview map, BMP summary sheets, and a table summarizing each project can be found in Appendix G.

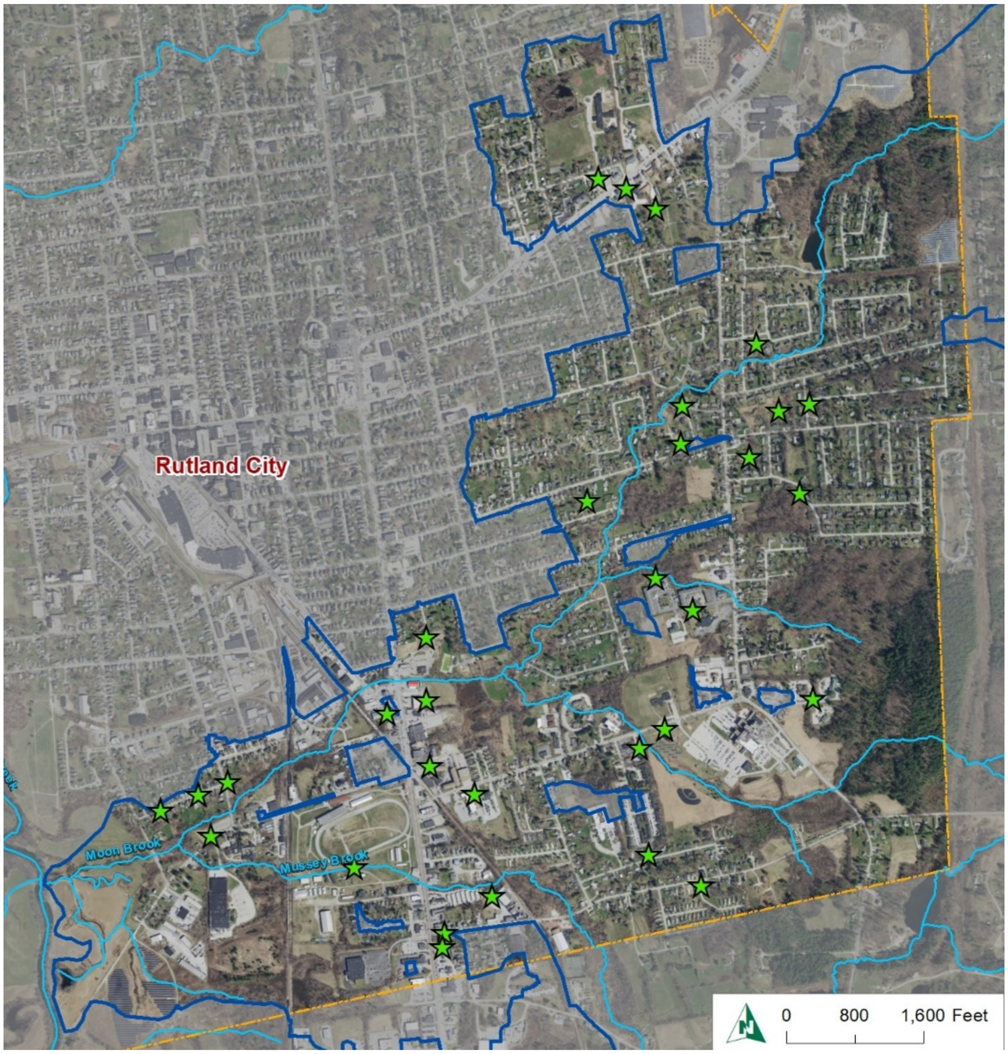

Figure 7. The location of the BMPs identified and ranked during the final preliminary ranking are shown with green stars.

4.3 *Initial Landowner Outreach and Project List Refinement*

The study area is within Rutland City and consists of very limited publicly owned parcels outside of public road right-of-way, which are generally constrained. As such, the majority of proposed BMPs are located on private properties. Landowner outreach was initially completed by project partners Birchline Planning, LLC (Birchline). Birchline worked with the City of Rutland to reach out to select landowners who own properties with BMPs ranked highly in the preliminary ranking. However, landowner support was unable to be obtained at this stage.

Additional outreach was completed by Watershed and the Rutland NRCD to select high priority properties. Landowners at one such property, Killington & Westview, were amenable to meeting with Watershed and the Rutland NRCD to discuss a BMP on their property. However, during the site visit in July of 2019, wetlands concerns were noted for this site. A State of Vermont wetlands scientist visited the site in August of 2019 to assess these wetlands concerns. She determined that the area in question was classified as a Class II wetland and was thus unsuitable for stormwater BMP design and implementation. This determination can be found in Appendix H. Due to this determination the site was removed from further consideration.

During follow up site visits, one additional site was identified by the project team for potential BMP implementation, White Memorial Park. Watershed and the Rutland NRCD met with the Parks and Recreation Parks Director at the park to discuss stormwater BMP opportunities. He indicated that the Parks and Recreation Department would be open to additional management of stormwater at the park. As such, this project was added to the list of potential BMPs.

On September 9, 2019, Watershed again met with the City of Rutland stakeholders and the Rutland NRCD to discuss potentially amenable landowners with BMPs identified on their properties. During this meeting, one additional site was discussed and ultimately added to the list of BMPs – the Ocean State Job Lot property. It was discussed that stormwater from both the Ocean State Job Lot property and a section of Route 7 uphill from the property could be managed in a combined BMP. This site was then assessed in the field following this meeting. It was determined that this site provided a good opportunity for BMP implementation and was subsequently added to the list of potential BMPs. Minutes from this meeting can be found in Appendix I.

4.4 Top 20 BMPs

The revised preliminary ranking and the additional sites added during discussions with stakeholders were combined to determine the Top 20 BMPs. The Top 20 projects are those that received additional concept design. These 20 BMPs are listed below in Table 1. The table includes the name of the project and the type of BMP proposed for the site. The location of these sites within the study area can be seen below in Figure 8. Individual site maps can be found in Appendix J.

Table 1. The Top 20 projects are listed below with the proposed BMP type.

Project Name	***BMP Type***
Heritage Credit Union	Underground Infiltration
Ocean State Job Lot	Gravel Wetland, Impervious Cover Reduction
VAC Parking Lot	Gravel Wetland
Green Mountain Missionary Baptist	Infiltration Basin
White Memorial Park	Infiltration Basin, Bioretention
Comfort Inn Plaza	Underground Infiltration
Granger St Infiltration	Infiltration Basin
Woodland Dr	Gravel Wetland
Fairgrounds	Buffer Enhancement
St Joseph's Cemetery	Gravel Wetland
Temple St Lawn	Gravel Wetland
Gibson Ave Green Streets E	Bioretention, Curb Bump Out, Infiltration Trench, Residential GSI
Curtis Ave Green Streets	Curb Bump Out, Bioretention, Infiltration Trench, Residential GSI
Piedmont Pond Rd	Infiltration Basin
Killington Ave Greenspace	Gravel Wetland
25 Curtis Ave	Infiltration Basin
Gibson Ave Green Streets W	Bioretention, Curb Bump Out, Infiltration Trench, Residential GSI
Westview Ave Detention	Gravel Wetland
Regency Manor	Underground Sand Filter
Jasmin Ln Lawn	Gravel Wetland

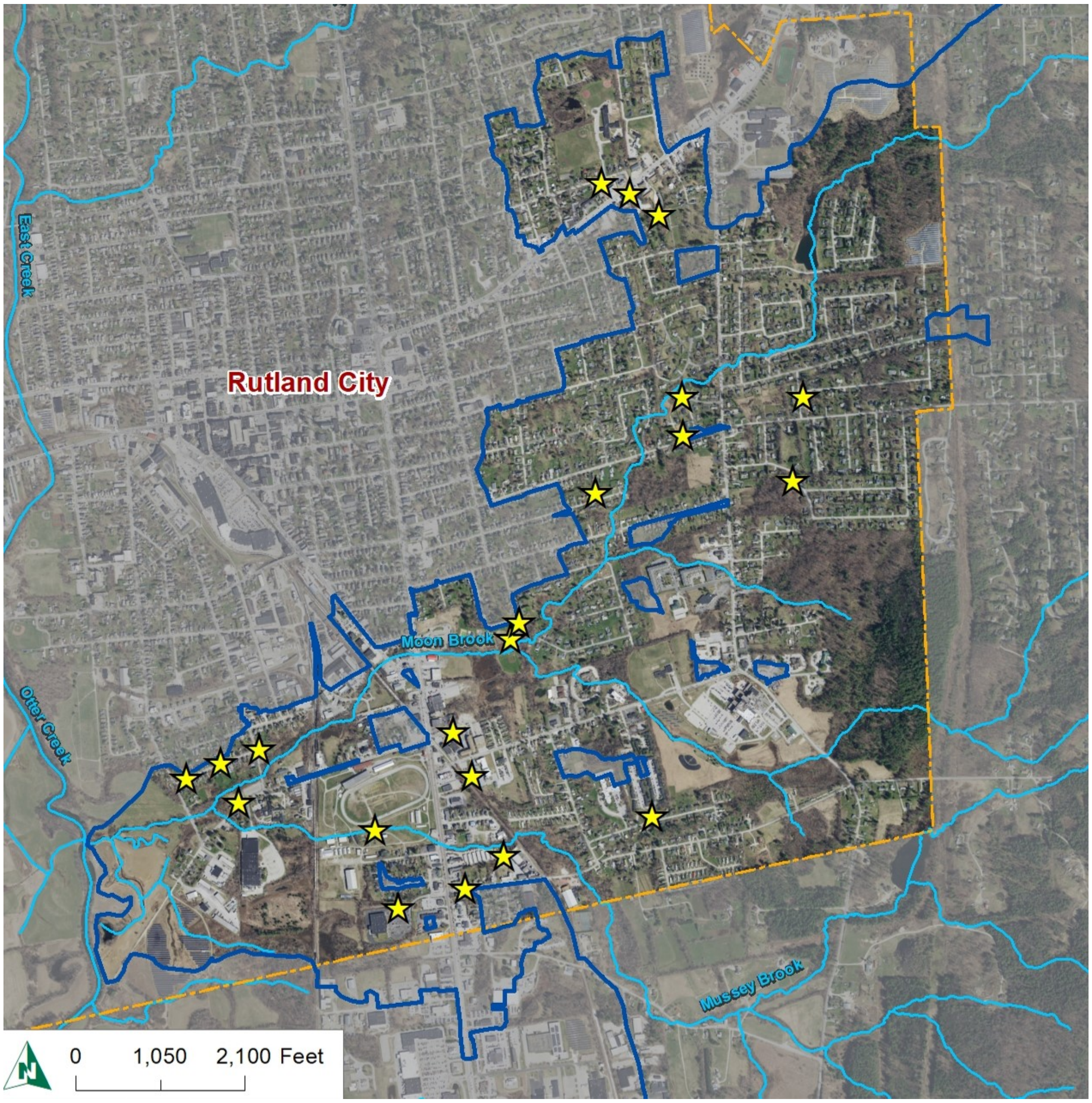

Figure 8. The Top 20 project locations are shown with yellow stars.

4.5 Modeling and Concept Refinement

Modeling was completed for each of the Top 20 sites, which 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 (see Appendix J for individual site maps with drainage area boundaries). Each of the sites was modeled in HydroCAD to determine the appropriate BMP size and resultant stormwater volume benefits (see Appendix K for HydroCAD modeling reports).

Each of these sites was 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). Pollutant loading estimates were also calculated using the Source Loading and Management Model for Windows (WinSLAMM) to determine the annual TSS and TP loading from the drainage area of each site. Pollutant load reductions from each of the BMPs were then calculated using one of two sources, depending on the practice type. The Source Loading and Management Model for Windows (WinSLAMM) was used when possible, and, for those practices that WinSLAMM does not model well (generally non-infiltration-based practices; based on experience and literature), pollutant removal rates published by the University of New Hampshire Stormwater Center were applied to the initial pollutant loading modeled with WinSLAMM for the site's current conditions. This yielded expected pollutant removal loads (lbs) and rates (%). WinSLAMM model results can be found in Appendix K. All modeling results can be found in the table located in Appendix L.

The modeled volume and pollutant loading reductions are shown in Table 2. If these 20 projects were to be implemented, it would reduce annual TSS loading by 157,883 lbs and annual TP loading by 178.6 lbs according to the STP Calculator and 93.9 lbs according to the more conservative WinSLAMM models. Note that discussions of TP reductions in the remainder of this report will reference the STP Calculator modeling results unless otherwise noted.

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

Table 2. Modeling results for the Top 20 projects are shown below.

Project Name	*Volume Managed (ac-ft)*	*Volume Infiltrated (ac-ft)*	*TSS Yield (lbs)*	*TSS Removal (lbs)*	*TSS Removal (%)*	*WinSLAMM TP Yield (lbs)*	*WinSLAMM TP Removal (lbs)*	*WinSLAMM TP Removal (%)*	*STP Calculator TP Yield (lbs)*	*STP Calculator TP Removal (lbs)*	*STP Calculator TP Removal (%)*
Allen Street Infiltration	0.46	0.46	10,090	8,990	89.10%	8.14	7.20	88.48%	19.18	18.31	95.48%
Ocean State Job Lot	0.701	0	16,455	15,797	96.00%	5.85	3.39	58.00%	18.70	11.61	62.09%
VAC Parking Lot	0.494	0	7,564	7,261	96.00%	5.42	3.14	58.00%	14.33	8.78	61.26%
Green Mountain Missionary Baptist	1.595	1.595	15,040	13,993	93.04%	15.01	13.85	92.29%	28.22	27.18	96.33%
White Memorial Park	0.454	0.454	5,973	5,527	92.5% (Infiltration Basin); 100% (Bio-retention)	5.28	4.83	91.4% (Infiltration Basin); 100% (Bio-retention)	5.97 (Infiltration Basin); 1.68 (Bio-retention)	5.97 (Infiltration Basin); 1.68 (Bio-retention)	100% (Infiltration Basin); 100% (Bio-retention)
Comfort Inn Plaza	1.630	1.630	23,427	22,813	97.38%	16.15	15.37	95.21%	10.58	10.58	100.00%
Granger St Infiltration	0.461	0.461	4,220	4,114	97.50%	2.95	2.88	97.82%	8.62	8.62	99.98%
Woodland Dr	0.871	0	14,429	13,852	96.00%	14.16	8.21	58.00%	25.20	15.39	61.06%
Fairgrounds	0.46	0	12,628	7,577	60.00%	13.96	2.79	20.00%	22.47	4.49	20.00%
St Joseph's Cemetery	0.87	0	14,135	13,570	96.00%	12.72	7.38	58.00%	23.90	14.70	61.50%
Temple St Lawn	1.074	0	16,067	15,424	96.00%	15.18	8.81	58.00%	29.59	18.17	61.42%

Project Name	*Volume Managed (ac-ft)*	*Volume Infiltrated (ac-ft)*	*TSS Yield (lbs)*	*TSS Removal (lbs)*	*TSS Removal (%)*	*WinSLAMM TP Yield (lbs)*	*WinSLAMM TP Removal (lbs)*	*WinSLAMM TP Removal (%)*	*STP Calculator TP Yield (lbs)*	*STP Calculator TP Removal (lbs)*	*STP Calculator TP Removal (%)*
Gibson Ave Green Streets E	0.190	0.19	1,690	1,684	99.63%	1.35	1.35	99.67%	3.46	3.46	100.00%
Curtis Ave Green Streets	0.142	0.142	1,583	1,567	99.04%	1.28	1.26	99.12%	2.56	2.56	100.00%
Piedmont Pond Rd	0.098	0.098	1,268	1,172	92.44%	1.11	1.02	92.19%	1.92	1.86	96.90%
Killington Ave Greenspace	0.34	0	5,774	5,543	96.00%	5.02	2.91	58.00%	9.26	5.70	61.57%
25 Curtis Ave	0.168	0.168	3,346	3,197	95.54%	1.02	0.97	95.51%	2.78	2.78	100%
Gibson Ave Green Streets W	0.103	0.103	777	776	99.89%	0.68	0.68	99.89%	1.39	1.39	100.00%
Westview Ave Detention	0.45	0	7,821	7,508	96.00%	8.73	5.06	58.00%	13.32	8.09	60.75%
Regency Manor	0.371	0	4,063	3,901	96.00%	2.34	1.36	58.00%	9.46	2.49	26.33%
Jasmin Ln Lawn	0.30	0	3,767	3,616	96.00%	2.52	1.46	58.00%	7.74	4.82	62.29%

4.6 Final Ranking Methodology

A prioritization matrix was utilized to quantitatively rank each of the Top 20 projects. Considerations that factored into the ranking 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
- TSS removed
- TP removed
- Other project benefits
- Project cost

The final ranking table, the final ranking criteria and their associated scores, an overview map, one-page summary sheets, and a descriptive memo are included as Appendix L.

4.6.1 Project Cost Estimation

Project cost, listed as one of the criteria considered, was calculated for each project using a spreadsheet-based method. The methodology for determining these planning level costs is a variation of the method first developed for the City of South Burlington by the Horsley Witten (HW) Group as part of the Centennial Brook Flow Restoration Plan development. The criteria used in this cost estimation can be found in Appendix L. This methodology provides consistent budgetary cost estimates across BMPs.

Cost estimates are based on average costs for conceptual level projects and deviation from these estimates is expected as projects move forward with engineering design. There are differences between project cost estimates presented in the plan and actual project bid costs. The BMP cost estimates presented in the plan are based on limited site investigation. This methodology, while providing consistency in budget cost estimating, may fail to accurately reflect project cost impacts associated with actual site conditions and constraints. Therefore, the BMP cost estimates presented are suitable for planning purposes only and not detailed program budgeting. The BMP cost estimates were developed based on the following assumptions:

Design Control Volumes: Design control volumes were based on the estimated runoff volume associated with the Channel Protection volume (CPv) or Water Quality volume (WQv) storm events for off-line, underground, or GSI-type practices. Off-line stormwater management systems are designed to manage storm events by diverting a percentage of stormwater from a storm drainage system. Underground systems and GSI-type practices were conceptually designed as offline practices that only accept runoff from the target storm event. Runoff volumes for all storm events were determined based on HydroCAD model results that rely on the Soil Conservation Service (SCS) TR-55 and TR-20 hydrologic methods.

Unit Costs and Site Adjustment Factors: Unit cost for each BMP and site adjustment factors were derived from research by the Charles River Watershed Association and Center for Watershed Protection, as well as from experience with actual construction[3] and modified for this project to reflect the newest cost estimates

[3] Horsley Witten Group, Inc. 2014. Centennial Brook Watershed: Flow Restoration VTBMPDSS Modeling Analysis and BMP Supporting Information. Memorandum dated January 9th, 2014.

available and inflation from 2016 dollars to 2019 dollars. Cost adjustment factors were used to account for site-specific differences typically related to project size, location, and complexity.

Underground filtration chamber systems were typically designed using Stormtech chamber systems.

Site-Specific Costs: Cost of significant utility or other work related to the construction of the BMP itself. Site-specific costs are variable based on past experience.

Base Construction Cost: Calculated as the product of the design control volume, the unit cost, and the site adjustment factor.

Permits and Engineering Costs: Used either 20% for large aboveground projects or 35% for smaller or complex projects.

Total Project Cost: Calculated as the sum of the base construction cost, permitting and engineering costs, and land acquisition costs.

Cost per Impervious Acre: Calculated as the construction costs plus the permitting and engineering costs, divided by the impervious acres managed by the BMP.

Operation and Maintenance: The annual operation and maintenance (O&M) was calculated as 3% of the base construction costs, with a maximum of $10,000.

Minimum Cost Adjustment: After total project costs were determined for each proposed BMP based on the HW methodology, costs were reviewed and adjusted so that projects involving a simple BMP were assigned a minimum cost of $10,000 and more complex projects were assigned a minimum cost of $25,000.

4.7 Final Prioritization

Each of the factors noted in the final ranking (see Appendix L) were scored and scores were totaled for each of the criteria. Projects were assigned a rank from 1 to 20 with those projects receiving the highest scores assigned the highest rank. In the case of a tie between two projects, the TP removed (lbs; as calculated by the STP Calculator) by the practice was used as a tiebreaker. A list of the sites, the proposed BMP, the ranking sore, and their assigned rank are shown below in Table 3. The location of the Top 20 projects within the study area are shown above in Figure 8. As future funding becomes available for project implementation, this prioritization matrix can be utilized in selecting additional projects for implementation.

Table 3. The Top 20 projects are shown in ranked order.

Project Name	*Proposed BMP Practice Type*	*Total Score*	*BMP Rank*
Allen Street Infiltration	Underground Infiltration	58	1
Ocean State Job Lot	Gravel Wetland, Impervious Cover Reduction	52	2
VAC Parking Lot	Gravel Wetland	49	3
Green Mountain Missionary Baptist	Infiltration Basin	39	4
White Memorial Park	Infiltration Basin, Bioretention	36	5
Comfort Inn Plaza	Underground Infiltration	33	6
Granger St Infiltration	Infiltration Basin	32	7
Woodland Dr	Gravel Wetland	31	8
Fairgrounds	Buffer Enhancement	31	9
St Joseph's Cemetery	Gravel Wetland	30	10
Temple St Lawn	Gravel Wetland	29	11
Gibson Ave Green Streets E	Bioretention, Curb Bump Out, Infiltration Trench, Residential GSI	27	12
Curtis Ave Green Streets	Curb Bump Out, Bioretention, Infiltration Trench, Residential GSI	26	13
Piedmont Pond Rd	Infiltration Basin	26	14
Killington Ave Greenspace	Gravel Wetland	25	15
25 Curtis Ave	Infiltration Basin	25	16
Gibson Ave Green Streets W	Bioretention, Curb Bump Out, Infiltration Trench, Residential GSI	25	17
Westview Ave Detention	Gravel Wetland	24	18
Regency Manor	Underground Sand Filter	22	19
Jasmin Ln Lawn	Gravel Wetland	21	20

4.8 Selection of Top 3 Potential BMPs

The Top 3 sites in this plan were selected for 30% engineering designs. Selection of the Top 3 sites considered the results from initial site investigations, modeling and ranking matrices, input from stakeholders concerning project priorities, and the willingness of the private landowners to voluntarily participate in this plan. The Top 3 sites, which are further described in Section 5, are Allen Street Infiltration, Ocean State Job Lot, and VAC Parking Lot. The locations of these Top 3 sites within the study area are shown in Figure 9 below. The Top 3 sites are listed in

Table 4.

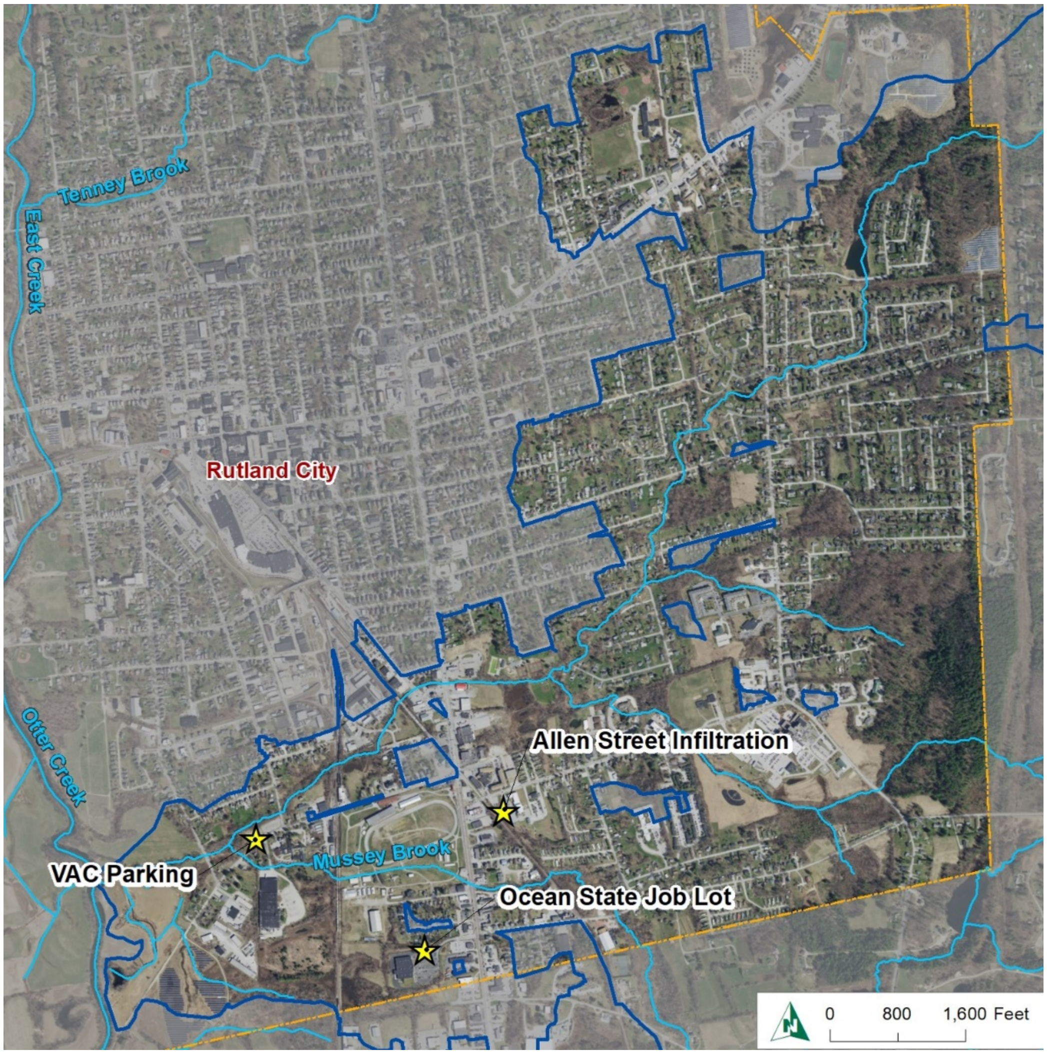

Figure 9. The Top 3 sites are depicted with yellow stars within the study area.

Table 4. The Top 3 sites are listed below.

Project Name	*Proposed BMP Practice Type*	*BMP Rank*
Allen Street Infiltration	Underground Infiltration	1
Ocean State Job Lot	Gravel Wetland, Impervious Cover Reduction	2
VAC Parking Lot	Gravel Wetland	3

5 30% Designs

When implemented, these Top 3 BMPs (Allen Street Infiltration, Ocean State Job Lot, and VAC Parking Lot) would treat drainage from approximately 29 acres, 17.5 acres (60%) of which is impervious. Modeled pollutant reductions for these projects, shown below in Table 5, indicate that these BMPs will prevent nearly 32,049 lbs of TSS and 38.7 lbs of TP from reaching receiving waters annually. They will also infiltrate 0.46 ac ft of stormwater, reducing the volume of stormwater reaching receiving waters via piped and overland flow and providing groundwater recharge. See Appendix K for complete modeling reports. The 30% designs and their associated cost estimates can be found in Appendix M.

Table 5. Modeling results for the Top 3 projects are shown below.

Project Name	Volume Managed (ac-ft)	Volume Infiltrated (ac-ft)	TSS Yield (lbs)	TSS Removal (lbs)	TSS Removal (%)	WinSLAMM TP Yield (lbs)	WinSLAMM TP Removal (lbs)	WinSLAMM TP Removal (%)	STP Calculator TP Yield (lbs)	STP Calculator TP Removal (lbs)	STP Calculator TP Removal (%)
Allen Street Infiltration	0.46	0.46	10,090	8,990	89.10%	8.14	7.20	88.48%	19.18	18.31	95.48%
Ocean State Job Lot	0.701	0	16,455	15,797	96.00%	5.85	3.39	58.00%	18.70	11.61	62.09%
VAC Parking Lot	0.494	0	7,564	7,261	96.00%	5.42	3.14	58.00%	14.33	8.78	61.26%

5.1 Allen Street Infiltration

5.1.1 30% Concept Design Description

The first site is located on property owned by Heritage Family Credit Union along the south side of Allen Street just east of the intersection with S Main St (Route 7). Rutland City stakeholders have noted that the stormline that runs west along Allen St is often overwhelmed in large storms and the capacity is exceeded. Currently, the stormline turns north along S Main St and drains directly to Moon Brook without management (see Figure 11).

Figure 10. The existing infiltration chambers are located under the Heritage Family Credit Union parking lot.

The Heritage Family Credit Union site has a State stormwater permit (6547-INDS.R) for management of their site's drainage. They have an existing subsurface infiltration chamber system in their western parking lot and a stormwater pond that manages the majority of their southern parking lots (Figure 10). Representatives from the Heritage Family Credit Union have noted that the existing subsurface infiltration chambers have been functioning well since they were installed.

Watershed and the Rutland NRCD completed a site walk with Randy Martelle, the Senior Vice President of Operations for Heritage Family Credit Union in July of 2019. The existing stormwater infrastructure on site was assessed during this site walk and the practices were found to be in good condition.

The concept for this proposed BMP is to create a new subsurface infiltration system under Heritage Family Credit Union parking lot to the west of the existing subsurface infiltration chamber system. Drainage from the stormline running west down Allen St would be intercepted and redirected to the practice. The site would manage stormwater from 13.8 acres of commercial, road, and residential drainage, 5.2 acres of which (38%) are classified as impervious. The remainder of the drainage area is primarily managed pervious such as mowed lawns. See Figure 11 below for a map of the area that would drain to this proposed practice. The infiltration chambers would be sized to manage the Water Quality volume (WQv), the first inch of rainfall that carries the majority of pollutants with it, from the Allen St stormline. BMP Summary sheets and drainage area maps are included in Appendix O.

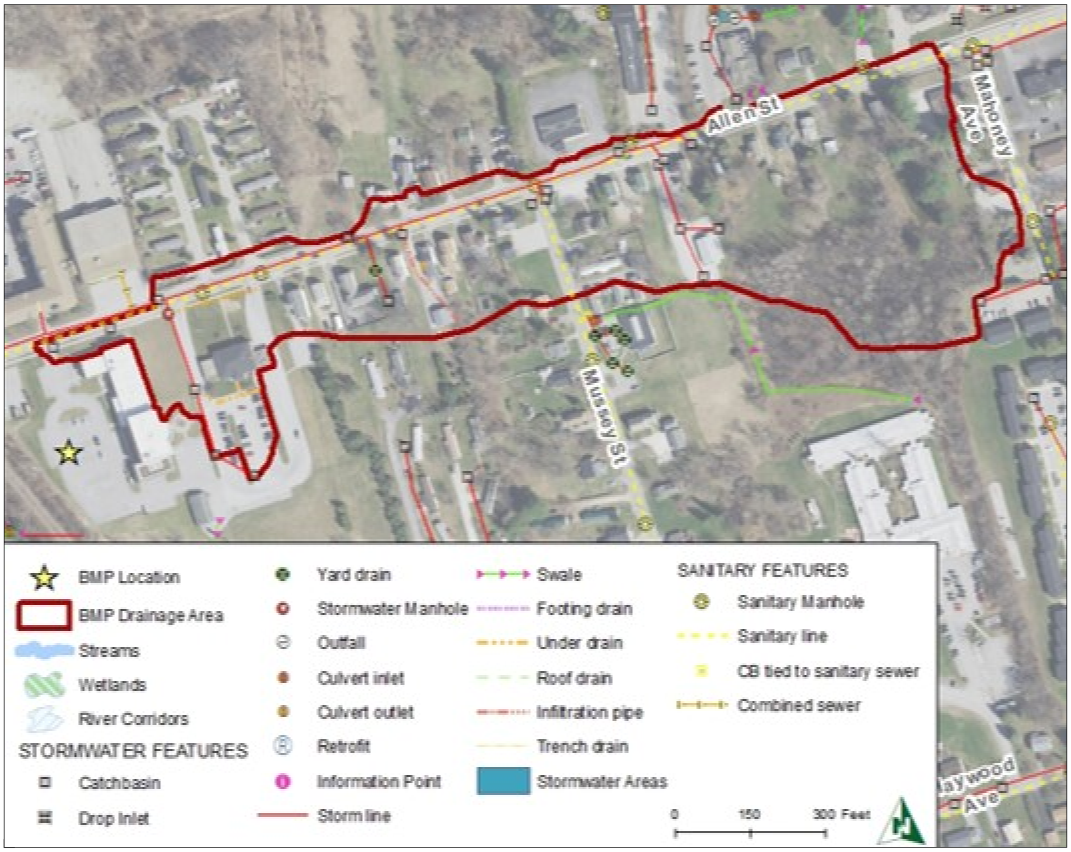

Figure 11. The drainage area for the proposed subsurface infiltration chambers is shown with a dark red boundary. The approximate location of the proposed practice is shown with a yellow star.

5.1.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent nearly 9,000 lbs of total suspended solids (TSS) and 18.31 of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was management and infiltration of the Water Quality volume (WQv, or 1 inch of rain in a 24-hour period), equal to 20,125 ft^3 of runoff. See Table 6 for the benefit summary table.

Table 6. Allen Street Infiltration benefit summary table.

TSS Removed	8,990 lbs
TP Removed	18.31 lbs
Impervious Treated	5.2 acres
Total Drainage Area	13.8 acres

5.1.3 Cost Estimates

The total estimate cost for this project is approximately $196,936. Note that these costs are preliminary and will need to be update during the final design process. Cost projections can be found in Table 7.

- The cost per pound of phosphorus treated is $10,756.
- The cost per impervious acre treated is $37,872.
- The cost per cubic foot of runoff treated is $9.79.

Table 7. The initial construction cost projection for the Allen Street Infiltration site is included below.

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Site Preparation					
N/A	MOBILIZATION	LS	1	$1,000.00	$1,000.00
653.55	PROJECT DEMARCATION FENCE	LF	360	$1.17	$421.20
649.51	GEOTEXTILE FOR SILT FENCE	SY	70	$4.13	$289.10
N/A	CONSTRUCTION STAKING	HR	4	$125.00	$500.00
				Subtotal:	$2,210.30
Chambers - Excavation and Materials					
		EXCAVATION			
203.15	COMMON EXCAVATION	CY	1500	$9.86	$14,790.00
		MATERIALS			
N/A	DC780		121	$245.00	$29,645.00
N/A	SC740 Plain End Cap		9	$51.18	$460.62
N/A	SC740 12T End Cap		12	$218.50	$2,622.00
N/A	SC740 24B End Cap		11	$337.58	$3,713.41
N/A	24" Tee		5	$371.06	$1,855.30
N/A	24" 90 Bend		2	$298.75	$597.50
N/A	24" Couplers		22	$33.20	$730.40
N/A	24" N12 AASHTO		80	$21.08	$1,686.40
N/A	12" Tee		2	$117.06	$234.12
N/A	12" 90 Bend		1	$78.29	$78.29
N/A	12" N12 AASHTO		120	$7.25	$870.00
N/A	12" Couplers		10	$8.30	$83.03
N/A	601TG to wrap system		1500	$0.82	$1,230.00
N/A	315WTK for scour/isolator row		500	$0.72	$360.00
N/A	6" Hole Saw		1	$172.17	$172.17
N/A	6" N12 FOR INSPECTION PORTS		80	$2.63	$210.40
N/A	6" INSERTA TEE FOR INSPECTION PORT		12	$100.45	$1,205.40
N/A	12" INLINE DRAIN FOR INSPECTION PORT		12	$351.90	$4,222.80
N/A	30" Nyloplast Basin		1	$2,500.00	$2,500.00
N/A	Structure Provided by Others		3		$0.00
629.54	CRUSHED STONE BEDDING (3/4" - 1 1/2" STONE)	TON	893	$34.04	$30,397.72

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
PLANTING (ABOVE CHAMBERS IN GREENSPACE)					
651.15	SEED	LB	5	$7.66	$38.30
653.20	TEMPORARY EROSION MATTING	SY	170	$2.20	$374.00
651.25	HAY MULCH	TON	0.25	$597.15	$149.29
PAVING					
	ASHPALT	SF	5400	$4.00	$21,600.00
				Subtotal:	$119,826.15
New Infrastructure for Conveyance of Runoff to Practice					
STRUCTURES AND PIPES					
604.18	PRECAST REINFORCED CONCRETE DROP INLET WITH CAST IRON GRATE (SPLITTER/MANIFOLD OR OTHER)	EACH	3	$4,009.29	$12,027.87
601.0915	CPEP	LF	252	$64.04	$16,138.08
204.30	GRANULAR BACKFILL FOR STRUCTURES	CY	4	$40.30	$161.20
				Subtotal:	$28,327.15
	Construction Contingency - 20%				$36,087.26
Construction Subtotal:					$180,436.31
	Refine Survey	HR	16	$125.00	$2,000.00
	Refine H&H Modeling	HR	16	$125.00	$2,000.00
	60% Design	HR	24	$125.00	$3,000.00
	100% Design	HR	40	$125.00	$5,000.00
	Permitting & Cost Estimation	HR	36	$125.00	$4,500.00
Design Subtotal:					$16,500.00
Total					**$196,936.31**

5.1.4 Next Steps

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 infiltrated and that larger storms bypass the system safely. Randy Martelle, the Senior Vice President of Operations, has been consulted on this project and gave preliminary permission for the 30% design to be completed. However, the final 30% design has not been formally approved by Mr. Martelle. Heritage Family Credit Union should be contacted, and formal approval needs to be granted prior to pursing final design funding. When approval and funding for implementation is secured, construction of the practice should be scheduled to minimize impacts to the Heritage Family Credit Union parking lot and property. All disturbance of the site (i.e., removal of pavement for installation of the infiltration chamber system) should be restored following construction.

5.1.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix N. In summary:

Stormwater Permit

Currently, a stormwater permit will not be required for this project. The Heritage Credit Union site, where the practice is proposed, currently has a stormwater permit (6547-INDS.R). The proposed practice would not impact the existing system.

The site should qualify for an Erosion Prevention and Sediment Control permit (3-9020) under the Low Risk categorization if the following guidelines are followed:

- Less than 2 acres of disturbance at any one time.
- All soils must be stabilized (temporary or final) within 7 days.
- Runoff from the site must pass through a 50' vegetated buffer prior to entering any Water of the State.

Local Permitting

No local permits are anticipated.

Other Permits

It is not anticipated that any Act 250, wetlands, river corridor, or lakeshore permits would be required for this project.

5.2 Ocean State Job Lot

5.2.1 30% Concept Design Description

The Ocean State Job Lot property is located at 241 S Main St along the western side of the road and west of Panera Bread (Figure 13). The Ocean State Job Lot has an expired State stormwater permit (1-1238) and an associated sedimentation basin. The Panera Bread has a stormwater pond located just to the east of the Ocean State Job Lot sedimentation basin and has a current State stormwater permit (6672-INDS). The Ocean State Job Lot parcel has more than 3 acres of impervious cover and does not have a current State stormwater permit (Figure 12). As such, this site will be subject to the State "3-acre permit", which requires all parcels with greater than 3 acres of imperious cover without a current stormwater permit to meet permit standards.

Figure 12. The Ocean State Job Lot site has significant impervious primarily from the parking lot and travel lanes as well as the building footprint.

In October of 2019, Watershed staff and City of Rutland staff met with John Barbato, the Director of Real Estate for Ocean State Job Lot, and Nicole Kesselring, President of Enman Kesselring Engineers (engineering consultants hired by Ocean State Job Lot) at the store to discuss potential stormwater management options. The project stakeholders discussed potential stormwater management options on the site with a focus on a combined system that would manage both the drainage from the Ocean State Job Lot site and City-owned property along South Main St. The City of Rutland has both flow reduction and phosphorus reduction goals that are a requirement of their municipal permit. This combined system could help both Ocean State Job Lot and the City of Rutland to meet required stormwater management goals.

The proposed stormwater BMP includes the construction of a gravel wetland along the northern side of the parking lot. There is potential to redirect drainage from S Main St west down the Ocean State Job Lot driveway to combine with Ocean State Job Lot property's drainage. A new gravel wetland is proposed along the northern edge of the Ocean State parking lot. The northernmost row of parking spaces would be removed to accommodate this linear feature, the location of which is depicted with a yellow star in the map below (Figure 13). The remainder of this row of parking along the northern edge of the parcel could also be removed to reduce impervious cover on site. The Ocean State Job Lot building has a flat roof, and the location of the roof drains were unknown at the time of the design. It was assumed during design that the roof drains could be directed into the main stormwater system for the property and managed in the gravel wetland. If the roof drains are not able to be managed in the system, the BMP could be proportionately downsized during final design. Another consideration during final design is the routing of the stormlines along South Main St to the system. Additional verification of pipe inverts and flow direction will need to be completed during final design. BMP Summary sheets and drainage area maps are included in Appendix O.

This practice would manage 7.7 acres, 94% (7.3 acres) of which is impervious. An additional 0.18 acres of impervious could be removed as a part of this project (see the green polygon in Figure 13 below). The drainage area includes the majority of the Ocean State Job Lot site, the driveway to the store, and commercial and road areas along S Main St (Route 7).

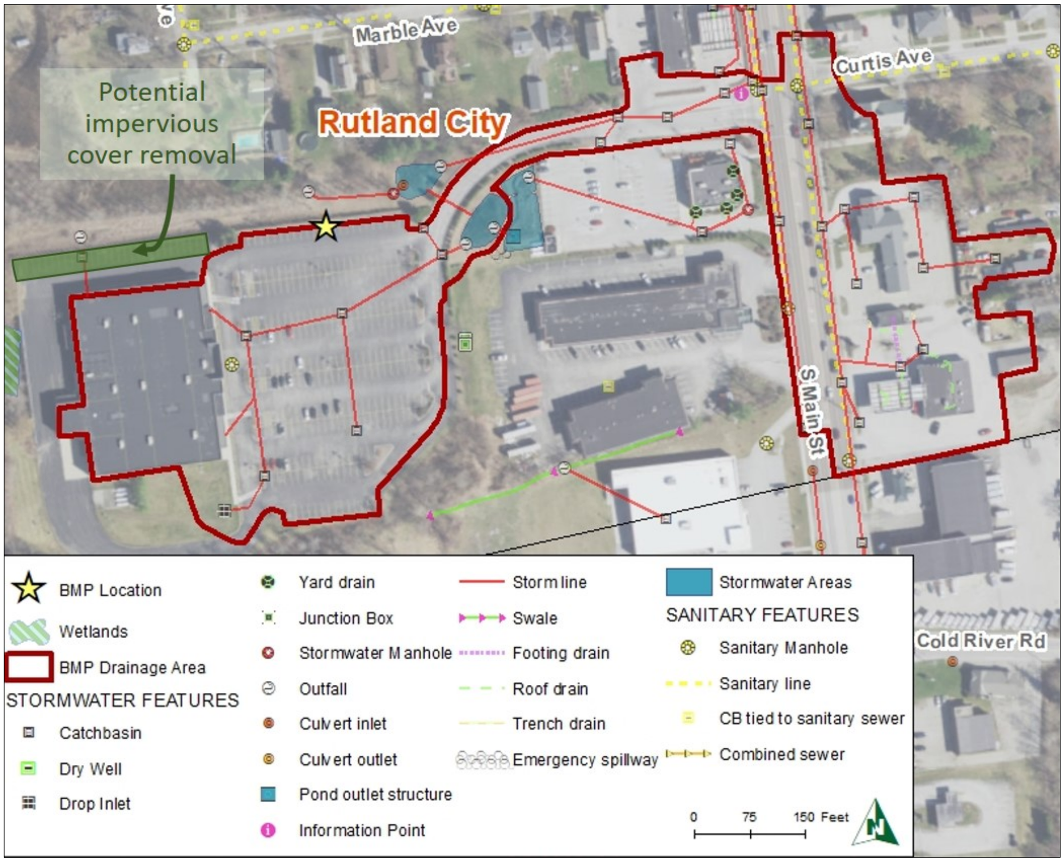

Figure 13. The drainage area for the proposed gravel wetland is shown with a dark red boundary. The approximate location of the proposed practice is shown with a yellow star. The potential impervious cover removal area is shown with a green polygon.

5.2.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent nearly 16,000 lbs of total suspended solids (TSS) and 11.61 lbs of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was management of the Channel Protection volume (CPv, or 2.11 inches of rain in a 24-hour period), equal to 30,548 ft^3 of runoff. See Table 8 for the benefit summary table.

Table 8. Ocean State Job Lot benefit summary table.

TSS Removed	15,797 lbs
TP Removed	11.61 lbs
Impervious Treated	7.3 acres
Total Drainage Area	7.7 acres

5.2.3 Cost Estimates

The total estimate cost for this project is $290,374. Note that these costs are preliminary and will need to be update during the final design process. Cost projections can be found in Table 9.

- The cost per pound of phosphorus treated is $25,011.
- The cost per impervious acre treated is $39,777.
- The cost per cubic foot of runoff treated is $9.51.

Table 9. The initial construction cost projection for the Ocean State Job Lot site is included below.

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Site Preparation					
	Mobilization	LS	1	$25,000.00	$25,000.00
653.55	Project Demarcation Fencing	LF	1260	$1.17	$1,474.20
653.20	Temporary Erosion Matting	SY	1800	$2.20	$3,960.00
649.51	Geotextile for silt fence	SY	204	$4.13	$842.52
652.10	EPSC Plan	LS	1	$5,000.00	$5,000.00
652.20	Monitoring EPSC Plan	HR	40	$125.00	$5,000.00
	Construction Staking	HR	16	$125.00	$2,000.00
				Subtotal:	$43,276.72
Gravel Wetland					
203.15	Common Excavation	CY	5000	$9.86	$49,300.00
651.35	Muck Soil	CY	99	$30.96	$3,050.02
301.25	3/4" to 1 1/2" Crushed Stone (Crushed Stone Bedding)	CY	294	$36.49	$10,730.76
629.54	Pea Stone (Crushed Stone Bedding)	CY	49	$36.49	$1,770.58
649.31	Geotextile Under Stone Fill	SY	800	$2.51	$2,008.00
N/A	Wetland Plant Seeds	LBS	20	$125.00	$2,500.00
651.15	Seed	LBS	20	$7.66	$153.20
605.10	6" Underdrain Piping	LF	90	$21.86	$1,967.40
				Subtotal:	$71,479.96
New Infrastructure					
	RELOCATE ELECTIC/TELE/SEWER	LS	1	$25,000.00	$25,000.00
	ROUTE 7 IMPACT	LS	1	$25,000.00	$25,000.00
613.11	STONE FILL, TYPE II	CY	86	$42.49	$3,647.85
604.18	PRECAST REINFORCED CONCRETE DROP INLET WITH CAST IRON GRATE	EACH	3	$4,009.29	$12,027.87
601.0915	18" CPEP	LF	279	$64.04	$17,867.16
				Subtotal:	$83,542.88
Construction Engineering					
	Construction Oversight	HR	80	$125.00	$10,000.00
				Subtotal:	$10,000.00
	Incidentals - 5%				$13,018.72
	Construction Contingency - 20%				$52,074.89

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Construction Subtotal:					$260,374.44
	Refine Survey	HR	24	$125.00	$3,000.00
	Refine H&H Modeling	HR	16	$125.00	$2,000.00
	60% Design	HR	40	$125.00	$5,000.00
	100% Design	HR	80	$125.00	$10,000.00
	Permitting & Cost Estimation	HR	80	$125.00	$10,000.00
Design Subtotal:					$30,000.00
Total					**$290,374.44**

5.2.4 Next Steps

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 managed in the system and that larger storms bypass the system safely. Preliminary permission to complete the 30% design was provided, but a formal agreement between Ocean State Job Lot and the City of Rutland should be obtained prior to seeking funding for final design and implementation. This agreement should specify the terms of this public – private partnership. As a part of this agreement, a cost sharing agreement will need to be formalized.

5.2.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix N. In summary:

Stormwater Permit

Currently, a stormwater permit will be required for the Ocean State Job Lot site as it has more than 3 acres of impervious cover without a current stormwater permit. The site does have an expired permit (1-1238) for the existing sedimentation basin.

The site should qualify for an Erosion Prevention and Sediment Control permit (3-9020) under the Low Risk categorization if the following guidelines are followed:

- Less than 2 acres of disturbance at any one time.
- All soils must be stabilized (temporary or final) within 7 days.
- Runoff from the site must pass through a 50’ vegetated buffer prior to entering any Water of the State.

Local Permitting

No local permits are anticipated.

Other Permits

It is not anticipated that any river corridor or lakeshore permits would be required for this project. The site will need review by a Wetlands Scientist prior to final design and implementation due to the presence of hydric soils near the proposed practice. The site does have an existing Act 250 permit (1R0794), and as such would need to be reviewed and the permit possibly amended to reflect the improve drainage conditions.

5.3 VAC Parking Lot

5.3.1 30% Concept Design Description

Figure 14. The BMP is proposed in the greenspace adjacent to the VAC parking lot.

The third site is located on the Vermont Achievement Center (VAC) property along Park St just west of the intersection of Park St and Granger St. The section of the VAC property in question is the grass field area to the west of the VAC parking lot (Figure 15). Currently this area is not actively used by VAC and is maintained through mowing during the spring and summer (Figure 14). The area is located across Park St from the main VAC campus.

The proposed BMP for this site includes redirecting the stormline running west down Park Street to a new gravel wetland in this greenspace next to the VAC parking lot. The proposed location is shown with a star on Figure 15. The design also includes a shallow grass swale along the perimeter of the parking lot to collect the drainage from the lot and direct it to the gravel wetland. The gravel wetland is designed to discharge north to Moon Brook and is located adjacent to but outside of the river corridor. There are two catchbasins in the drainage area that are mapped as being connected to the sanitary sewer, but the VT DEC have noted that “1984 Sewer Plans unclear as to which CB are combined and which are not”. As a part of the final design, the connections should be verified. If these catchbasins are connected to the sanitary sewer, they should be disconnected from the sanitary system and connected to the stormwater system and managed in this project if feasible. If this is not feasible, the BMP footprint could be downsized proportionately. The BMP would manage 7.5 acres, 5 acres of which (68%) is classified as impervious. The drainage area is shown in dark red in Figure 15 below.

Watershed and the City of Rutland reached out to VAC to gauge their willingness to participate in this project. Watershed and Mitch Golub, President/CEO of VAC, discussed the project during a phone call. Following this, Watershed and the Rutland NRCD met with VAC representatives on site in September 2019 to further discuss the concept and investigate the site. VAC representatives were generally receptive to the proposed project. Watershed discussed the project with the VAC Board in November 2019 to provide an overview of the proposed project and answer any questions from board members. The VAC Board was generally receptive to the proposed project. The Board will take a formal vote to approve the project, but this has not happened at the time of this report. Summaries of the phone call and site visit with VAC are included in Appendix H. BMP Summary sheets and drainage area maps are included in Appendix O.

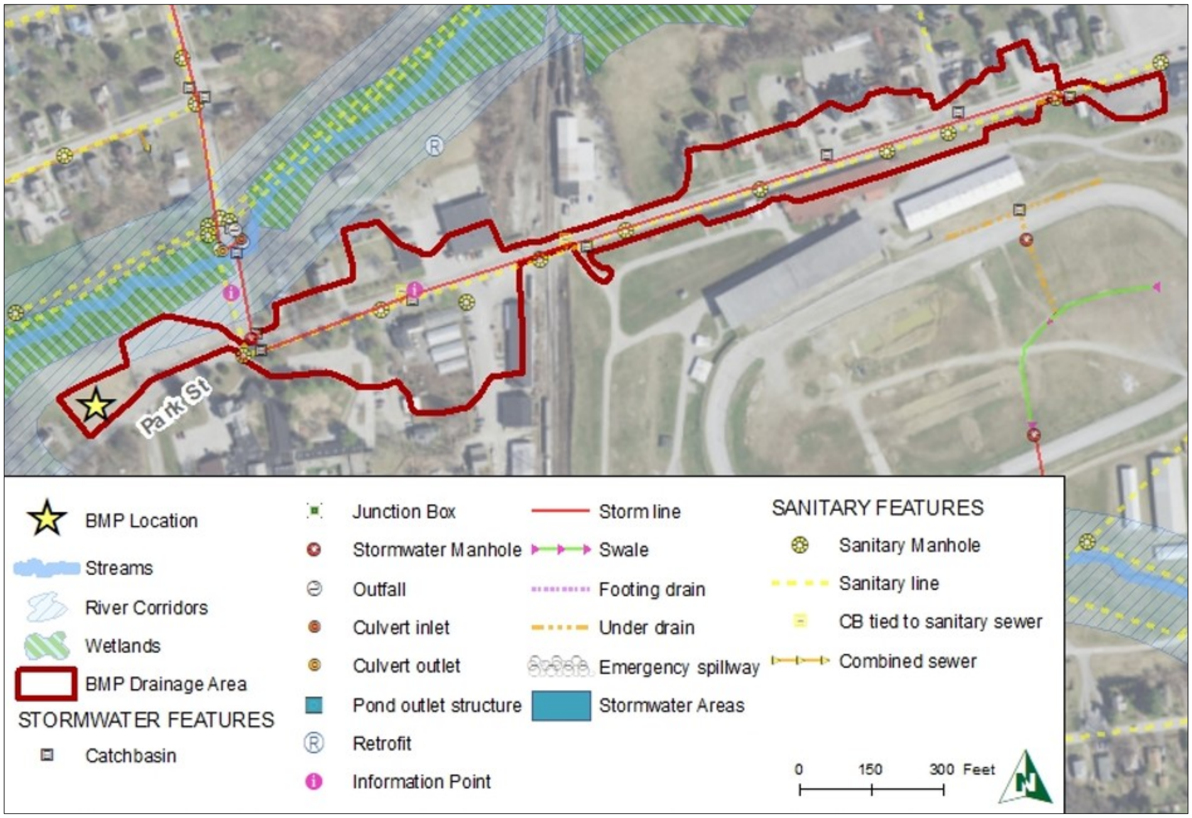

Figure 15. The drainage area for the proposed gravel wetland is shown with a dark red boundary. The approximate location of the proposed practice is shown with a yellow star.

5.3.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent more than 7,000 lbs of total suspended solids (TSS) and 8.78 lbs of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was management of the Channel Protection volume (CPv, or 2.11 inches of rain in a 24-hour period), equal to 21,519 ft^3 of runoff. See Table 10 for the benefit summary table.

Table 10. VAC Parking Lot benefit summary table.

TSS Removed	7,261 lbs
TP Removed	8.78 lbs
Impervious Treated	5 acres
Total Drainage Area	7.5 acres

5.3.3 Cost Estimates

The total estimate cost for this project is $191,669. Note that these costs are preliminary. Cost projections can be found in Table 11.

- The cost per pound of phosphorus treated is $21,830.
- The cost per impervious acre treated is $38,334.
- The cost per cubic foot of runoff treated is $8.91.

Table 11. The initial construction cost projection for the VAC Parking Lot site is included below.

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Site Preparation					
	Mobilization	LS	1	$25,000.00	$25,000.00
653.55	Project Demarcation Fencing	LF	463	$1.17	$541.71
653.20	Temporary Erosion Matting	SY	780	$2.20	$1,716.00
649.51	Geotextile for silt fence	SY	137	$4.13	$565.81
652.10	EPSC Plan	LS	1	$5,000.00	$5,000.00
652.20	Monitoring EPSC Plan	HR	40	$125.00	$5,000.00
	Construction Staking	HR	16	$125.00	$2,000.00
				Subtotal:	$39,823.52
Gravel Wetland					
203.15	Common Excavation	CY	1080	$9.86	$10,648.80
651.35	Muck Soil	CY	128	$30.96	$3,956.57
301.25	3/4" to 1 1/2" Crushed Stone (Crushed Stone Bedding)	CY	381	$36.49	$13,920.26
629.54	Pea Stone (Crushed Stone Bedding)	CY	63	$36.49	$2,296.84
649.31	Geotextile Under Stone Fill	SY	1000	$2.51	$2,510.00
N/A	Wetland Plant Seeds	LBS	15	$125.00	$1,875.00
651.15	Seed	LBS	15	$7.66	$114.90
605.10	6" Underdrain Piping	LF	80	$21.86	$1,748.80
				Subtotal:	$37,071.18
New Infrastructure					
900.620	HYDRODYNAMIC SWIRL SEPARATOR (6' HYDROINTERNATIONAL DOWNSTREAM DEFENDER OR EQUAL)	EACH	1	$10,000.00	$10,000.00
613.11	STONE FILL, TYPE II	CY	86	$42.49	$3,647.85
604.18	PRECAST REINFORCED CONCRETE DROP INLET WITH CAST IRON GRATE	EACH	1	$4,009.29	$4,009.29
601.0915	18" CPEP	LF	387	$64.04	$24,783.48
				Subtotal:	$42,440.62

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Construction Engineering					
	Construction Oversight	HR	80	$125.00	$10,000.00
				Subtotal:	$10,000.00
	Incidentals - 5%				$8,083.46
	Construction Contingency - 20%				$32,333.83
Construction Subtotal:					$161,669.14
	Refine Survey	HR	24	$125.00	$3,000.00
	Refine H&H Modeling	HR	16	$125.00	$2,000.00
	60% Design	HR	40	$125.00	$5,000.00
	100% Design	HR	80	$125.00	$10,000.00
	Permitting & Cost Estimation	HR	80	$125.00	$10,000.00
Design Subtotal:					$30,000.00
Total:					**$191,669.14**

5.3.4 Next Steps

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 managed and that larger storms bypass the system safely. Preliminary permission was provided by Mitch Golub, President/CEO of VAC. However, formal VAC Board approval should be confirmed prior to pursing funding for final design.

5.3.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix N. In summary:

Stormwater Permit

Currently, a stormwater permit is not required for this site.

The site should qualify for an Erosion Prevention and Sediment Control permit (3-9020) under the Low Risk categorization if the following guidelines are followed:

Less than 2 acres of disturbance at any one time.

All soils must be stabilized (temporary or final) within 7 days.

Runoff from the site must pass through a 50’ vegetated buffer prior to entering any Water of the State.

Local Permitting

No local permits are anticipated.

Other Permits

It is not anticipated that any Act 250 or lakeshore permits would be required for this project. The site will need review by a Wetlands Scientist prior to final design and implementation due to the presence of hydric soils near the proposed practice. The site will need review by a River Scientist prior to the completion of final design due to its proximity to the river corridor.

7 Final Recommendations

This SWMP has identified a suite of potential BMP concepts and locations that would have a positive impact on water quality in the study area and receiving waters including Moon Brook and Mussey Brook as well as Otter Creek and Lake Champlain. Although designs were only advanced for the Top 3 projects, this plan also serves to highlight other opportunities throughout the study area. As such, 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 stormwater management into the landscape. It is our recommendation that the City of Rutland and appropriate private partners move to implement the Top 3 practices and that the City moves forward with additional design and implementation of the other projects presented in this plan. As these practices are the result of a stormwater master planning effort under a 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 already at the 30% concept level, consider grant requests for final design and implementation.
- Following implementation of the priority projects, submit grant funding requests for higher-scoring projects that may include both preliminary and final design.

It is also recommended that the City complete the formal Moon Brook Flow Restoration Plan (FRP) and schedule implementation of these projects. Currently, these Top 20 projects have been submitted to the VT DEC for inclusion in the Best Management Decision Support System (BMPDSS) model for Moon Brook to determine if these practices will meet the required high flow reductions for Rutland City within Moon Brook. If targets are not met, it is recommended that projects from the final preliminary ranking be included in the watershed model until the target is met.