Stormwater Master Plan
Castleton River Headwaters
Castleton, Ira, West Rutland, and Pittsford, Vermont

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Prepared by:

Fitzgerald Environmental Associates, LLC.
18 Severance Green, Suite 203
Colchester, VT 05446

Fitzgerald Environmental Associates, LLC.
Applied Watershed Science & Ecology

and

Poultney Mettowee Natural Resources Conservation District
PO Box 209
Poultney, VT 05764

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1.0 Introduction

The Castleton River watershed is located in Rutland County, Vermont, and drains most of the Towns of Castleton, Hubbardton, and West Rutland, and portions of Benson, Sudbury, Pittsford, Ira, Poultney, and Fair Haven. In 2016 the Poultney Mettowee Natural Resources Conservation District (PMNRCD) received grant funding from the Vermont Agency of Natural Resources (VTANR) Ecosystem Restoration Program to continue stormwater master planning efforts in the Castleton River watershed. The project is a continuation of stormwater master planning completed by PMNRCD and consultant Fitzgerald Environmental Associates (FEA) from 2015 to 2016 in the Lake Bomoseen watershed, which is part of the Castleton River watershed (Figure 1).

PMNRCD hired FEA in the fall of 2016 to assist with the development of a Stormwater Master Plan (SWMP) for the Castleton River Headwaters (Figure 1). The SWMP follows the VTANR SWMP guidelines and was developed over the course of 2016 and 2017 through extensive field work, interaction with multiple stakeholders within the study area to prioritize projects, and follow-up analysis and design work.

1.1 Watershed and Planning Background

The Castleton River watershed drains to the Poultney River, which is one of the major tributaries to the South Lake of Lake Champlain. South Lake has been identified as a "Gap Watershed", one that will not meet water quality standards under any of the proposed land management or best practices scenarios in the State's proposed TMDL Implementation Plan (November, 2014). In fact, South Lake would need to reduce phosphorus inputs by 45% to meet Water Quality Standards (M. Rupe, 4/7/15, Interagency Training, Rutland). Water Quality Reports by PMNRCD between 2007 and 2016 include data from the Castleton River and/or its tributaries. During low flow, the Castleton River has moderate to low levels of phosphorus, while the locations monitored appear to contain high concentrations of phosphorus during storm events (storm event monitoring occurs 1-3 times per monitoring season; PMNRCD, 2006, 2007, 2008, 2010, 2011, 2015, 2016).

The watershed is divided into two HUC12 subwatersheds: Castleton River Headwaters and the Lake Bomoseen and Castleton River (Figure 1). A SWMP for the Lake Bomoseen watershed was completed by PMNRCD and FEA, with input and assistance from VTANR, the Lake Bomoseen Association (LBA), and the Towns of Hubbardton and Castleton, in December of 2016 (PMNRCD and FEA, 2016).

The goal of the Lake Bomoseen SWMP was to identify and evaluate anthropogenic sources of sediment and nutrients flowing to Lake Bomoseen, and to identify projects to mitigate these inputs. As part of the Lake Bomoseen SWMP, 48 potential projects were identified, 20 projects were ranked as high priority, and six projects were selected for conceptual designs. These projects were approved by the Lake Bomoseen Association and the Lake Bomoseen Water Quality Committee (LBWQC) and received support from the Castleton Planning Commission, the Castleton Select Board, and the Hubbardton Planning Commission and Select Board. PMNRCD and the above-mentioned partners have been working to advance high priority projects in the Lake Bomoseen watershed. These efforts include further municipal and landowner outreach, project scoping, and grant funding applications.

Although PMNRCD and FEA's community outreach efforts for the Lake Bomoseen and Castleton Headwaters SWMPs have overlapped at times, the geographic areas and identified projects are distinct in each SWMP. Due to the geographic separation and the fact that the Lake Bomoseen SWMP has been completed and circulated among partners over the last year, PMNRCD and FEA decided to keep the two SWMP reports separate.

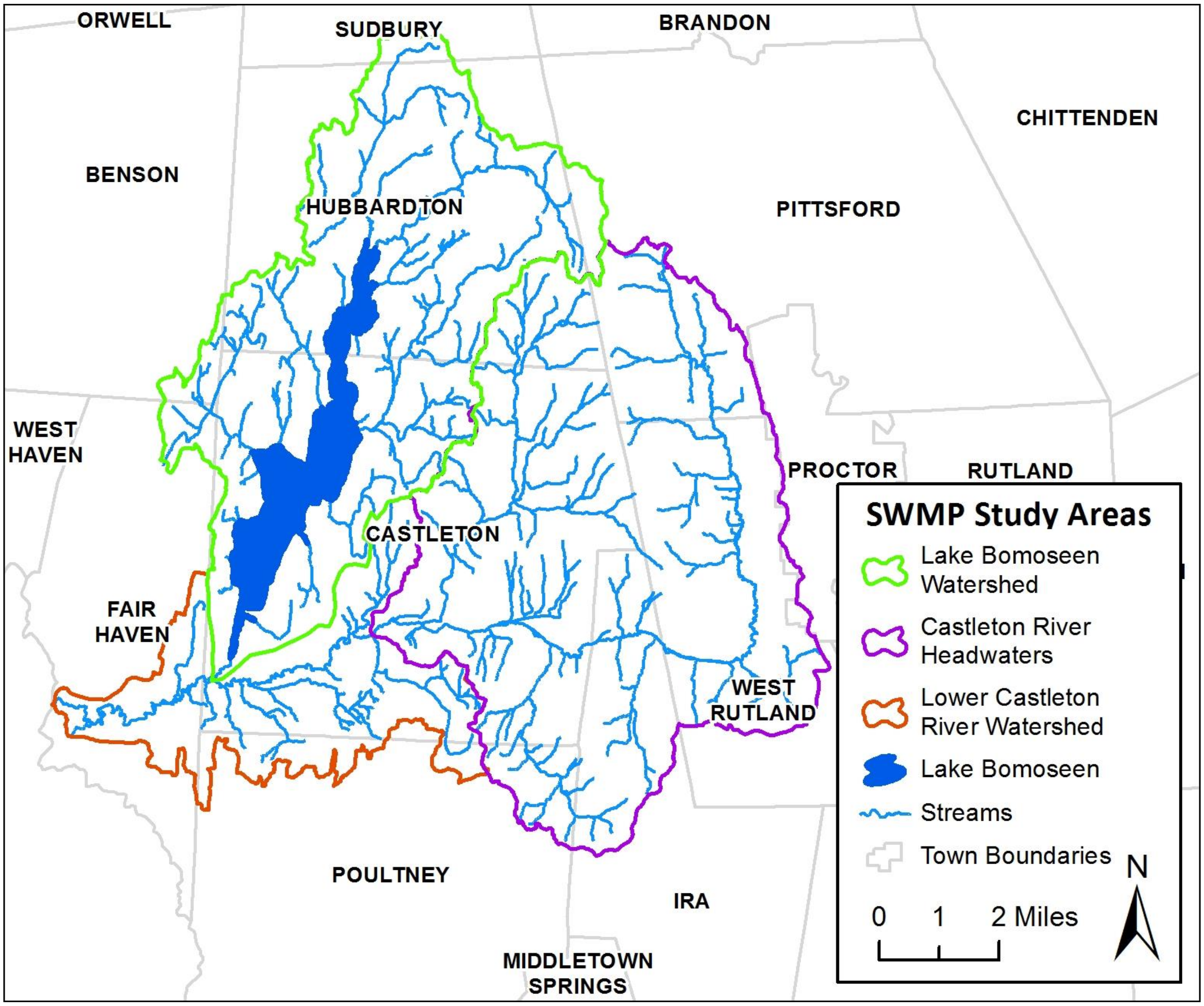

Figure 1: Castleton River Headwaters and Lake Bomoseen watershed study areas

1.2 Castleton Headwaters Project Goals

The goal of this project was to evaluate approximately 30,000 acres within the Castleton River watershed to identify sources of increased stormwater runoff and associated sediments and nutrients. Phosphorus reducing projects are of particular importance given the water quality concerns within the greater South Lake watershed. The work involved identifying sources of stormwater, prioritizing sources based on various environmental, economic, and social criteria, and designing projects to mitigate those sources. Stormwater mitigation projects are aimed at reducing or eliminating stormwater at the source through GSI approaches, retrofits of older and underperforming stormwater features, back road erosion projects, and improving floodplain access within the river corridor to increase sediment and nutrient attenuation. The initial project goals were to identify at least 10 projects and to create conceptual designs (roughly 30% design) for at least five projects.

2.0 Study Area Description

The Castleton River drains approximately 99 square miles of land located in Rutland County, Vermont (Figure 2). The Castleton River joins the Poultney River at the Vermont / New York border. The Poultney River flows to South Lake near Whitehall, New York; waters then drain to the north via South Lake to the main section of Lake Champlain (SMRC, 2007). Significant bodies of water in the Lake Bomoseen Watershed include the 2,360-acre Lake Bomoseen, 202-acre Glen Lake, 42-acre Pine Pond, 62-acre Love's Marsh, all of which drain to the Castleton River (Castleton Town Plan, p. 43).

The Castleton River watershed is located largely within the Taconic Mountains. The upper headwaters of the Castleton River watershed flow through the West Rutland Marsh. The highest elevation in the watershed is over 2,700 feet at the peak of Herrick Mountain. The lowest elevation in the watershed is approximately 297 feet at the confluence of the Castleton River with the Poultney River (SMRC, 2007).

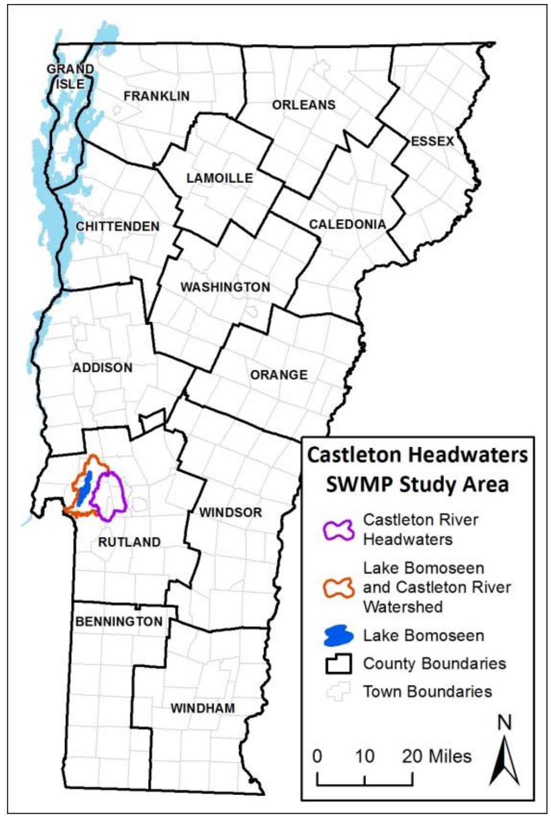

Figure 2: Castleton River Headwaters study area location map.

Land cover data based on imagery from 2011 National Land Cover Dataset (Homer et al., 2015) are summarized in Table 1. Development is concentrated along the Route 4A corridor, including higher density town centers for Fair Haven, Castleton, and West Rutland. The remainder of each watershed is predominantly rural with a mixture of forest and agricultural areas. Agricultural fields and large areas of forested and shrub wetlands are found along the broad river valleys throughout the lower Castleton River watershed. The headwaters area has a moderate density of agricultural lands along Route 4A and East Hubbardton Road, following the Castleton River and North Breton Brook respectively.

Table 1: Land cover data for the Castleton River watershed

	Watershed			
Land Cover Type	**Lake Bomoseen**	**Castleton Rivers Headwaters**	**Lower Castleton River**	**Overall**
Water	12.3%	0.1%	0.5%	4.7%
Developed	5.4%	5.2%	10.8%	6.0%
Barren	0.0%	0.0%	1.8%	0.3%
Forest	69.2%	77.7%	46.3%	70.0%
Shrub/Scrub	1.5%	2.4%	6.6%	2.7%
Grassland/Herbaceous	0.2%	0.3%	0.4%	0.3%
Agriculture	4.8%	8.7%	17.4%	8.5%
Wetlands	6.5%	5.6%	16.2%	7.5%
Total Area (mi^2)	37.4	47.8	14.1	99.2

The following is from SMRC's 2007 Phase 2 Geomorphic Assessment Report for the Castleton River:

> In recent geologic time (prior to 14,000 years before present) advancing and retreating glaciers occupied this landscape, with ice up to a mile or more in thickness above the present land surface in the Champlain Valley to the north. Glacial tills now blanket much of the upper bedrock-controlled slopes and headwaters of the Castleton watershed. (Stewart & MacClintock, 1969).
>
> As the global climate warmed and the glaciers receded, a large fresh-water lake (Lake Vermont) inundated the Champlain Valley, and joined Lake Albany to the south in the Hudson River valley. At its highest stage, Lake Vermont's waters extended through the low-lying Castleton River valley to the north of West Rutland and encompassed the broad valley now occupied by Lake Bomoseen. Ancient lake sand deposits are mapped from Castleton village downstream to the confluence with the Poultney River (Stewart and MacClintock, 1969).
>
> Lake Vermont waters receded in stages and were slowly replaced with sea water from the St Laurence Seaway creating the Champlain Sea. The maximum elevation of these marine waters is not believed to have extended into the present-day Castleton River watershed (Wagner, 1972). Nevertheless, changing base levels in the Champlain Valley during this Champlain Sea event would have influenced erosional and depositional cycles in the Castleton River watershed. Champlain Sea waters had receded from the greater Champlain Valley by approximately 10,000 years before present, as the rate of land rise began to outpace the rate of sea-level rise. River systems, including the Castleton River, then continued moving and redepositing sediments left in the wake of the glaciers, and further eroding the Taconic Mountains. As base levels dropped in the Champlain Valley (and the Poultney River), the Castleton River eroded downward through the Lake Vermont delta deposits and underlying lake silts and clays. Today, in the town of Fair Haven, the Castleton River is incised up to 80 feet into these deposits. Downward incision was apparently arrested at exposures of channel-spanning bedrock in the present-day village of Fair Haven. Currently, these bedrock exposures serve as a local base level for upstream reaches of the Castleton River (SMRC, 2007).

3.0 Stormwater Management Planning Library

We began our SWMP efforts by gathering and reviewing information and documentation related to stormwater runoff and watershed management within the Lake Bomoseen and Castleton River headwaters watershed. Below is a summary of available data, mapping, and documentation at the local and state level. The planning library is included in Appendix A. Sources for this information include:

- **Local Datasets**
  - PMNRCD Water Quality Monitoring Data – 2008 - 2016
  - Culvert Assessment and AOP modeling - 2011/2015
- **Town and Regional Plans**
  - Vermont Hazard Mitigation Plan, Rutland Region - 2011
  - Castleton Town Plan - 2013
  - Hubbardton Town Plan – 2016
  - Ira Town Plan - 2015

  - West Rutland Town Plan - 2016
- **State Data and Plans**
  - VTDEC Poultney Mettowee Basin Plan – 2014
  - VTDEC West Rutland Stormwater Report - 2012
  - VTDEC Castleton Village Stormwater Report - 2013
  - Castleton River Phase 1 Geomorphic Assessment - 2005
  - Castleton River Phase 2 Geomorphic Assessment – 2007
  - VTDEC Hydrologically Collected Road Segment Data
  - Light Detection and Ranging (LiDAR) Topography Data - 2015
- **Other Datasets**
  - Vermont Water Quality Standards - 2014

4.0 Stormwater Problem Areas

One of the primary objectives of the SWMP is to "develop a comprehensive list of stormwater problems" within the study area. FEA and PMNRCD conducted a total of five (5) field tours of the project area and had meetings with representatives from the Towns of Castleton, West Rutland, and Pittsford to identify and/or discuss existing problem areas, evaluate and prioritize sites, and recommend potential solutions.

4.1 Identification of Problem Areas

The initial round of stormwater problem area identification began with a desktop exercise to scan the watershed with aerial imagery, NRCS soils data, VTDEC stormwater infrastructure mapping, contour data, and road erosion risk in a GIS. Potential project areas were identified and mapped for review during site visits. A total of 75 stormwater problem areas were visited and assessed in the field (see maps in Appendix C and table in Appendix D). We grouped the problem areas into five (5) project categories described below.

- **River Corridor and Buffer Improvements –** Potential areas to improve water quality and/or flood resiliency through floodplain and channel improvements or protection. Many of these projects were identified during the stream geomorphic assessment of the Castleton River, and subsequent river corridor planning efforts.
- **Stormwater BMP Installation or Retrofit –** Many sites were identified where sediment and nutrient loads could be reduced through the implementation or retrofit of stormwater best management practices in areas of concentrated surface runoff or stormwater drainage infrastructure.
- **Road Erosion, Ditch & Driveway Runoff –** Potential areas of sediment and nutrient loading from road erosion were identified during field visits. Runoff and erosion projects were identified in many areas where runoff from steep roads and driveways (typically gravel) was causing increased sediment and nutrient loading due to ditch erosion.
- **Streambank and Channel Erosion –** Locations of eroding streambanks and river channels were identified remotely and during field visits. Actively eroding stream banks are likely moderate to large sources of sediment and nutrient loads.

- **Other Erosion –** Potential sediment loading from other sources of erosion (e.g., hillside gullies) were identified during remotely and during field visits.

4.2 Evaluation and Prioritization of Problem Areas

The 75 projects described in Appendix D were prioritized based on the potential for each project to reduce nutrient and sediment inputs to surface waters, landowner support for the project, operation and maintenance requirements for the recommended project, cost and constructability of the project, and additional benefits associated with implementation of the project. Photographs of each site are provided in Appendix E.

GIS-based Site Screening

Using the field data points collected with sub-meter GPS during our watershed tours, we evaluated key characteristics for each site indicating the potential for increased stormwater runoff and pollutant loading, among several other factors described below. These GIS-based observations, along with field-based observations of site characteristics, are summarized in the Appendix D table under the "Problem Area Description" column.

The following geospatial data were reviewed and evaluated as part of the GIS-based screening:

- **Aerial Photography** – We used the 0.5 m imagery collected for Rutland County in 2011 and 2016 to review the site land cover characteristics (i.e., forest, grass, impervious) and measure the total impervious area in acres draining to the project area as identified in the field.
- **LiDAR** – We used the 0.7m LiDAR data for Rutland County collected in 2015. We developed 1-foot and 2-foot contours to delineate stormwater drainage areas at the subwatershed and site scale. Land cover and soils were then evaluated within these drainage boundaries. We also used the LiDAR to evaluate the slope of ditches and gravel roads as this relates to runoff potential, road/ditch stability, and potential remediation measures.
- **NRCS Soils** – We used the Rutland County Soils data to evaluate the inherent runoff and erosion potential of native soil types (i.e., hydrologic soil group, erodible land class). For project sites with potential for green stormwater infrastructure (GSI), we assessed the general runoff characteristics of the drainage area based on hydrologic soil group (HSG).
- **Parcel Data** – We used the parcel data available through VCGI to scope the limits of potential projects based on approximate parcel boundaries and road right-of-way.
- **VTDEC Stormwater Infrastructure Mapping** – We used maps completed by VTDEC in 2012 and 2013 to locate outfalls and other drainage features as well as determine drainage areas and flow paths of stormwater features.
- **VTDEC Hydrologically Collected Road Segment Data –** We used a statewide inventory of road erosion risk and hydrologic connectivity of road segments to prioritize areas of potential sediment loading to visit for field surveys.
- **Water Quality Monitoring Data** – The District began collecting water samples from the Castleton River in 2006. Six sites along the Castleton mainstem have been sampled at various intervals over the past 10 years. The District is currently sampling CA01 at the site of the former Birdseye Ski Resort parking lot downstream of the West Rutland Marsh and CA05 at the Blissville Road bridge. In 2015, eight new sites were added around Lake Bomoseen to

support the Lake Bomoseen Stormwater Master Plan, as well as on North Breton Brook in the Castleton Headwaters. The 2016, an additional seven sites were added in the Castleton Watershed to support this SWMP effort.

The stormwater problem areas identified during field tours of the study area were assigned several numerical scoring metrics that are weighted to assist in prioritizing each project based on water quality benefits, project feasibility, maintenance requirements, costs, and any additional benefits. The maximum possible score is 30 and the individual site scores ranged from 10 to 22 (Figure 3). Each category is described below and includes a description of the scoring for each criterion. Final evaluation criteria summarized in the table in Appendix D included the overall prioritization and the following components of the score:

- **Water Quality Benefits (15 points total)**
  - **Nutrient Reduction Effectiveness (4 points)** – Degree of nutrient removal potential with project implementation, this accounts for both the existing nutrient loads and the removal efficiency and capacity of the proposed treatment. Nutrient loading was quantified based on the watershed size, the land cover types, and percent impervious surfaces, and the effectiveness was based on the treatment efficacy of the potential mitigation options appropriate for the space and location of the treatment area.
    - 0 points – No nutrient source and/or no increased treatment
    - 1 point – Minor nutrient source and/or minor increase in treatment
    - 2 points – Moderate nutrient source with some increase in treatment
    - 3 points – Moderate nutrient source with significant increase in treatment
    - 4 points – Major nutrient source with significant increase in treatment
  - **Sediment Reduction Effectiveness (4 points)** – Degree of sediment removal potential with project implementation, this accounts for both the existing sediment loads and the removal efficiency and capacity of the proposed treatment. Sediment loading was quantified based on the watershed size, the land cover types, and percent impervious surfaces, and the effectiveness was based on the treatment efficacy of the potential mitigation options appropriate for the space and location of the treatment area.
    - 0 points – No sediment source and/or no increased treatment
    - 1 point – Minor sediment source and/or minor increase in treatment
    - 2 points – Moderate sediment source with some increase in treatment
    - 3 points – Moderate sediment source with significant increase in treatment
    - 4 points – Major sediment source with significant increase in treatment
  - **Drainage Area (1 point)** – Approximate drainage area to site is greater than 2 acres
  - **Impervious Drainage (3 points)**– Approximate area of impervious surfaces draining to the site.
    - 0 points – Area of impervious surfaces is less than 0.25 acres
    - 1 point – Area of impervious surfaces is 0.25-0.5 acres
    - 2 points – Area of impervious surfaces is 0.5-1.0 acres
    - 3 points – Area of impervious surfaces is >1.0 acres

- **Connectivity to Surface Waters (3 points)**
  - 0 points – All stormwater infiltrates on site
  - 1 point – Stormwater receives some treatment before reaching receiving waters
  - 2 points – Stormwater drains into drainage infrastructure that directly outlets to receiving waters (assumes no erosion or additional pollutant loading to discharge point)
  - 3 points – Stormwater drains directly into receiving waters (typically stormwater draining directly into a large wetland is assigned 2 points)

- **Landowner Support (2 points)**
  - 0 points – Project is located on private property, no contact with landowner
  - 1 point – Project is on Town or State property with no contact
  - 2 points – Project has been discussed and is supported by landowner
- **Operation and Maintenance Requirements (2 points)**
  - 0 points – Project will require significantly increased maintenance effort
  - 1 point – Project will require some increased maintenance effort
  - 2 points – Project will require no additional maintenance effort
- **Cost and Constructability (6 points) –** This score is based on the overall project cost (low score for high cost) and accounts for additional design, permitting requirements, and implementation considerations, such as site constraints and utilities, prior to project implementation.
- **Additional Benefits (5 points total) –** Description of other project benefits, total score is roughly a count of the number of additional benefits. Additional benefits considered in the prioritization are as follows:
  - **(1) Chronic Problem Area** – The site requires frequent maintenance and/or is an ongoing problem affecting water quality
  - **(2) Seasonal Flooding** – The site is affected by or contributes to seasonal flooding
  - **(3) Educational** – The site provides an opportunity to educate the public about stormwater treatment practices
  - **(4) High Visibility** – The site is highly visible and will benefit from aesthetically designed treatment practices
  - **(5) Infrastructure Conflicts** – The stormwater problem area is increasing erosion or inundation vulnerability of adjacent infrastructure (i.e. roads, buildings, etc.)
  - **(6) Drains to Connected Stormwater Infrastructure** – The site drains into a larger stormwater conveyance system that is less likely to receive downstream treatment
  - **(7) Reduces Thermal Pollution** – Project implementation will reduce the risk of thermal loading from runoff to receiving surface waters
  - **(8) Improves BMP Performance** – Project implementation will improve the performance of existing stormwater treatment practices that receive runoff from the site
  - **(9) Peak Flow Reduction** – Project implementation will significantly reduce stormwater peak flows leaving the site

Figure 3: A previously stabilized gully on Upper Birdseye Road had the lowest score (left photo, Project CA-26). Erosion and transport of large volumes of sediment from the Castleton transfer station lot and a small culvert had the highest problem area score (right photo, Project CA-16).

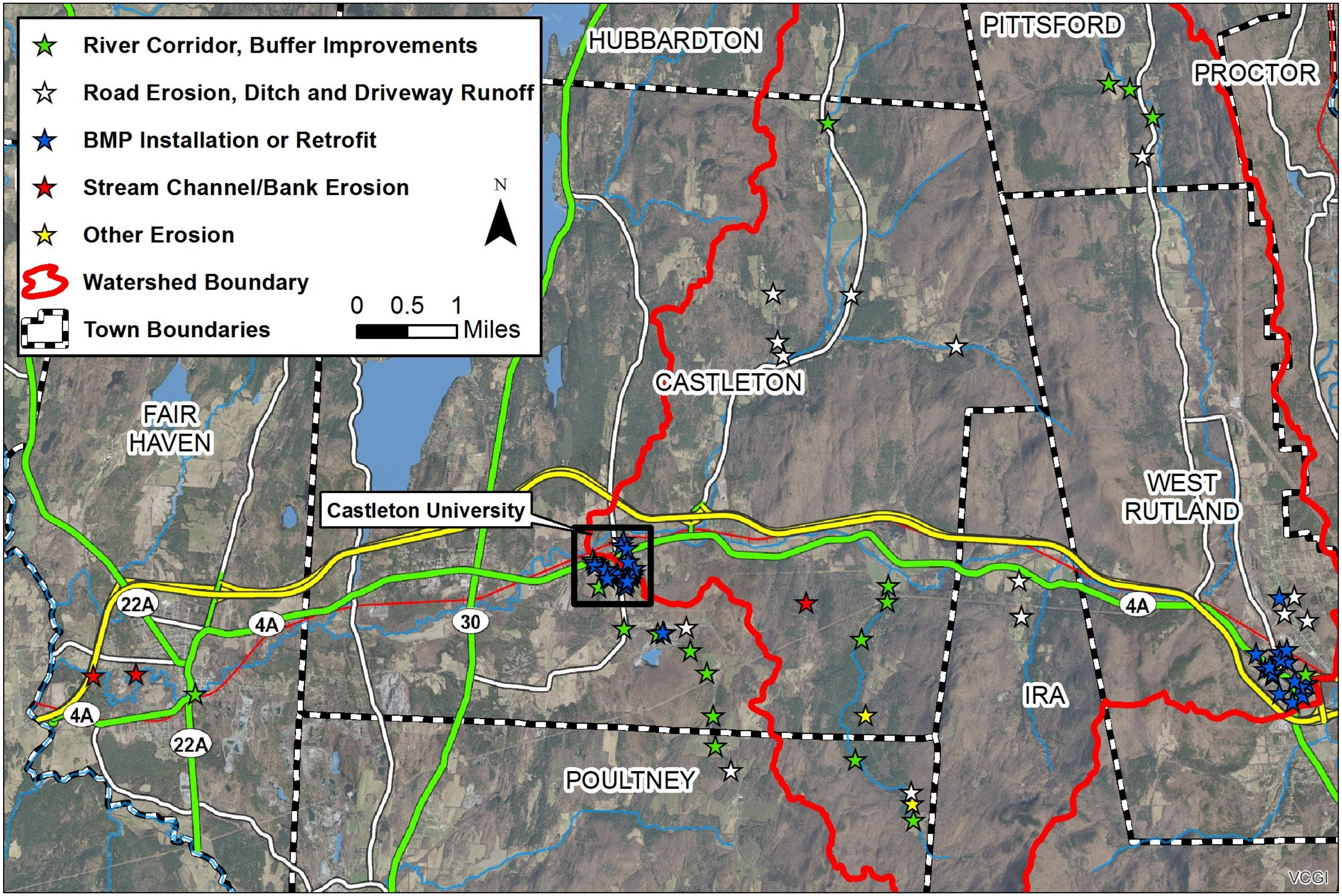

Figure 4: Stormwater Problem Area Overview Map. See larger maps in Appendix C for greater detail.

4.3 Project Prioritization and Conceptual Designs

The Castleton Headwaters SWMP partners reviewed and commented on the list of preliminary projects during various meetings and email correspondences (see Appendix B). From the list of 75 projects described in the SWMP, a subset of high-priority projects were discussed for further development. Based on stakeholder input and the prioritization categories shown in the Problem Area Table in Appendix D, twelve (12) projects from the list of high-priority sites were chosen for site restoration plan development and five (5) projects were chosen for conceptual design development (30% design).

Site Restoration Plans

Twelve (12) projects from the list of high-priority sites were chosen for site restoration plan development. Project summaries are included in Appendix F. Each summary includes:

- A description of the site location and problems identified
- A summary of the recommended design and site plan
- Additional design and permitting requirements
- A list of the next steps towards project implementation
- A description of project benefits
- A preliminary cost opinion

The projects chosen for site restoration plan development were:

1. **Project CA-2: Upper Eaton Hill Road, Castleton** – A ditch on the west side of the road, just down from Horse Amour, is severely eroded. Two to three erosional nickpoints were observed in the ditch. The road shoulder was moderately eroded due to grader berms and lack of stable turnouts. This section of road drains to a small intermittent tributary to North Breton Brook.
2. **Project CA-3: Middle Eaton Hill Road, Castleton –** A steep ditch (7-10% slope) is present along west side of road approximately half way up Eaton Rd. During a field visit in the Fall of 2016, the ditch had a V-shape and was actively eroding. A turnout directs runoff to a bedrock channel leading to a small perennial stream.
3. **Project CA-4: Lower Eaton Hill Road, Castleton** – A ditch on the gravel road leads stormwater directly into North Breton Book. The road has a 3-4% grade. Cleaning of the ditch with a V-shape was noted during a field visit in the Fall of 2016.
4. **Project CA-9: Castleton Village School –** The Castleton Village School has a green space in between two buildings with a gravel walking path. A drop inlet catch basin drains runoff from the site into a larger storm drain network that discharges at project site CA-7.
5. **Project CU-1: Castleton University –** This site receives runoff from a drainage area of approximately ½ acre, nearly all of which is paved. Runoff enters a catch basin on the northern end of the parking lot, which is part of a larger collection system leading to a large wet detention pond to the west of the student housing along Pond Hill Brook.

6. **Project CU-3: Castleton University** – A gravel footpath to the fitness center is eroding and depositing sediment on a paved area with a catchbasin. Water bars across the path are not diverting water into the adjacent rain gardens.
7. **Project PIT-4: Allen Mills Road, Pittsford –** Some minor to moderate erosion is occurring in the roadside ditches, especially along the north side of the road that lacks check dams and turnouts. The gravel road has an approximately 10% slope near its intersection with Whipple Hollow Road. This section of the road is mapped as hydrologically connected to nearby wetlands.
8. **Project WR-3: Crescent Street, West Rutland –** The portion of Crescent Street between Pleasant Street and Slason Street has a few short sections of paved ditch; otherwise appropriate roadside drainage is lacking. Runoff from this section of road enters a wetland area across from Slason Street. Erosion was visible along the road edge and at several driveways.
9. **Project WR-8: Carris Reels Property, West Rutland –** The rooftops and gravel parking areas present on the large commercial property (Figure 5) drain to two culverts. The culverts empty into a catch basin then discharge directly into the adjacent canal.
10. **Projects WR-9: West Rutland School –** A large paved parking area and road drain to the main entrance to the town school and flow onto Main Street with no treatment or infiltration.
11. **Project WR-16: Price Chopper, West Rutland –** A large grassed swale between the Price Chopper parking lot and Route 4A receives runoff from a very large impervious area. The swale outlet is directly piped to the canal.
12. **Project WR-17: Swale between Jiffy Mart and Bailey Motors, West Rutland –** A grassed swale receives runoff from a large commercial area, the outlet is directly piped to a stream. The lower portion of the swale appears to be stable and has stone check dams to trap sediment.

Figure 5: Large gravel parking area draining to the canal at project WR-8

30% Concept Designs

Six (6) of the highest priority projects were selected to include in five (5) 30% concept designs (Appendix G). Concept designs include:

- A description of the site location and problems identified, including photographs
- Hydrologic and hydraulic modeling of the contributing drainage area and BMP footprint
- Pollutant loading calculations for the contributing drainage area
- Preliminary BMP sizing and design specifications
- A conceptual site plan and typical details
- A preliminary cost opinion
- A summary of project benefits
- A summary of next steps to advance the project

The projects chosen for 30% conceptual design were:

1. **Project CA-16: Castleton Transfer Station, Staso Road, Castleton** – Concentrated runoff from the transfer station lot and a 12" CPP culvert with flow from upslope run across the lower parking area and flow into the 24" CMP under the road discharging to the stream. The flow paths have resulted in gully and rill erosion in the lower parking area, where the runoff accumulates before spilling into the roadside ditch. From the ditch, the runoff enters nearby Pond Hill Brook.
2. **Project CU-4: South Road, Castleton University –** Runoff from South Road bypasses a green space with an existing catch basin and flows into next basin to west. The shoulder is eroded and bare, and the runoff picks up fine sediment and carries it to the adjacent stream via the storm drain network along University Drive.
3. **Project CU-7: Alumni Drive, Castleton University –** Nearly and acre of impervious parking lot along Alumni Drive sheet flows to the west over a grass/gravel slope into a shallow depression and swale along rail trail. The runoff from this area receives minimal treatment before entering the storm drain network. Ponding occurs along a depression in the rail trail, causing inundation along the edge of the trail.
4. **Project WR-7: Town Park on Marble Street** – The runoff from southeastern portion of VTDEC stormwater infrastructure mapping subwatershed 26 drains into the municipal storm drain infrastructure along Marble Street with minimal sediment, nutrient, or flow attenuation. Nearby open space in the town park that could be used for a new BMP.
5. **Project WR-12 & WR-13: West Rutland School –** Half of the large paved lot and all of the gravel lot drain to a stone lined ditch along the steep entrance ramp to a vegetated swale along High Street (WR-13). The swale has a gentle grade to a dry well inlet. The other half of the paved lot drains to a low point along the edge of pavement and receives no treatment before entering the storm drain system on High Street (WR-12).

Figure 6: Eroding University Drive road shoulder observed during a storm event in October 2016. The concept design for this area (CU-4) describes a BMP retrofit that would treat this runoff.

5.0 Next Steps

This Stormwater Master Plan represents an extensive effort to identify, describe, and evaluate stormwater problem areas affecting the Castleton River watershed. For each project recommendation, we provided a preliminary cost estimate and a site rating to aid the PMNRCD, Castleton State University, and Town representatives in planning and prioritizing restoration efforts. Many of the problem area descriptions (e.g., roadside ditches) will aid the Town Highway Departments in proactively stabilizing and maintaining these features to avoid future stormwater problems, and to come into compliance with the forthcoming VTANR Municipal Roads General Permit.

We recommend that PMNRCD continues to work with VTDEC, the Towns and Castleton State University to secure funding for the high priority projects described in Appendices C, D, and E. Based on the level of scoping and design work already completed to date, overall project prioritization, and past stakeholder input, we recommend that the projects described in the conceptual designs and the restoration plans are prioritized for further work in the near term.

In addition to addressing the problem areas identified in this document, the Towns can take steps to reduce future stormwater problems through planning and zoning regulations. Town Plans for each of the towns in the Castleton Watershed list important stormwater best management strategies, including preservation of wetlands and the potential requirement of building setbacks that may be explored for future action (Town of Castleton, Hubbardton, Ira, and West Rutland Town Plans). Hubbardton recently implemented a River Corridor Overlay that will reduce development encroachment within 50 feet of streams and wetlands (RRPC, personal communication). These strategies and other planning and zoning regulations may be applied to existing and future growth to reduce the risk of stormwater runoff conflicts and nutrient and sediment loading to receiving waters.

Finally, though eighteen (18) projects were selected as high-priority based on selected criteria (Total score of 18 or higher), the other identified projects (and any additional new problem areas that develop over time) are also important and should be remediated as time and resources permit.

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