CAVENDISH STORMWATER MASTER PLAN

Final Report

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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 Cavendish Stormwater Master Plan completed by 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 with 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 in this area. There is great need to reduce stormwater impacts including phosphorus and sediment from stormwater runoff to receiving waters within the Town. 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, future regulations may require management of existing impervious areas.

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.

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 BMPs include infiltration trenches, bioretention practices, subsurface infiltration chambers, infiltration basins, and others.

Nitrates- Natural chemicals including nitrogen and oxygen that are found in stormwater.

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 the Black River, this includes the entire area draining to the point where the river discharges to the Connecticut 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

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. 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 is 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 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 of Cavendish, Vermont (see Figure 1). Cavendish, in Windsor County, includes a portion of the Black River as well as a number of smaller rivers and streams. The Town spans about 25,356 acres, approximately 86% of which is classified as forested while approximately 1.4% (346 acres) is classified as impervious cover.

While much of Cavendish is considered rural, there are significant areas of residential, commercial, and industrial development found throughout the Town, as well as mixed agricultural lands. Additionally, most of the soils in the watershed have low infiltration potential as indicated by Natural Resources Conservation Service (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 (51%) while only 4% are in group A. 24% are in group B and 4% are in group D. The combination of steep slopes with limited infiltration capacity makes this area particularly susceptible to erosion.

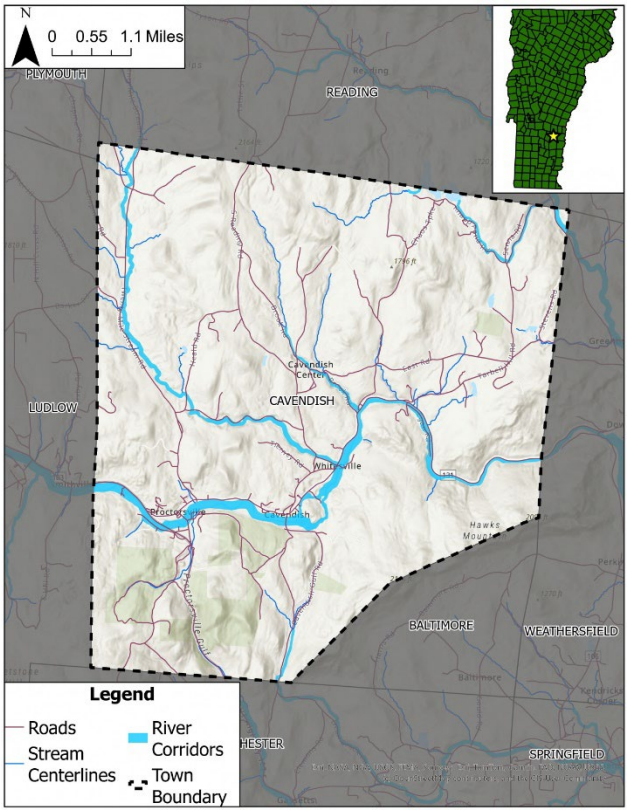

Figure 1. The SWMP study area includes the Town of Cavendish.

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

- parcel boundaries;
- topography;
- stormwater infrastructure and permits;
- impervious cover;
- land use/land cover;
- hydrologic soil groups;
- and river corridors, wetlands, and hydric soils.

3.2 Problem Definition

Cavendish is located within the Black-Ottauquechee watershed (see Figure 2).

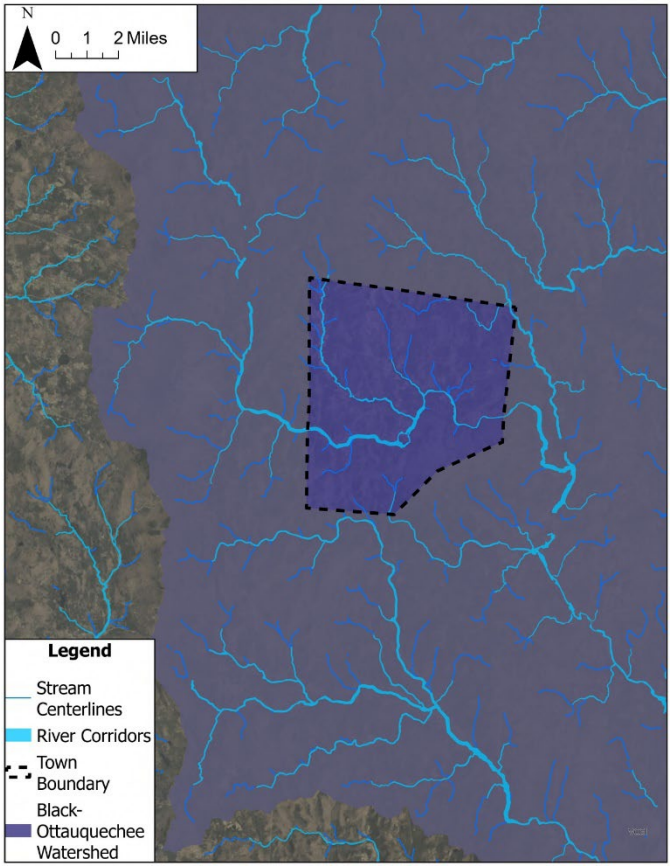

Figure 2. Cavendish is located within the Black-Ottauquechee watershed (purple).

The Black River has numerous reaches that are adversely impacted by stormwater runoff and development.

Two segments of the Black River are designated as impaired in the State's 303(d) list of waters for the length of 8.3 miles due to artificial flow regulation and condition by the dam and *E. coli* from combined sewer overflows. Two segments of the river are also on the State's 2016 Stressed Waters List due to sediment, nutrients, and *E. coli.*

Cavendish faces unique challenges as it includes steep slopes in a highly developed area all of which drains to the Black River. There are a number of areas of impervious cover including 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, often on steep slopes with highly erodible soils or within river corridors. This has resulted in untreated stormwater draining from developed lands, transporting pollutants, and discharging to surface waters.

Cavendish has experienced significant development along Main Street and the surrounding areas, with expanding coverage of impervious surfaces. Main Street runs parallel to the Black River with significant development falling within in or close to the river corridor. This development has constrained the river in several locations. In addition to expanding development along these corridors, Cavendish experiences erosion because of steep slopes and poor soils, further contributing to sediment and nutrient loading in surface waters.

The human-influenced stressors in the Black-Ottauquechee watershed include industrial and commercial development, parking areas, widespread contamination from historic industrial development, construction of roads, and residential development. Additionally, due to a high-density of development within the river corridor and limited floodplain access, both nuisance flooding and more extreme floods can and do occur. Unmanaged stormwater runoff, particularly from impervious surfaces and landscaped pervious areas, exacerbates flooding. The Black River watershed and its tributaries have experienced 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. These heavy rains and easily erodible soils have contributed to erosion issues throughout the area. The stormwater management

practices investigated seek to protect local river resources as well as the larger Long Island Sound, which currently has a Total Maximum Daily Load (TMDL) in place, requiring reductions in nitrogen loading to the Long Island Sound via its tributaries through reductions in stormwater and urban and agricultural runoff pollution.

4 Methodology

4.1 Identification of All Opportunities

4.1.1 Kickoff Meeting

The project team met with stakeholders from the Town of Cavendish, Mount Ascutney Regional Planning Commission, and VT DEC on June 25, 2024, to discuss the SWMP and solicit information on specific stormwater-related problems in the Town as well as any planned developments or other relevant activities. The noted areas included specific problem areas and other general areas of importance. Meeting minutes from this meeting are included in Appendix B - Kick-Off Meeting Materials.

4.1.2 Desktop Assessment and Digital Map Preparation

Data Review and Desktop Assessment

A desktop assessment was completed to identify additional potential sites for stormwater best management practice (BMP) implementation. All data compiled and reviewed, and a summary memo can be found in Appendix C - Data Library.

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 general documents such as past studies conducted within the Black River watershed, and future regional planning goals.

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 (2024). Existing GIS resources and associated attribute data were thoroughly reviewed as part of this process.

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 future permitting. A point location was created for each identified site or area for assessment in the field.

A total of 31 locations were identified for stormwater retrofit potential including sites identified during the desktop assessment and those noted by stakeholders during the Kick-Off Meeting. For a map of these sites, see Figure 3. A larger map of the sites and a table listing the sites with descriptions are included in Appendix D - Desktop Assessment.

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 study area. 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.

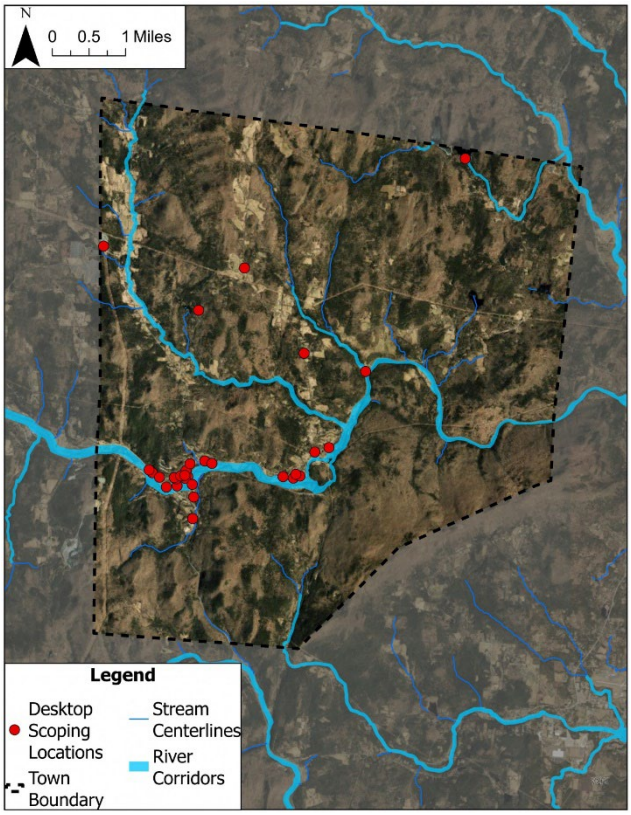

Figure 3. The 31 sites identified for field assessment are shown with red circles.

Figure 4. Screenshot of mobile data collection app.

The base layers were pre-loaded into a project-specific mobile app that was customized for this SWMP using the Fulcrum platform[1]. A screenshot of the mobile data collection app with several of these layers displayed is shown in Figure 4. The app was also pre-loaded with the 31 point locations for the potential BMP sites, which included locations of problem areas and potential opportunities (see green pins in Figure 4). These points allowed for easy site location and data collection in the field.

4.1.3 Field Data Collection

Targeted investigations were completed for the sites identified on the initial retrofit list as well as sites encountered during field work that were not initially identified. These investigations involved a visit to the prospective BMP location to assess the best retrofit appropriate for site-specific conditions and complete an initial assessment of project feasibility. Factors considered included, but were not limited to, potential utility conflicts, ownership of site, space, poor soils, steepness, and current and future site use. During the assessment, the team also determined if there were

[1] www.fulcrumapp.com

any ancillary benefits to the project (e.g., educational, flood mitigation, etc.), obtained photo documentation, and noted any potential questions about the site for follow-up (e.g., parcel ownership, location of utilities, road right-of-way width, etc.).

A total of 37 sites were assessed through the course of these field visits (Figure 5). Three locations were unable to be fully assessed due to private property. Three additional opportunities were identified and added to the preliminary BMP opportunity list. Several locations were updated to better reflect the potential BMP location. Several locations were assessed and determined not to be recommended for further analysis due to site-specific conditions such as utilities, existing site use, or the preference for another location to manage the area of concern. Following this process, a total of 30 sites remained as potential BMP opportunities (including sites where landowner outreach was conducted). See Appendix E - Field Assessment for an overview map, one-page summary sheets, and a summary memo describing these projects.

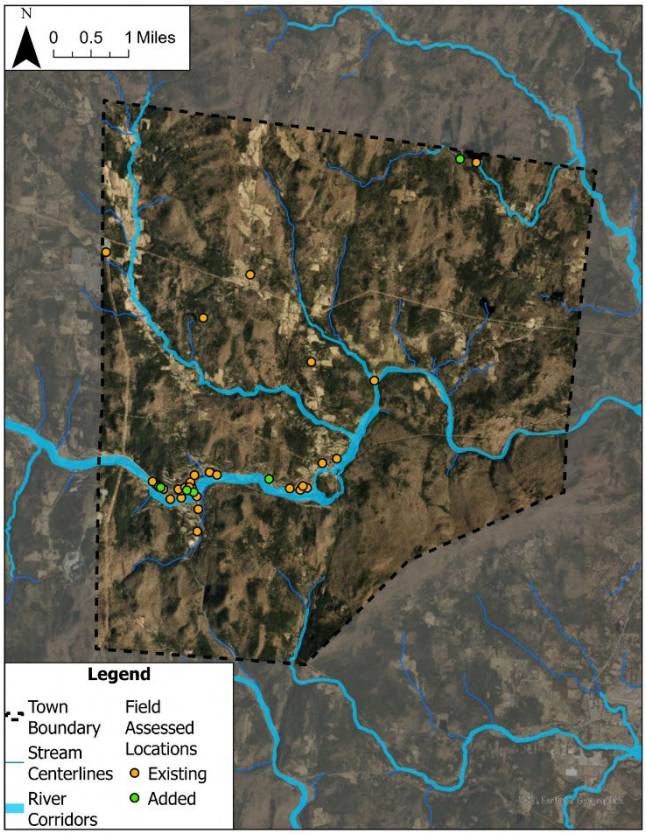

Figure 5. Field assessment sites including: 31 sites existing from the desktop review (orange) and 6 sites added in the field (green).

4.2 *Preliminary BMP Prioritization*

After initial field visits were completed the project list was updated. A preliminary prioritization system was then utilized to prioritize the remaining 30 projects (Figure 6). The goal of this prioritization was to identify the top 18 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, hydrologic connectivity, land ownership, hydrologic soil group, and feasibility issues. See Appendix F - Preliminary Prioritization for the prioritization table, one-page summary sheets with initial prioritization information, an overview map of sites prioritized, and a memo detailing this process.

The initial prioritization list was distributed to project stakeholders, and the project team then held a virtual meeting with these stakeholders on January 14, 2025, to discuss the prioritization and select sites to be included in the Top 18 project list. See Appendix F - Preliminary Prioritization for the original Top 18 project list.

Landowner outreach was conducted for all privately-owned sites following this meeting. A summary of all phone and email communications conducted with private landowners is provided in Appendix G - Final Ranking.

4.3 Top 18 BMPs

Following landowner outreach and stakeholder feedback, the Top 18 list was updated to reflect the results of the preliminary prioritization, landowner outreach efforts, stakeholder priorities, and any feasibility issues previously unknown to the project team. The finalized Top 18 list is shown below in Table 1. The table includes the project location and proposed practice type.

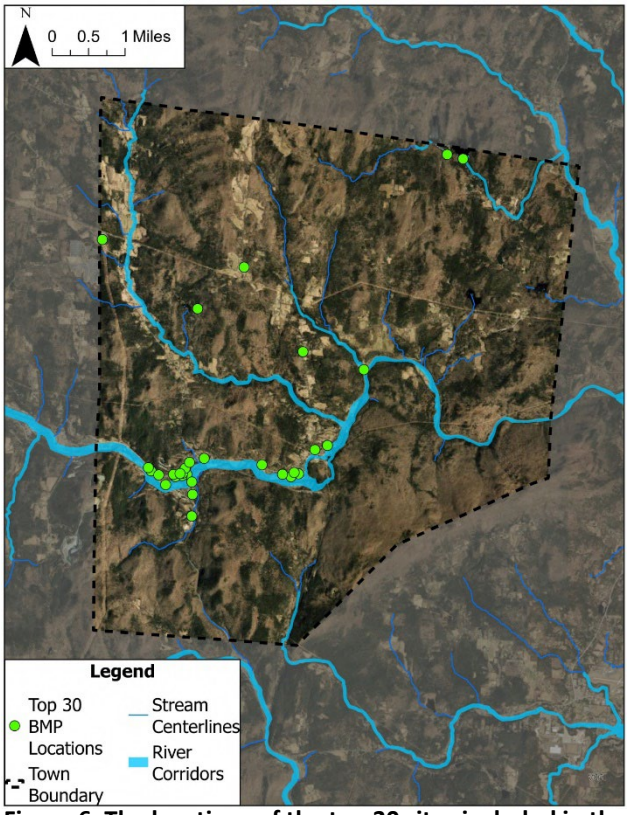

Figure 6. The locations of the top 30 sites included in the preliminary prioritization are shown within the study area.

Table 1. The updated Top 18 projects list.

Project Name	Location	Proposed Practice Type
Power Plant Rd	268–284 Quent Phelan Rd, Ludlow	Perimeter infiltration filter or collect in swales to one basin
Knapp Pond 1 Access Area	1190 Knapp Pond Rd, Cavendish	Parking lot regrading and infiltration basin
Cavendish Elementary School and Fire Station	573 Main St, Proctorsville	Bioretention (infiltrating)
Main St and Castle Hill Dr	110–152 Castle Hill Dr, Proctorsville	Infiltration Basin
Singleton's	356 Main St, Proctorsville	Bioretention (infiltrating with minimal infiltration)
Cavendish Historical Society Museum	1932 Main St, Cavendish	Bioretention (infiltrating with minimal infiltration)
Built Rite	1531 VT-131, Cavendish	Infiltration Basin
Gilcris Enterprises	283 Peaceful Valley Rd, Proctorsville	Detention swale
Park Pl	58 Depot St, Proctorsville	Subsurface chambers

Project Name	Location	Proposed Practice Type
Cavendish Town Garage	157 VT-131, Cavendish	Sediment trap
Mack Molding Co Inc	2044 Main St, Cavendish	Subsurface chambers
Cavendish Transfer Station	354 VT-131, Cavendish	Curtain drain
Main St Stream Stabilization	1643 Main St, Cavendish	Erosion restoration
Center Rd and Hoey Rd	986 Center Rd, Cavendish	Ditch / swale improvements
Knapp Pond 2 Access Area	1426 Knapp Pond Rd, Cavendish	Swales and lot regrading; bioretention / infiltration basin
Depot St and Pratt Hill	198 Depot St, Proctorsville	Road bumpouts; bioretentions (infiltrating)
Cavendish Fire Department	2154 Main St, Cavendish	Subsurface chambers
Heald Rd Farm	2040–2084 Heald Rd, Proctorsville	Swale with check dams

4.4 Modeling and Concept Refinement

EPA Region 1's Stormwater Management Optimization Tool ("Opti-Tool") was utilized to model structural BMPs. Opti-Tool is a spreadsheet-based modeling tool that calculates stormwater treatment practice (STP) storage capacity, STP implementation cost estimates, and pollutant reduction estimates based on existing land use information. Land use data for the Top 18 BMP sites were extracted from the 2016 statewide land-cover dataset provided by the Vermont Center for Geographic Information (VCGI). This data was manually edited for improved accuracy where needed. Further land-use classifications were generated based on the mapped zoning classes for each town (i.e., commercial, medium density residential, agricultural, etc.). Opti-Tool can provide pollutant estimates for four target pollutants: total nitrogen (TN), total phosphorus (TP), total suspended soils (TSS), and zinc (Zn). TN, TP, and TSS values were calculated for this project. Zn is mainly a pollutant of concern in industrial areas, which is not particularly relevant for Cavendish.

This modeling allowed for accurate sizing of the proposed practices as well as an understanding of the water quality and quantity benefits. The modeled volume and pollutant loading reductions are shown in Table 2. Complete modeling results can be found in Appendix G - Final Ranking.

Table 2. Modeling results for the Top 18 projects are shown below.

Project Name	Volume Managed (ac-ft)	Volume Infiltrated (ac-ft)	TN Load (kg)	TN Removal (kg)	TN Removal (%)	TSS Load (kg)	TSS Removal (kg)	TSS Removal (%)	TP Load (kg)	TP Removal (kg)	TP Removal (%)
Power Plant Rd	0.74	0.74	68.88	59.58	86.50	1747.90	1490.96	85.30	7.98	7.03	88.10
Knapp Pond 1 Access Area	0.03	0.03	2.92	2.87	98.30	73.14	71.89	98.30	0.34	0.34	98.60
Cavendish Elementary School and Fire Station	0.12	0.12	9.97	9.51	95.00	259.62	237.95	92.00	1.21	1.12	93.00
Main St and Castle Hill Dr	0.25	0.25	20.47	18.22	89.00	565.57	466.02	82.40	2.59	2.19	84.30
Singleton's	0.10	0.10	9.04	8.21	90.80	226.98	205.42	90.50	1.05	0.94	89.30
Cavendish Historical Society Museum	0.03	0.03	2.56	2.19	85.50	64.07	54.78	85.50	0.29	0.25	85.30
Built Rite	0.12	0.12	10.41	9.58	92.00	260.78	239.66	91.90	1.22	1.10	90.30
Park Pl	0.54	0.54	41.35	38.25	92.50	1333.31	1190.64	89.30	5.90	5.32	90.10
Cavendish Town Garage	0.09	0.09	7.17	6.09	85.00	206.38	152.35	74.00	0.94	0.70	34.00

Project Name	Volume Managed (ac-ft)	Volume Infiltrated (ac-ft)	TN Load (kg)	TN Removal (kg)	TN Removal (%)	TSS Load (kg)	TSS Removal (kg)	TSS Removal (%)	TP Load (kg)	TP Removal (kg)	TP Removal (%)
Gilcris Enterprises	0.19	0.19	18.84	14.64	77.70	499.08	366.33	73.40	2.31	1.67	72.40
Cavendish Transfer Station	0.11	0.11	9.32	8.96	96.00	234.59	224.25	96.00	1.10	1.06	44.00
Main St Stream Stabilization	N/A	N/A	4.54	1.18	26.00	5775.07	1899.67	32.90	1.38	0.45	32.90
Center Rd and Hoey Rd	0.07	minimal infiltration	6.54	5.89	90.10	164.93	148.93	90.30	0.77	0.67	87.10
Knapp Pond 2 Access Area	0.02	0.02	2.07	1.98	95.90	53.49	49.64	92.80	0.25	0.23	90.90
Depot St and Pratt Hill	0.09	0.09	8.35	7.03	84.20	252.29	221.00	87.60	1.11	0.94	84.70
Cavendish Fire Department	0.24	minimal infiltration	19.86	17.65	88.90	612.15	538.08	87.90	2.72	2.30	84.70
Mack Molding Co Inc	0.35	minimal infiltration	30.59	29.15	95.30	788.24	758.28	96.20	3.67	3.37	92.00
Heald Rd Farm	0.07	N/A	5.37	1.32	24.50	0.00	0.00	51.00	0.67	0.42	62.40

4.5 Final Prioritization Methodology

A final prioritization matrix was utilized to quantitatively rank each of the Top 18 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
- Nitrates removed
- TSS removed
- TP removed
- Other project benefits
- Project cost

Criteria used in the final prioritization (with associated scores listed and explained) is included in Appendix G - Final Ranking.

4.5.1 Project Cost Estimation

Project cost, listed as one of the criteria considered, was calculated for the Top 18 sites using Opti-Tool and adjusted for inflation to meet 2025 value.

The costs provide estimates assuming private contractors will be hired to complete construction of the BMPs. Costs could be reduced for publicly-owned sites if the Town were to use their own existing resources.

4.6 Final Prioritization

Each of the factors noted in Appendix G, the top 18 sites were scored and scores were totaled for each of the criteria. Projects were assigned a rank from one to eighteen with those projects receiving the highest scores assigned the highest rank. A summary of the practices with their assigned rank are shown below in Table 3. The location of the Top 18 projects within the Town are shown in Figure 7.

As future funding becomes available for project implementation, this prioritization matrix can be utilized in selecting additional projects for implementation. Also included in Appendix G - Final Ranking is the final prioritization table, an overview map of the Top 18 ranked sites, and one-page summary sheets.

Table 3. The Top 18 projects are shown in prioritized order.

Project Name	Proposed BMP Practice Type	Total Score	BMP Rank
Power Plant Rd	Perimeter infiltration filter or collect in swales to one basin	49	1
Knapp Pond 1 Access Area	Parking lot regrading and infiltration basin	42	2
Cavendish Elementary School and Fire Station	Bioretention (infiltrating)	39	3
Main St and Castle Hill Dr	Infiltration Basin	37	4
Singleton's	Bioretention (infiltrating with minimal infiltration)	36	5
Cavendish Historical Society Museum	Bioretention (infiltrating with minimal infiltration)	35	6
Built Rite	Infiltration Basin	34	7
Park Pl	Subsurface chambers	32	8
Cavendish Town Garage	Sediment trap	29	9
Gilcris Enterprises	Detention swale	28	10
Cavendish Transfer Station	Curtain drain	26	11
Main St Stream Stabilization	Erosion restoration	26	12
Center Rd and Hoey Rd	Ditch / swale improvements	25	13
Knapp Pond 2 Access Area	Swales and lot regrading; bioretention / infiltration basin	24	14
Depot St and Pratt Hill	Road bumpouts; bioretentions (infiltrating)	23	15
Cavendish Fire Department	Subsurface chambers	22	16
Mack Molding Co Inc	Subsurface chambers	22	17
Heald Rd Farm	Swale with check dams	20	18

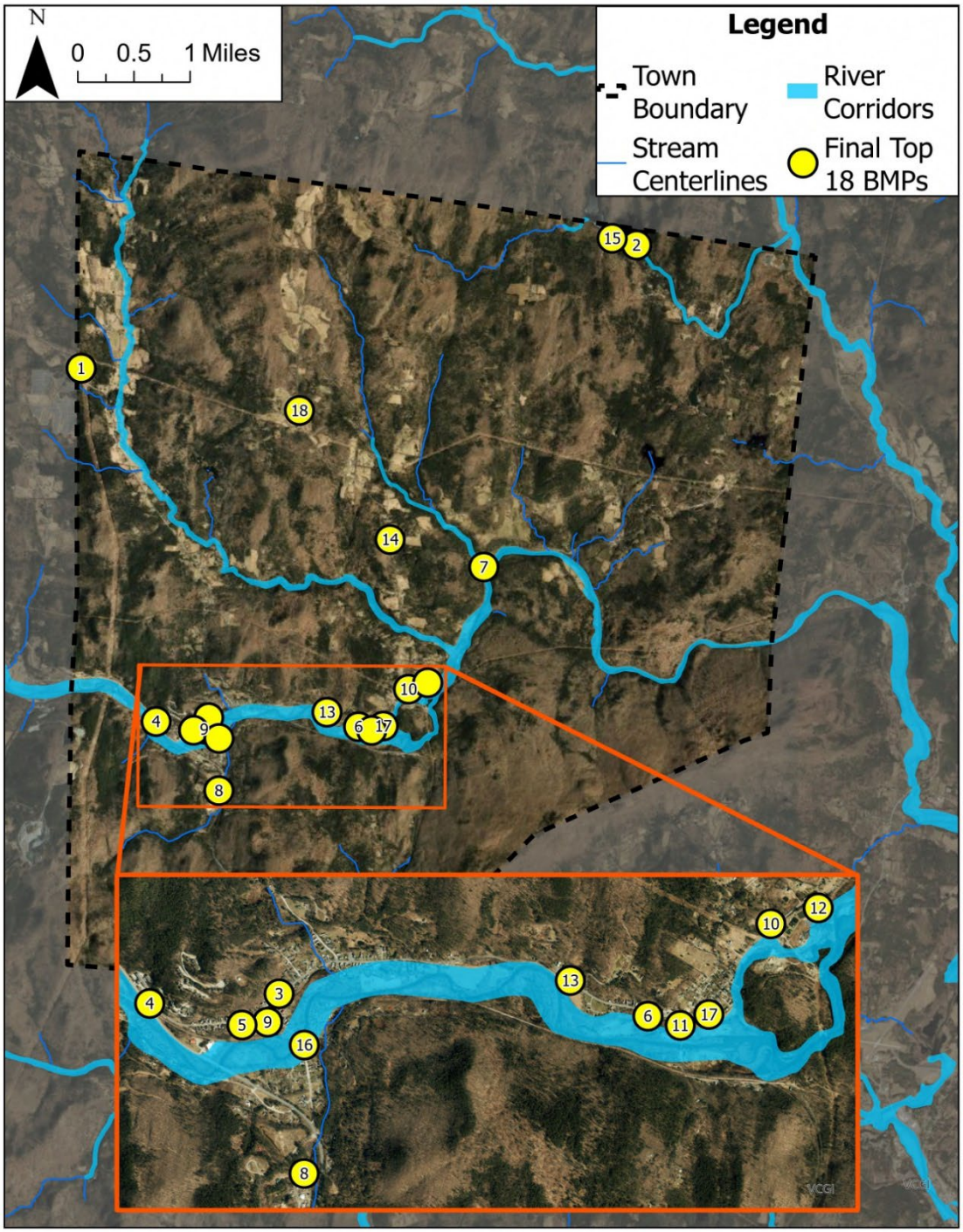

Figure 7. The location of the Top 18 projects in final ranked order are shown within the Town.

Top 18 Priority BMPs

The selected Top 18 BMP sites are briefly described below. An overview map, one-page summary sheets, and a summary of landowner outreach investigations are included in Appendix G - Final Ranking.

Site: 1

Project Name: Power Plant Rd

Description: This project involves the impervious area located on Power Plant Road off Quent Phelan Rd on the West side of Cavendish. The drainage area includes unmanaged stormwater runoff from these impervious surfaces as surrounding pervious areas including a forested hill to the Northwest. Currently, there is no mapped stormwater infrastructure at this site. Stormwater travels via overland flow downhill to the Southeast, collecting sediment and pollutants as it travels across impervious surfaces. A perimeter infiltration filter is proposed to manage the drainage from this impervious area. The yellow star in Figure 8 indicates where the BMP would be in relation to the impervious area, though this filter would extend along the perimeter of the pavement. The drainage area is 20.2 acres, 8.7 acres (43%), of which is classified as impervious.

Outreach: Watershed Consulting decided not to pursue this project further as part of this SWMP because this site is restricted due to being an energy installation.

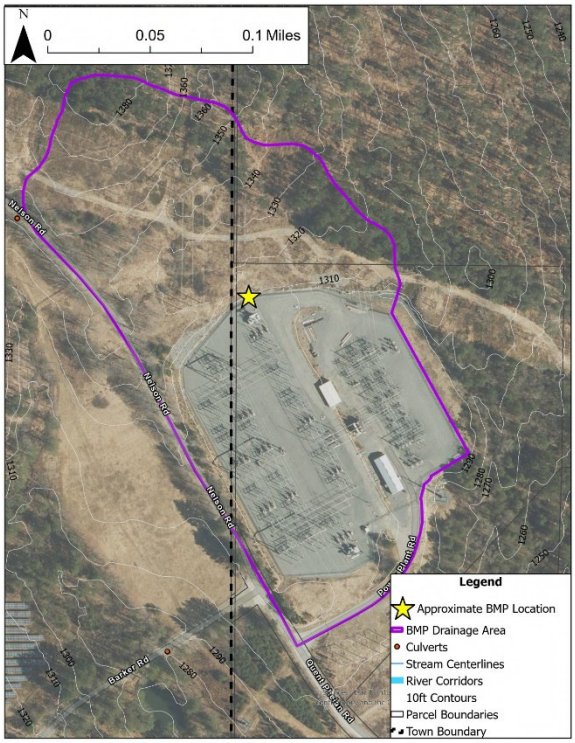

Figure 8. The drainage area for the Power Plant Rd is shown outlined in purple. The location for the proposed infiltration basin is depicted with a yellow star.

Site: 2

Project Name: Knapp Pond 1 Access Area

Description: This project involves the parking lot at the Eastern of 2 Knapp Pond Access Areas on Knapp Pond Road in Cavendish. Currently, unmanaged stormwater runoff from this parking lot flows directly into Knapp Pond. An infiltration Basin in the green space to the South of this parking lot is proposed to manage this runoff, combined with the regrading of this parking lot so that stormwater flows away from the Pond to the South where it can be treated in this basin. The infiltration basin is proposed in the approximate location of the yellow star in Figure 9 and the area that will drain to this basin is showed outlined in purple. The drainage area is 0.5 acres, 0.4 acres (81%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

Figure 9. The drainage area for The Knapp Pond 1 Access Area site is shown outlined in purple. The location for the proposed infiltration basin is depicted with a yellow star.

Site: 3

Project Name: Cavendish Elementary School and Fire Station

Description: This project involves the stormlines draining the Cavendish Town Elementary School site located on Main St. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the school. Currently, a series of catch basins feed runoff into a stormline that transports the water down Depot St. before discharging into the Black River without treatment. Two infiltrating bioretention systems are proposed to manage the drainage from this area. The concept includes redirecting existing stormlines to this system. These bioretention areas are proposed in the approximate location of the yellow stars in Figure 10 and the areas that will drain to these bioretention areas are shown outlined in purple. The total drainage area for both bioretention areas is 3.5 acres, 1.0 acres (30%) of which is classified as impervious.

Outreach: The elementary school was contacted by mail on 4/21/25. On 7/24/25, Watershed Consulting held a meeting with the elementary school principal, Emma Vastola, and the Green Mountain Unified School District facilities manager, Todd Parah. During this meeting, project details, advantages, and concerns were discussed. After this meeting, it was decided that this project would not move forward.

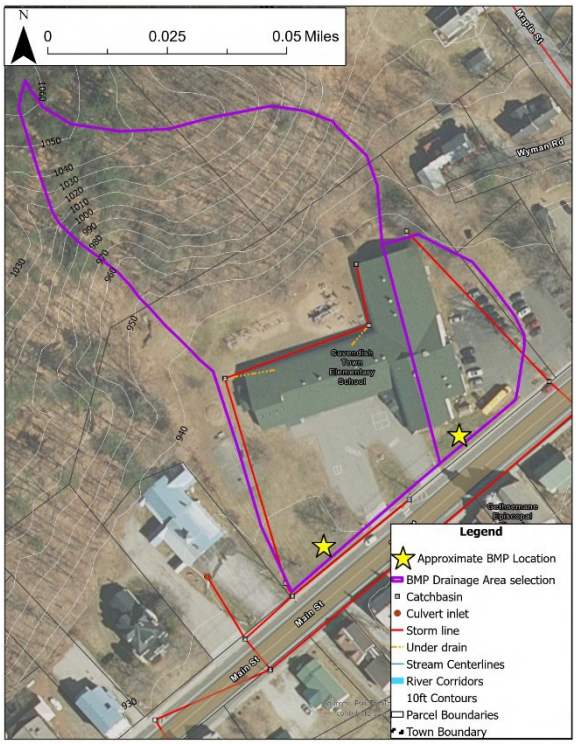

Figure 10. The drainage areas for the Elementary School and Fire Station site are shown outlined in purple. The locations for the proposed biofiltration features are depicted with yellow stars.

Site: 4

Project Name: Main St and Castle Hill Dr

Description: This project involves the intersection where Main St and Castle Hill Dr both intersect Route 103. The drainage area includes stormwater runoff from the hillside that drains to this point, including a few buildings, roads, and parking areas, as well as grassy and forested pervious areas. Currently, stormwater travels via overland flow, swales, and stormlines down the hill where a collection of three outfalls reach one culvert that crosses Route 103 and discharges into the Black River. It is proposed to retrofit the existing collection area of outfalls into a bioretention basin to treat this stormwater before it enters the culvert. The bioretention is proposed in the approximate location of the yellow star in Figure 11 and the area that will drain to this bioretention is shown outlined in purple. The drainage area is 12.43 acres, 2.69 acres (21.64%) of which is classified as impervious.

Outreach: This project involves VTRANS right of way as well as some private lands. Because of the complexity of working in the VTRANS right of way, this project was deemed lower priority, and no outreach was carried out.

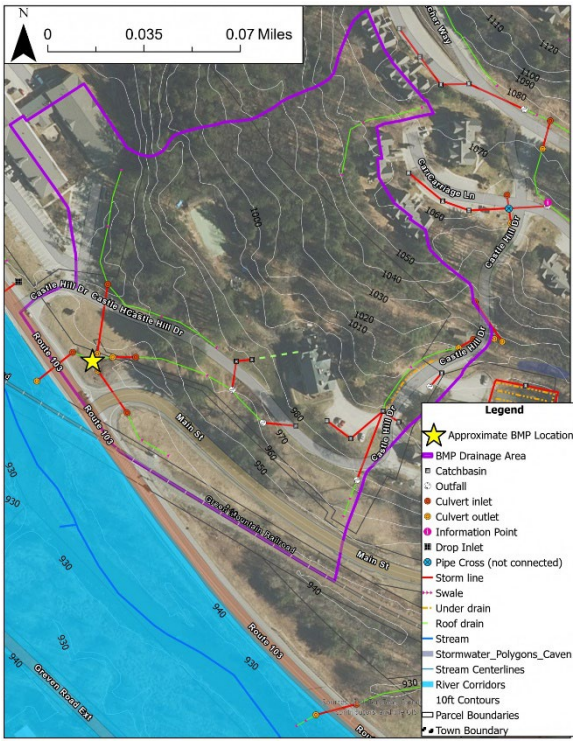

Figure 11. The drainage area for the Main St and Castle Hill Dr site is shown outlined in purple. The location for the proposed infiltration basin is depicted with a yellow star.

Site: 5

Project Name: Singleton's

Description: This project involves Singleton's General Store and the surrounding area. The drainage area includes unmanaged stormwater runoff from pervious and impervious surfaces at the site. Currently, stormwater is collected and conveyed via catchbasins and storm lines to a swale located south of Singleton's (Figure 12). Untreated drainage from this area is transported under the Green Mountain Railroad tracks in a culvert and the discharges into the Black River. A minimally infiltrating bioretention area is proposed to manage the drainage from this site. The concept includes redirecting existing stormlines to this system. The bioretention area is proposed in the approximate location of the yellow star in Figure 12 and the area that will drain to this gravel wetland is shown outlined in purple. The drainage area is 1.9 acres, 1.2 acres (63%) of which is classified as impervious.

Outreach: The Singleton's store email was contacted on 4/17/25, and the store phone called. There was no response.

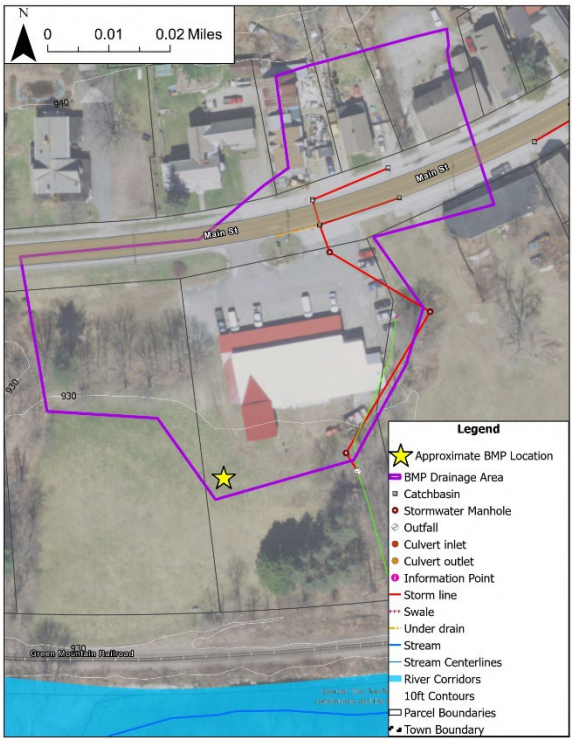

Figure 12. The drainage area for the Singleton's site is shown outlined in purple. The location for the proposed biofiltration practice is depicted with a yellow star.

Site: 6

Project Name: Cavendish Historical Society Museum

Description: This project involves the northern half of the Cavendish Historical Society Museum located on Main St. The drainage area includes unmanaged stormwater runoff from pervious and impervious surfaces at the Museum. Currently, stormwater is collected and conveyed via catchbasins and storm lines and then drains untreated into the stream West of the site. A minimally infiltrating bioretention area located in the greenspace West of the museum is proposed to manage the drainage from this area. The concept includes redirecting drainage so that it flows into this system rather than the existing catchbasins. The bioretention area is proposed in the approximate location of the yellow star in Figure 13 and the area that will drain to this gravel wetland is shown outlined in purple. The drainage area is 0.6 acres, 0.3 acres (54%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

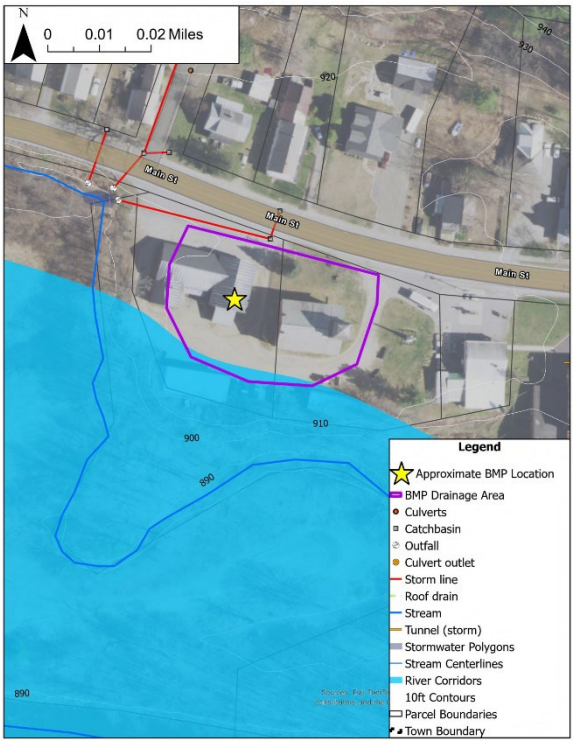

Figure 13. The drainage area for the Cavendish Historical Society Museum site is shown outlined in purple. The location for the proposed bioretention practice is depicted with a yellow star.

Site: 7

Project Name: Built Rite

Description: This project involves the Built Rite site located at the intersection of VT Route 131 and Brook Rd. The drainage area includes unmanaged stormwater runoff from impervious surfaces at Built Rite. Currently, stormwater sheet flows into Elm Brook, and the majority of the site is in the stream corridor. An infiltration basin is proposed to manage the drainage from this area. The basin is proposed in the approximate location of the yellow star in Figure 14 and the area that will drain to this filter is shown outlined in purple. The drainage area is 2.8 acres, 1.4 acres (50%) of which is classified as impervious.

Outreach: The Built Rite company email was contacted on 4/17/25, and their phone number called, but there was no response.

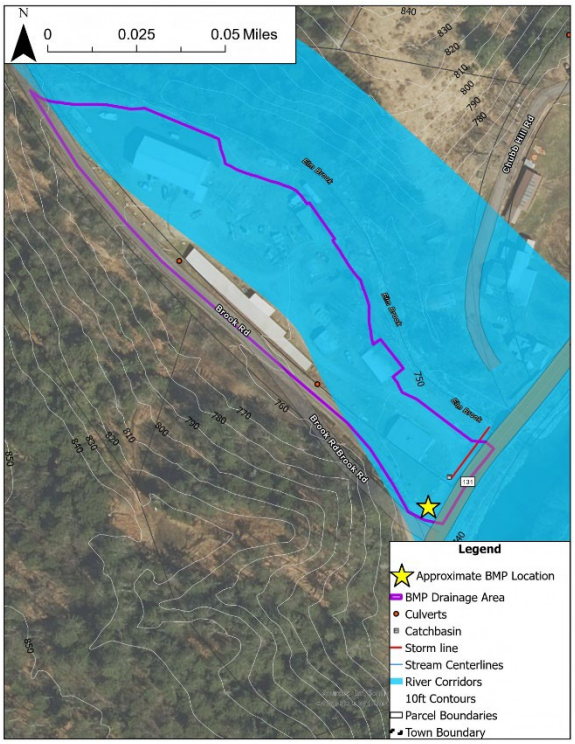

Figure 14. The drainage area for the Built Rite site is shown outlined in purple. The location for the proposed infiltration basin is depicted with a yellow star.

Site: 8

Project Name: Gilcris Enterprises

Description: This project involves the Gilcris Enterprises site on Peaceful Valley Rd in Cavendish. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the site. Currently, travels via a series of swales and culverts and drains unmanaged into the stream to the East of the site that runs parallel to Route 103. A detention swale is proposed to allow some of the runoff from this area to infiltrate rather than draining into the stream. The detention swale is proposed in the approximate location of the yellow star in Figure 15 and could be retrofitted from the existing swale. The area that will drain to this bioretention is shown outlined in purple. The drainage area is 7.0 acres, 2.1 acres (30%) of which is classified as impervious.

Outreach: Gilcris Enterprises is owned by Wayne Gilcris, who was initially contacted by email on 4/17/25. Gilcris has since been contacted numerous times via email and phone, by Watershed Consulting and has not responded. He was also contacted by Rick Chambers, Cavendish Town Manager.

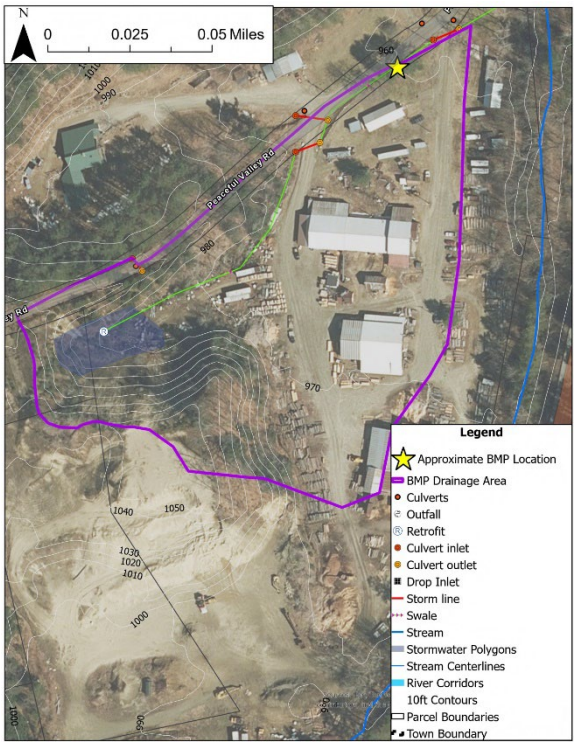

Figure 15. The drainage area for the Gilcris Enterprises site is shown outlined in purple. The location for the proposed detention swale is depicted with a yellow star.

Site: 9

Project Name: Park Pl

Description: This project involves a large area that flows drains into the stormline that discharges into the Black River near the intersection of Park Pl and Depot St. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the facility. Currently, stormwater is captured in catchbasins and travels via stormline towards the Black River where it ultimately discharges unmanaged. Infiltrating subsurface chambers are proposed to manage the drainage from this area. The concept includes redirecting drainage to the system from the majority of this stormline. The chambers are proposed at the approximate location of the yellow star in Figure 16 and the area that will drain to this bioretention is shown outlined in purple. The drainage area is 22.9 acres, 6 acres (26%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

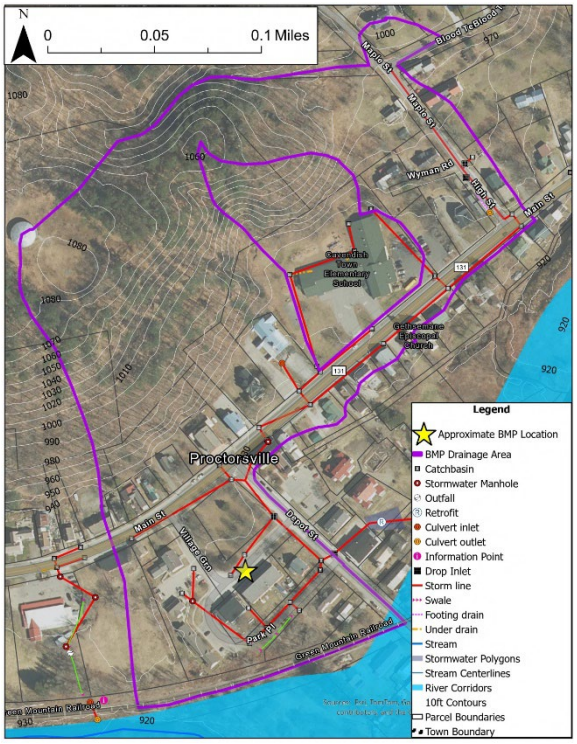

Figure 16. The drainage area for the Park Pl site is shown outlined in purple. The location for the proposed subsurface chambers is depicted with a yellow star.

Site: 10

Project Name: Cavendish Town Garage

Description: This project involves the Cavendish Town Garage in addition to the forested hillside draining down to it. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the Garage. Currently, stormwater travels via overland flow to culverts under the road and ultimately drains unmanaged into the Black River, carrying sediment from the Garage with it. Two sediment traps are proposed to manage the drainage from this area. These traps are proposed in the approximate locations of the yellow stars in Figure 17 and the areas that will drain to this bioretention are shown outlined in purple. The drainage area is 6 acres, 0.9 acres (15%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

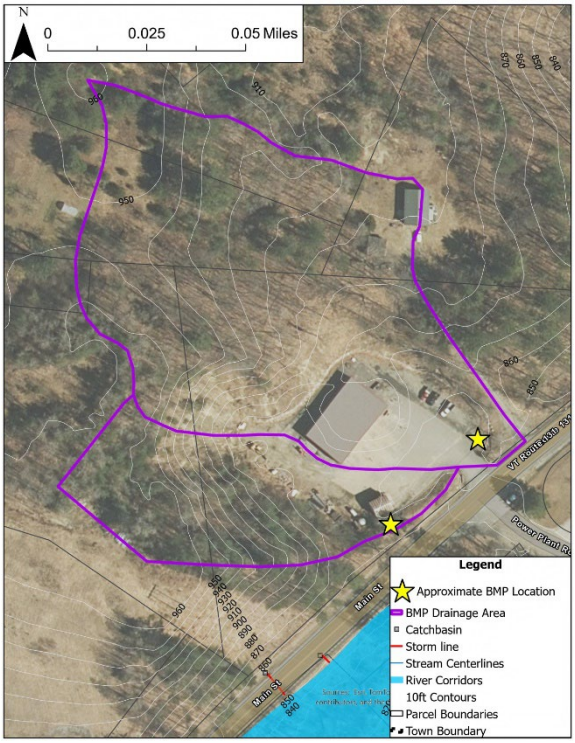

Figure 17. The drainage areas for the Town Garage site are shown outlined in purple. The location for the proposed sediment trap is depicted with a yellow star.

Site: 11

Project Name: Mack Molding Co Inc

Description: This project involves the Mack Molding site at the intersection of Main St and Mill St. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the site. Currently, stormwater is unmanaged and travels via overland flow and stormlines to discharge into the Black River. Minimally infiltrating subsurface chambers under the parking lot are proposed to manage the drainage from this area. The concept includes redirecting stormline drainage to the system. The chambers are proposed at the approximate location of the yellow star in Figure 18 and the area that will drain to this bioretention is shown outlined in purple. The drainage area is 6.5 acres, 4.3 acres (67%) of which is classified as impervious.

Outreach: The northern sales division of Mack Molding was contacted via email on 4/17/25.

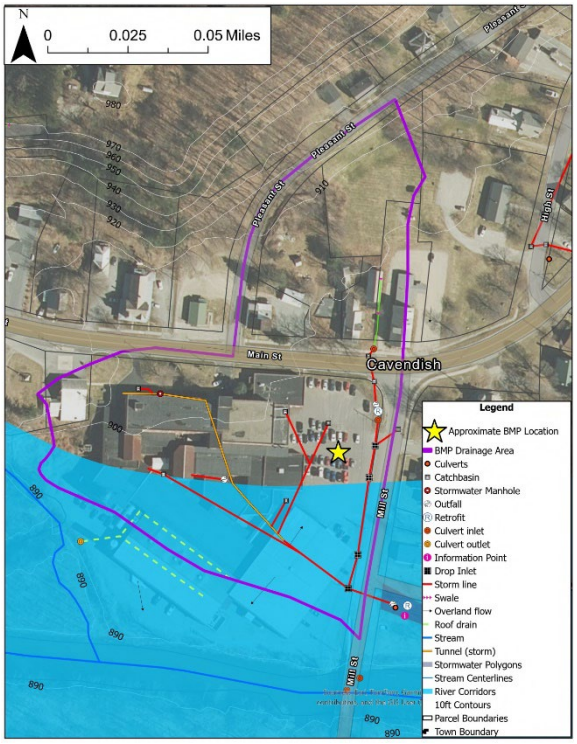

Figure 18. The drainage area for the Mack Molding Co site is shown outlined in purple. The location for the proposed subsurface chambers is depicted with a yellow star.

Site: 12

Project Name: Cavendish Transfer Station

Description: This project involves the Cavendish Transfer Station site located at the intersection of VT Routh 131 and Power Plant Rd (this is not the same Power Plant Rd as site #1). The drainage area includes unmanaged stormwater runoff from impervious surfaces at the facility. Currently, stormwater is unmanaged and travels via overland flow directly into the Black River. Three curtain drains located around the main impervious areas are proposed to manage the drainage from this area. The proposed areas for these curtain drains are outlined in purple. Combined, these drainage areas are 3.1 acres, 1.3 acres (42%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

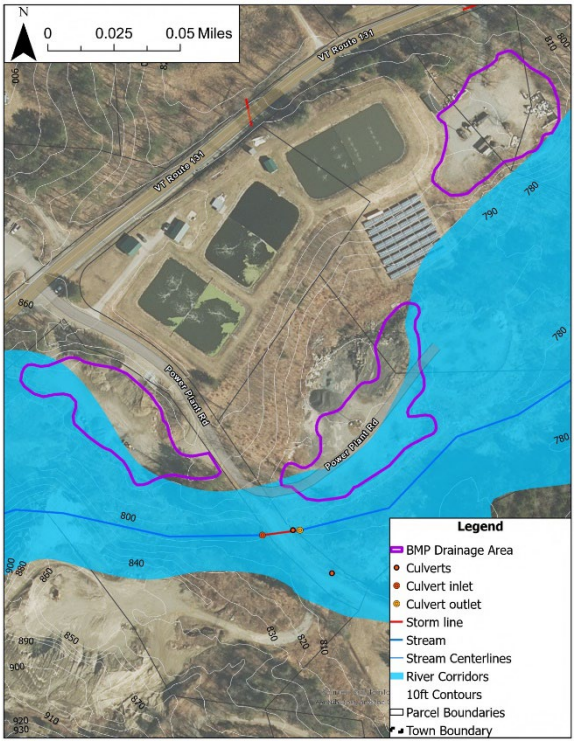

Figure 19. The drainage areas for the Cavendish Transfer Station site are shown outlined in purple. The three proposed curtain drains would run along these boundaries.

Site: 13

Project Name: Main St Stream Stabilization

Description: This project involves erosion restoration of the stream that crosses Main St via culvert just West of the intersection of Main St and Stone Way. The drainage area includes a portion of the stream near the culvert that crosses Main St. Currently, there is erosion observed before and after this culvert. Stepped pools, gabions, and other bioengineering is proposed to stabilize banks and slow flow in this area. The drainage area, shown outlined in purple in Figure 20, is 0.33 acres, 0.003 acres (1%) of which is classified as impervious.

Outreach: Watershed Consulting decided not to move forward with this project at this time as part of the SWMP because it is a streams project that could potentially be covered with other funding.

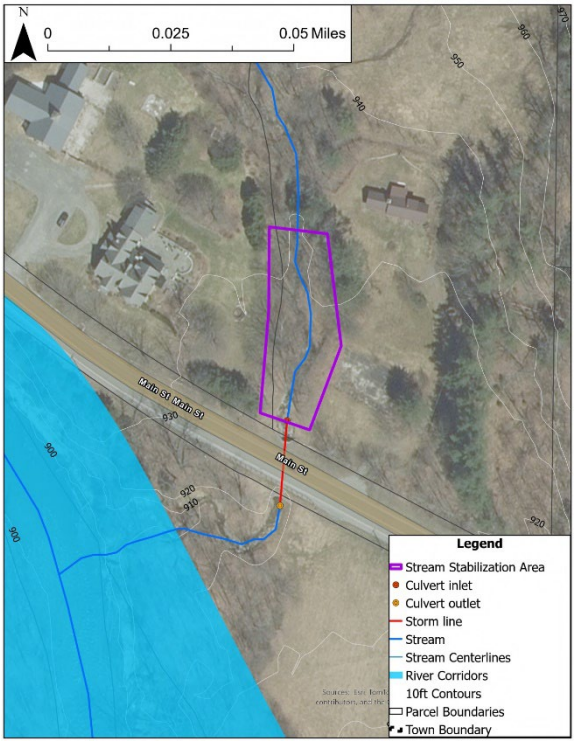

Figure 20. The approximate area for the Main Street Stabilization site is shown outlined in purple.

Site: 14

Project Name: Center Rd and Hoey Rd

Description: This project involves the intersection of Center Rd and Hoey Rd in Cavendish. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the site. Currently, stormwater is unmanaged and travels via overland flow to drain into an unmapped small stream just East of the site, releasing sediments and pollutants into the waterway. A minimally infiltrating ditch or swale located in the right of way at the intersection is proposed to manage the drainage from this area. This infiltration feature is proposed in the approximate location of the yellow star in Figure 21 and the area that will drain to this bioretention is shown outlined in purple. The drainage area is 1.9 acres, 0.9 acres (45%) of which is classified as impervious.

Outreach: Cavendish Town Manager Rick Chambers spoke to Nelson Rickert, the property owner, who said that he may be interested in the project. Chambers did not have any contact info for Rickert that he could share. Watershed Consulting sent a letter to Rickert in the mail but did not receive a response.

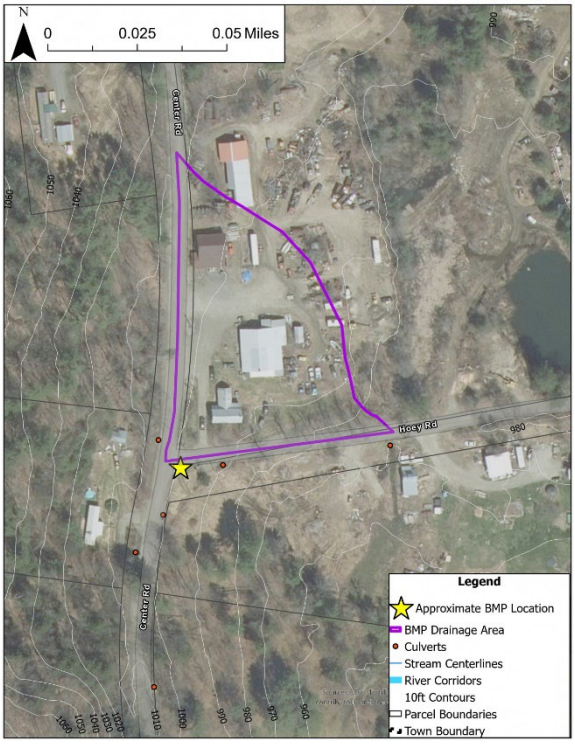

Figure 21. The drainage area for the Center Rd and Hoey Rd site is shown outlined in purple. The location for the proposed swale is depicted with a yellow star.

Site: 15

Project Name: Knapp Pond 2 Access Area

Description: This project involves the parking lot at the Western of 2 Knapp Pond Access Areas on Knapp Pond Road in Cavendish. Currently, unmanaged stormwater runoff from this parking lot flows directly into Knapp Pond. An infiltration Basin in the green space to the South of this parking lot is proposed to manage this runoff, combined with the regrading of this parking lot so that stormwater flows away from the Pond to the South where it can be treated in this basin. The infiltration basin is proposed in the approximate location of the yellow star in Figure 22 and the area that will drain to this basin is shown outlined in purple. The drainage area is 0.6 acres, 0.3 acres (49%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

Figure 22. The drainage area for Knapp Pond 2 Access Area site is shown outlined in purple. The location for the proposed detention swale is depicted with a yellow star.

Site: 16

Project Name: Depot St and Pratt Hill

Description: This project involves the section of Depot St between Pratt Hill and Greven Rd. The drainage area includes unmanaged stormwater runoff from impervious surfaces at the facility. Currently, stormwater is collected in catchbasins and travels via stormlines before draining unmanaged into the Black River. A series of road bumpouts containing infiltrating bioretention areas is proposed along this section of Depot St to manage the drainage. Road bumpouts have the added benefit of controlling traffic. The area that will drain to this bioretention is shown outlined in purple in Figure 23. The drainage area is 2.0 acres, 1.1 acres (55%) of which is classified as impervious.

Outreach: This site is owned by the Town of Cavendish, and as such, no additional outreach was carried out.

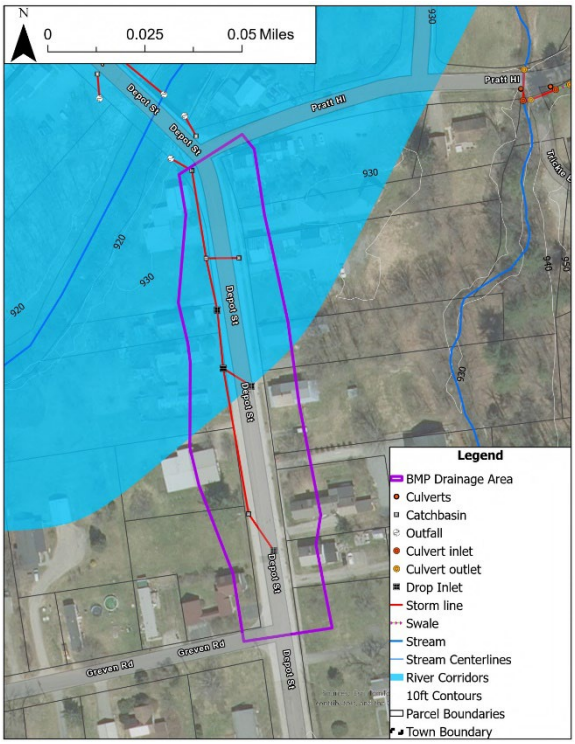

Figure 23. The drainage area for the Depot St and Pratt Hill site is shown outlined in purple. Bioretention road bumpouts would be dispersed throughout this area.

Site: 17

Project Name: Cavendish Fire Department

Description: This project involves the Cavendish Fire Department located at the intersection of Main St and High St in Cavendish. The drainage area includes unmanaged stormwater runoff from impervious surfaces at and uphill of the site. Currently, stormwater is captured in catch basins and travels via stormline before eventually draining untreated into the Black River, south of the Fire Department. Minimally infiltrating subsurface stormwater chambers are proposed under the Fire Department parking lot. This project includes redirecting drainage in the stormline to this system. The chambers are proposed in the approximate location of the yellow star in Figure 24 and the area that will drain to this system is shown outlined in purple. The drainage area is 8.2 acres, 2.8 acres (34%) of which is classified as impervious.

Outreach: Fire Warden Chris Marks was contacted by mail on 4/21/25.

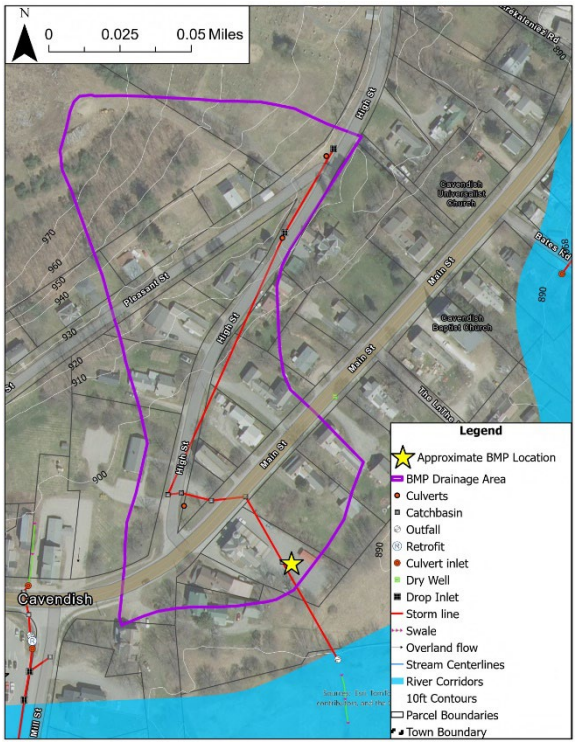

Figure 24. The drainage area for the Fire Department site is shown outlined in purple. The location for the subsurface chambers is depicted with a yellow star.

Site: 18

Project Name: Heald Rd Farm

Description: This project involves Heald Rd Farm at the intersection of Heald Rd and Town Farm Rd. The drainage area includes unmanaged stormwater runoff that travels via overland flow towards the road where it crosses underneath in a culvert. A swale with check dams is proposed to manage the drainage from this area. The swale is proposed in the approximate location of the yellow star in Figure 25 and the area that will drain to this bioretention is shown outlined in purple. The drainage area is 1.7 acres, 0.8 acres (47%) of which is classified as impervious.

Outreach: The owner of Heald Rd Farm, Jeff Stearns, was contacted by mail on 4/21/25 by Watershed Consulting, and was also contacted by phone by Rick Chambers, Cavendish Town Manager.

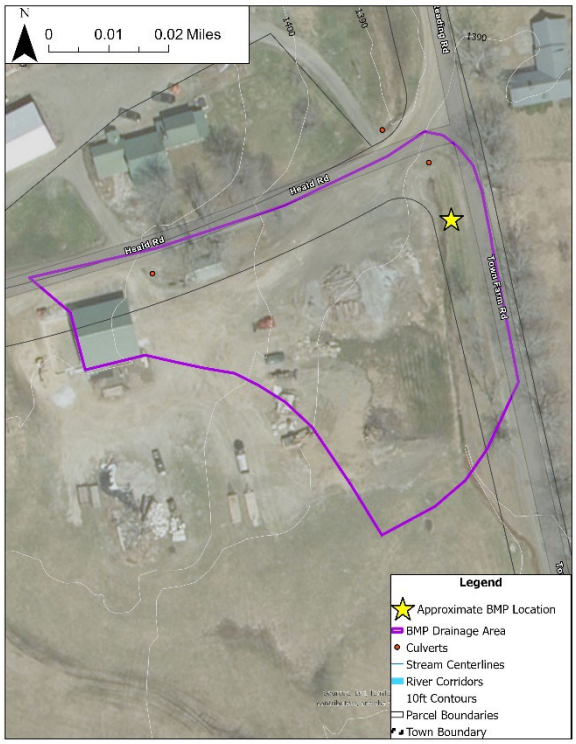

Figure 24. The drainage area for the Heald Rd Farm site is shown outlined in purple. The location for the swale with check dams is depicted with a yellow star.

5 30% Designs

The top three sites were chosen for the development of 30% design plans. The sites chosen for the Cavendish SWMP are Cavendish Town Office, Cavendish Fire Department, and Mack Molding. Three plan sheets were developed depicting proposed stormwater improvements at these locations. See Appendix H - 30% Plans for these plans. This information was used as the basis for the 30% proposed condition plans that were created for these sites. Site-specific concepts are discussed in the following sections.

When implemented, these three BMPs would treat drainage from approximately 16.34 acres, 7.02 acres (43%) of which is impervious. Modeled pollutant reductions for these projects, shown in Table 4, indicate that these BMPs will prevent 14.17 kg of TN, 527.03 kg of TSS, and 4.05 kg of TP from reaching receiving waters annually. They will also manage a total of 16,378 cubic feet of runoff. See Appendix I – HydroCAD Models for complete modeling reports. The 30% designs can be found in Appendix H - 30% Plans.

5.1 Cavendish Town Office

5.1.1 30% Concept Design Description

A bioretention feature is proposed south of the parking lot for the Town Office. This feature will treat runoff from a portion of the Town Office building as well as the parking area before it enters the storm system, reducing nutrient and sediment pollution.

The soils at this site are unmapped, but it is adjacent to mapped A soils, specifically Colton gravelly sandy loam, 15 to 25 percent slopes.

5.1.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 0.34 kg of total nitrogen (TN), 32.74 kg of total suspended solids (TSS), and 0.08 kg of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was infiltration of the Water Quality volume (WQv, 1 inch of rain in a 24-hour period), equal to approximately 653 ft^3 of runoff. See Table 5 for the benefit summary table.

Table 4. Town Office benefit summary table.

TN Removed	0.34 kg	29.6%
TSS Removed	32.74 kg	89.3%
TP Removed	0.08 kg	48.2%
Impervious Treated	0.16 acres	
Total Drainage Area	0.69 acres	

5.1.3 Cost Estimates

The total estimated cost for this project is $82,000. The estimated construction cost is $38,969 with the additional $43,031 related to mobilization/demobilization, final design construction engineering, contingency, and rounding to the next highest $1,000. Note that these costs are preliminary. Cost projections can be found in Table 5.

- The cost per kg of TN treated is $241,176.
- The cost per kg of TP treated is $2,505.
- The cost per impervious acre treated is $1,025,000.
- The cost per cubic foot of runoff treated is $126.

Table 5. The initial construction cost projection for the Town Office site is included below.

Cavendish Town Office
Bioretention Basin
3/6/2026
Opinion of Probable Costs - 30% Concept (Preliminary)

Vtrans Code	*Item*	*Description*	*Amount*	*Unit*	*Amount*	*Unit*	*Total*
General Construction							
653.20	Erosion Blanket	Blanket for slopes & channels	78	SY	$ 5.60	$/SY	$ 436
653.475	Silt Fence	Silt fence	40	LF	$ 3.96	$/LF	$ 158
605.2	6" Underdrain	Underdrain and discharge pipes	12	LF	$ 102.66	$/LF	$ 1,232
604.1	Concrete Catchbasin with cast iron grate	Outlet strucutre	1	LS	$ 6,600.00	LS	$ 6,600
203.15	Common Excavation	Excavation of basin	40	CY	$ 21.71	$/CY	$ 860
NA	Bioretention Soil	Bioretention Soil Mix	7	CY	$ 80.00	$/CY	$ 533
301.15	Gravel Subbase	Washed stone	3	CY	$ 88.08	$/CY	$ 294
203.28	Excavation of surfaces and pavements	Trench for inflow/outflow pipe	90	CY	$ 61.34	$/CY	$ 5,498
610.09	18 Inch CPEP	Inflow/outflow pipe plus riser	160	LF	$ 104.74	$/LF	$ 16,758
NA	Landscaping	Seed, plugs, shrubs	1	LS	$ 5,000.00	LS	$ 5,000
NA	Paving	Paving trench for inflow/outflow pipe	4	TON	$ 400.00	$/TON	$ 1,600
Subtotal Construction Cost:							**$ 38,969**
Mobilization/Demobilization							**$ 5,000**
Final Design							**$ 18,000**
Construction Engineering							**$ 12,000**
Contingency (20%)							**$ 7,794**
Total (rounded to the next highest $1,000) =							**$ 81,763**

5.1.4 Next Steps

It is recommended that the Town proceed with final design and implementation of this project. 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 treated by this practice.

5.1.5 Permit Needs

Clean Water Initiative Program (CWIP) forms were completed for these projects as a permit screening review form and are included in Appendix J - Project Review Forms. In summary:

Stormwater Permit

No stormwater permit is anticipated.

Other Permits

Approval is needed from VT Fish and Wildlife due to the presence of rare, threatened, or endangered species within one mile of the project location.

5.2 Cavendish Fire Department

5.2.1 30% Concept Design Description

Construction of subsurface sand filter chambers beneath the fire department parking lot is recommended. This feature will treat runoff from the fire department as well as areas of Pleasant Street, High Street, and Main Street that feed into the same stormline, reducing nutrient and sediment discharge into the Black River.

The soils at this site are partially unmapped, but adjacent to mapped B/D soils, specifically Podunk fine sandy loam, 0 to 3 percent slopes, occasionally flooded.

5.2.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 5.01 kg of total nitrogen, 468.71 kg of total suspended solids (TSS), and 1.60 kg of total phosphorus (TP) from entering receiving waters annually. The design standard

used for this retrofit was infiltration of the ¾ Water Quality volume (0.75 inch of rain in a 24-hour period), equal to approximately 4,966 ft^3 of runoff. See Table 4 for the benefit summary table.

Table 6. Cavendish Fire Department benefit summary table.

TN Removed	5.01 kg	28.40%
TSS Removed	468.71 kg	38.25%
TP Removed	1.60 kg	64.60%
Impervious Treated	2.59 acres	
Total Drainage Area	9.40 acres	

5.2.3 Cost Estimates

The total estimated cost for this project is $175,000. The estimated construction cost is $92,664 with the additional $82,336 related to mobilization/demobilization, final design construction engineering, contingency, and rounding to the next highest $1,000. Note that these costs are preliminary. Cost projections can be found in Table 5.

- The cost per kg of TN treated is $34,930.
- The cost per kg of TP treated is $373.
- The cost per impervious acre treated is $109,375.
- The cost per cubic foot of runoff treated is $35.

Table 7. The initial construction cost projection for the Cavendish Fire Department site is included below.

Cavendish Fire Department
Subsurface Chamber System
3/6/2026
Opinion of Probable Costs - 30% Concept (Preliminary)

Vtrans Code	*Item*	*Description*	*Amount*	*Unit*	*Amount*	*Unit*	*Total*
General Construction							
604.11	Concrete manhole with cast iron cover	Drainage control structures	2	EA	$ 6,600.00	EA	$ 13,200
605.2	6" Underdrain	Underdrain and discharge pipes	140	LF	$ 102.66	$/LF	$ 14,372
203.31	Sand Borrow	Sand filter	46	CY	$ 32.92	$/CY	$ 1,517
301.15	Gravel Subbase	Washed stone for stormtech	117	CY	$ 88.08	$/CY	$ 10,305
203.28	Excavation of surfaces and pavements	Chamber, new strucutre	343	CY	$ 61.34	$/CY	$ 21,010
NA	Stomtech Chambers	ADS cost	1	LS	$ 20,658.95	LS	$ 20,659
NA	Paving	Paving work area	29	TON	$ 400.00	$/TON	$ 11,600
Subtotal Construction Cost:							**$ 92,664**
Mobilization/Demobilization							**$ 10,000**
Final Design							**$ 35,000**
Construction Engineering							**$ 18,000**
Contingency (20%)							**$ 18,533**
Total (rounded to the next highest $1,000) =							**$ 175,000**

5.2.4 Next Steps

It is recommended that the Cavendish Fire Department proceeds with final design and implementation 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 treated by the practice.

5.2.5 Permit Needs

Clean Water Initiative Program (CWIP) forms were completed for these projects as a permit screening review form and are included in Appendix J - Project Review Forms. In summary:

Stormwater Permit

No stormwater permit is anticipated.

Other Permits

As there is no existing Act 250 permit for this area, this site does not require submission for Act 250 review. This project should be reviewed by a river scientist prior to final design due to its proximity to the river corridor. The project should also be reviewed by a wetland ecologist due to the likelihood of wetlands in the area, according to the Vermont Wetland Screening Tool. Approval is needed from VT Fish and Wildlife due to the presence of rare, threatened, or endangered species within one mile of the project location.

5.3 Mack Molding

5.3.1 30% Concept Design Description

Subsurface chambers are proposed under the Mack Molding parking lot, as well as a buffer along the side of the parking lot adjacent to the stream. This feature will treat runoff from the Mack molding site and Main Street, reducing discharge of nutrients and sediment into the stream.

The soils at this site are mostly unmapped, but are adjacent to A and B/D soils, specifically:

A: Colton gravelly sandy loam, 15 to 25 percent slopes

B/D: Rumney fine sandy loam, 0 to 3 percent slopes, frequently flooded

5.3.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 8.82 kg of total nitrogen, 281.72 kg of total suspended solids (TSS), and 2.38 kg of total phosphorus (TP) from entering receiving waters annually. The design standard used for this retrofit was infiltration of the ¾ Water Quality volume (0.75 inch of rain in a 24-hour period), equal to approximately 10,759 ft^3 of runoff. See Table 4 for the benefit summary table.

Table 8. Mack Molding benefit summary table.

TN Removed	8.82 kg	30.00%
TSS Removed	281.72 kg	38.25%
TP Removed	2.38 kg	68.70%
Impervious Treated	4.29 acres	
Total Drainage Area	6.25 acres	

5.3.3 Cost Estimates

The total estimated cost for this project is $322,000. The estimated construction cost is $215,816 with the additional $106,184 related to mobilization/demobilization, final design construction engineering, contingency, and rounding to the next highest $1,000. Note that these costs are preliminary. Cost projections can be found in Table 5.

- The cost per kg of TN treated is $36,508.
- The cost per kg of TP treated is $1,143.
- The cost per impervious acre treated is $135,294.

The cost per cubic foot of runoff treated is $30.

Table 9. The initial construction cost projection for the Mack Molding site is included below.

Mack Molding
Subsurface Chamber System
3/6/2026
Opinion of Probable Costs - 30% Concept (Preliminary)

Vtrans Code	*Item*	*Description*	*Amount*	*Unit*	*Amount*	*Unit*	*Total*
General Construction							
653.475	Silt Fence	Silt fence	502	LF	$ 3.96	$/LF	$ 1,988
604.11	Concrete manhole with cast iron cover	Drainage control structures	3	EA	$ 6,600.00	EA	$ 19,800
605.2	6" Underdrain	Underdrain and discharge pipes	573	LF	$ 102.66	$/LF	$ 58,824
203.31	Sand Borrow	Sand filter	92	CY	$ 32.92	$/CY	$ 3,038
301.15	Gravel Subbase	Washed stone for stormtech	252	CY	$ 88.08	$/CY	$ 22,196
301.15	Gravel Subbase	Washed stone for stone diaphram	64	CY	$ 88.08	$/CY	$ 5,622
203.28	Excavation of surfaces and pavements	Chamber, new strucutre	956	CY	$ 61.34	$/CY	$ 58,668
203.28	Excavation of surfaces and pavements	Diaphram	64	CY	$ 61.34	$/CY	$ 3,916
NA	Stomtech Chambers	ADS cost	1	LS	$ 41,762.81	LS	$ 41,763
Subtotal Construction Cost:							**$ 215,816**
Mobilization/Demobilization							**$ 10,000**
Final Design							**$ 35,000**
Construction Engineering							**$ 18,000**
Contingency (20%)							**$ 43,163**
Total (rounded to the next highest $1,000) =							**$ 322,000**

5.3.4 Next Steps

It is recommended that the site owner proceeds with final design and implementation 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 treated by the practice.

5.3.5 Permit Needs

Clean Water Initiative Program (CWIP) forms were completed for these projects as a permit screening review form and are included in Appendix J - Project Review Forms. In summary:

Stormwater Permit

As this site has more than three acres of impervious cover and does not have a current stormwater permit, it is expected that this site will require coverage under the 3-Acre Permit.

Other Permits

As there is no existing Act 250 permit for this area, this site does not require submission for Act 250 review. This project should be reviewed by the floodplain manager and stream alteration engineer prior to final design due to its proximity to the river and river corridor. The project should also be reviewed by a wetland ecologist due to the likelihood of wetlands in the area, according to the Vermont Wetland Screening Tool. Approval is needed from VT Fish and Wildlife due to the presence of rare, threatened, or endangered species within one mile of the project location.

6 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 Town of Cavendish and receiving waters. Although designs were only advanced for 3 of the Top 18 projects, this plan also serves to highlight 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 stormwater management in Cavendish's landscape. It is our recommendation that the Town move to implement the 3 practices selected for 30% design, and that the Town moves forward with additional design and implementation of the other projects presented in this plan, especially the Top 18 projects. 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 recommended that the Town of Cavendish keep in mind the importance of riparian buffers and setting back development from rivers wherever possible with all future development. For existing sites lacking an appropriate buffer area, improvements could include reducing impervious along edge of parking lots and other impervious surfaces to plant filter strips and riparian buffers. It is also recommended that the Town of Cavendish explore options for floodplain restoration projects upstream of the downtown area that is prone to flooding, as this may help alleviate future flood impacts.